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REPORT OF THE SPECIAL STUDY GROUP ON FEDERAL CONTRACT RESEARCH CENTERS (FCRCs)

Office of the Director of Defense Research and Engineering
Washington, D. C.

30 August 1971

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The Special Study Group on

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Part I. Basic Report

1. PURPOSE AND TASK STATEMENT

1.1 Purpose

This study responds to the recommendation of the Blue Ribbon Defense Panel Report on Federal Contract Research Centers (FCRCs). The special Study Group formed for this purpose has completed its task and presents here its findings, conclusions and recommendations.

1.2 Task Statement

The statement of the Study Group's task was developed directly from the recommendation on FCRCs in the Blue Ribbon Defense Panel Report, which contained extremely limited coverage of this subject. In view of its brevity, the pertinent text is quoted in its entirety as follows:

> The Federal Contract Research Centers (FCRCs) are a group of special nonprofit organizations created during and since World War II. Each has a special relationship with some agency of the Federal Government. There are currently 12 FCRCs under the sponsorship of the Department of Defense, with annual funding totalling about $250 million. Based on their principal efforts, they are categorized as: (1) general and continuing research and experimentation in support of military research and development; (2) systems planning, systems engineering, and technical direction of systems development; and (3) operations analysis, systems analysis, general advice and analysis, and long-range military planning.
>
> Originally every FCRC obtained all or most of its financial support from a single sponsor, but some are now attempting, with varying degrees of success, to diversify--to become less dependent on their Department of Defense sponsors, and in their view, less vulnerable.
>
> The close ties between sponsor and FCRC often prevent the sponsor from seeking study assistance elsewhere to obtain work better suited to his immediate requirements. It would be highly desirable to provide flexibility, whereby a sponsor could on occasion have research done by another FCRC. That this would lessen the reliance of an FCRC on a single sponsor could only be beneficial. It would soon be evident which FCRCs were strongest and they would be encouraged to become capable of competing successfully within their own ranks.
>
> Traditionally, there have been close relationships between most FCRCs and universities, and unquestionably the forging of

this link to the academic community was a major reason for creating FCRCs. The changing attitudes of university administrations, faculties, and students have already resulted in the severing of a number of long-standing university-FCRC relationships, and others are in imminent jeopardy.

There is little doubt that each FCRC was, when created, the most effective or expedient means of providing certain required capabilities to the Department of Defense. However, both the needs of the Department and the character of some of the FCRCs have changed substantially. The Panel believes that this is an appropriate time to reassess the special relationship of each FCRC and its Departmental sponsor.[1]

Specific comments on certain of the foregoing statements appear in the individual task group reports (Part II) and are summarized in the discussion (section 4, Part I).

In accordance with the recommendation of the Blue Ribbon Defense Panel, each FCRC sponsored by the Department of Defense was studied:

(1) To determine individually (a) which should be continued with substantially their present form and mission; (b) which should undergo significant changes; and (c) which may have outlived their usefulness as FCRCs.

(2) To explore, if considered appropriate, means by which collective FCRC capabilities could be made more widely available to DoD programs.

(3) To explore, if considered appropriate, means by which FCRC capabilities could be made more readily available to government agencies other than the DoD.

(4) To determine what actions, if any, could be taken to improve the operation and use of the FCRCs.

The Study Group was to report its findings and recommendations to the Director of Defense Research and Engineering.

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[1] Report to the President and the Secretary of Defense on the Department of Defense by the Blue Ribbon Defense Panel, 1 July 1970.

2. BACKGROUND

2.1 Definition of FCRC

Any detailed review of the literature over the past 8 years will reveal various attempts to define "Federal Contract Research Center." Since each writer approached the subject from a different point of view and with a different motive, most definitions have, to a certain degree, been self serving. This, coupled with the jungle of factual errors surrounding each of these organizations, has led to major misunderstandings concerning this very small number of organizations.

To avoid making the same error, the Study Group chooses to identify the FCRCs by name and to take as its point of reference the definition that was used when the FCRCs were first discussed in congressional hearings.

The FCRCs reviewed in this study are 12 in number, and in alphabetic order are as follows:

- Aerospace Corporation, El Segundo, California
- Analytic Services, Inc. (ANSER), Falls Church, Virginia
- Applied Physics Laboratory, Johns Hopkins University (APL/JHU), Silver Spring, Maryland
- Applied Physics Laboratory, University of Washington (APL/UW), Seattle, Washington
- Center for Naval Analyses (CNA), University of Rochester, Alexandria, Virginia
- Human Resources Research Organization (HumRRO), Alexandria, Virginia
- Institute for Defense Analyses (IDA), Arlington, Virginia
- Lincoln Laboratory, Massachusetts Institute of Technology, Lexington, Massachusetts
- Mitre Corporation, Bedford, Massachusetts
- Ordnance Research Laboratory (ORL), Pennsylvania State University, State College, Pennsylvania
- Rand Corporation, Santa Monica, California
- Research Analysis Corporation (RAC), McLean, Virginia

The definition of FCRC used in this study is taken from hearings before a Subcommittee of the Committee on Appropriations, House of Representatives, 88th Congress, second session. While discussing DoD appropriations for FY 1965, the subcommittee chairman, Mr. Mahon, referred to the organizations as the various "captive companies" which have been used by the Defense Department, and then defined them as follows:

> Federal Contract Research Centers are research organizations which are exclusively or almost exclusively financed by the Federal Government and which in most instances were originally

established to meet a research and development need of the Government. These organizations have a quasi-governmental status even though they are private organizations and their relations with the Government are defined under various contracts.

In the hearings, this definition was refined as follows:

Federal Contract Research Centers as utilized by the DoD refers only to those centers which provide assistance in the planning, developing and executing of RDT&E programs but excludes research organizations performing research and development tasks and those engaged in operating technical facilities.

It is also important to recognize that these Department of Defense FCRC's are a specific sub-set of a much larger and broader base group of organizations identified by the National Science Foundation as FFRDC's (Federally Funded Research and Development Centers).

2.2 History of FCRCs

The term Federal Contract Research Center apparently had its genesis in May 1963 when Dr. Harold Brown, then Director of Defense Research and Engineering, in testimony before the Subcommittee on Appropriations of the House of Representatives, spoke of a specific group of organizations which, he said, ". . . we would like to call Federal Contract Research Centers so as to avoid the question of profit, nonprofit, universities or others." At that time Dr. Brown identified 39 such organizations, including, for example, such laboratories as the Electronics Research Laboratory (Stanford Research Institute), the Allegany Ballistic Laboratories (Hercules Powder Company), the Laboratory of Insulation Research (MIT), and the Arctic Research Laboratory (University of Alaska). (For a complete list, see Appendix A.)

In his testimony before the same committee the following year, Dr. Brown said that the Department of Defense had again studied the list of FCRCs that had been submitted in 1963 and, as a result, had found it appropriate to reduce the numb r of organizations on the list from 39 to 21. (See Appendix B.)

During the years from 1964 to 1971, nine more organizations were dropped from the list. In some cases, it was determined that the organization should never have been on the list, since it did not meet the general definition of an FCRC--the Hudson Institute, for example. The Center for Social Studies was subsequently eliminated because it had joined a profit-making organization, and the Hudson Laboratory, Columbia University, was phased out as an organizational entity.

The organizations antedate the adoption of the term FCRC by many years. The first of the current 12 FCRCs was the Applied Physics Laboratory, the Johns Hopkins University (APL/JHU), which was organized in 1942

at the request of the wartime Office of Scientific Research and Development (OSRD). Its purpose was to give central direction and technological support to the association of contractors from universities and industry then being organized by OSRD to exploit, in the defense of U.S. naval forces, the ideas on radio proximity fuzes that had just been developed. By 1944, APL/JHU's contract had been taken over directly by the Navy Department, and its fleet air defense effort was directed to the development of the technology of shipborne surface-to-air guided missiles--a sponsorship and effort that have continued ever since. From this came the idea of the private R&D organization tailored to serve as a continuous agent of the Defense Department in a broad mission area in which the DoD lacked sufficient internal technological and technical-management capabilities.

A second type of private DoD-supporting organization was created in 1948 when Rand was incorporated. Rand grew out of the same nucleus of scientific and technological capability that was established during World War II from which APL/JHU, as well as a number of the other FCRCs, arose, while the APL/JHU and all the other Navy FCRCs were deliberately organized under university sponsorship to gain both university standards in managing their business affairs and the objectivity of product that it was felt only university-type independence could assure; Rand came into existence in 1946 originally under the auspices of an industrial organization, the Douglas Aircraft Corporation, to fulfill a special research contract being funded by the Army Air Corps. Later, primarily as the result of the need both to create an institutional form more suited to the nature of the special contract and to avoid a conflict of interest on the part of Douglas, it became an independent organization under private initiative, with the Air Force sponsoring what had come to be called Project RAND. In still greater contrast to APL/JHU, Rand devoted itself largely to the analytic study of national security, providing objective research, analysis and advice to the Air Force (and others) across a broad spectrum instead of doing laboratory-based technological work or hardware development.

If to the APL/JHU and Rand we add the Mitre Corporation, which was created in 1958 to do unprecedentedly large-scale systems engineering in a particular area where the need was increasingly evident in the Air Force, we have identified the three distinctly different types of organizations that collectively are referred to as FCRCs:

(1) The true technology-oriented laboratory--APL/JHU; APL/UW; Lincoln Laboratory, MIT; and ORL, Pennsylvania State University. Of special interest is that each of these laboratories is directly affilitated with and managed by a major university and is operated in accordance with its rules.

(2) The studies and analyses type--Rand; RAC, CNA, HumRRO, ANSER and IDA. With the exception of CNA, which became affiliated with the University of Rochester in 1967, these FCRCs are self managed.

(3) The systems-engineering/technical-direction type--Mitre and Aerospace, both of which are self managed.

The APL/JHU and the three laboratories discussed below, which constitute the first group, had much the same origins. The Lincoln Laboratory was established by a contract between the Air Force and MIT in 1951 following a series of studies which showed the contribution that large computers could make to air defense. The laboratory was then assigned the task of solving the problem of defense against the U.S.S.R. bomber threat, and subsequently developed the Semiautomatic Ground Environment (SAGE) air defense system. In the late 1950s, after completion of the first operational subsector, MIT made a policy decision to remove itself from the installation of the remainder of the operational SAGE system, a task which, though demanding, was no longer advanced engineering. The Mitre Corporation was then formed, primarily from Lincoln Laboratory personnel, for the systems engineering of SAGE. Lincoln, with its highly creative scientists and engineers in the physics, electronics and data-processing disciplines, addressed itself to space communications and the observables associated with reentry vehicles. Lincoln made notable contributions in these areas during the 1960s.

The Ordnance Research Laboratory (ORL) of Pennsylvania State University was established in 1945 when Harvard University chose to disestablish its World War II Underwater Sound Laboratory. The hull-mounted sonar work of the Harvard laboratory was combined with Columbia University's laboratory program, and together they became the Naval Underwater Sound Laboratory at New London, Connecticut, a DoD in-house laboratory. The torpedo sonar work that had been carried on at the Harvard laboratory became the Ordnance Research Laboratory at Pennsylvania State University. The ORL has been in operation since that date, with major emphasis on underwater systems, particularly torpedoes and the related disciplines of acoustics, hydrodynamics, controls, structures and propulsion. The ORL has also served the Naval Ordnance Systems Command by providing technical consultation and advice in the direction of several production torpedoes which were, wholly or in part, developments of the laboratory.

The Applied Physics Laboratory of the University of Washington (APL/UW) was formed at the end of World War II from personnel of the OSRD's National Defense Research Council (NDRC) who had been working on the VT-fuze problem on the campus of the University of Washington in Seattle. The APL/UW addressed the related problems of influence exploders for torpedoes, and has continued this effort since 1945, with major emphasis on undersea acoustics and related warfare systems. Its chief capabilities include underwater tracking ranges, underwater weapon-systems alignment, acoustic imaging, target acoustics, and the development of targets. Again, the laboratory has provided technical consultation and assistance to the Naval Ordnance Systems Command on projects resulting from its own laboratory developments.

The FCRCs of the second type (studies and analyses) were formed at various times by the individual Military Departments, or the Office of

the Secretary of Defense (OSD), as in the case of IDA--usually at the request of the Department--to provide a capability that was not then present either in-house or in industry. The motive in each case was different, but in general it was to create or retain a group of scientifically and technically oriented professionals capable of serving as independent, objective sources of analysis, evaluation and advice on general and specific problems of national security.

The origins of some of these six FCRCs are traceable to early groups working in particular areas, which became larger groups of broader scope and eventually emerged as the corporate entities they are today. The first of these studies and analyses FCRCs was started in 1942, when CNA was affiliated with Columbia University during World War II, and the latest of the group is ANSER, which was incorporated in 1958.

The way these FCRCs grew was essentially no different from the manner in which any successful corporation grows, except in their almost exclusive relationship with the sponsoring Military Department--and the accompanying financial support. When an FCRC successfully completed its work in one area, the sponsor was usually encouraged to continue and increase its support, and the FCRC was encouraged to examine problems in new areas of the "customer's" responsibility. Successive years of close relationship between the professionals in an FCRC and its sponsoring agency create in the FCRC a unique awareness of the sponsor's history, current organization, operations, procedures, and special problems in reaching and implementing decisions. It should be recognized that the same condition of awareness in special areas is cultivated in organizations other than FCRCs--the Stanford Research Institute, for example--as a result of repetitive sole-source contracts in those areas.

The Aerospace and Mitre Corporations, which were organized in 1960, comprise the third group (systems engineering/technical direction). The Air Force established Aerospace as a result of much congressional criticism of their heavy dependency on profit-making, hardware-producing corporations for management and support in the ballistic-missile field. While an alternate approach, in some situations, is a hardware-exclusion contract with a profit-making industry, such agreements are not easily acquired. In this situation, a hardware-accented, profit-making company accepts a contract to do planning and systems engineering, but that company must also accept a ban on the production of any associated system hardware. Although such a ban might be acceptable with respect to a single system, no profit company can afford to agree to either an across-the-board or a long-term ban on the production of hardware, especially when producing hardware is considered essential to qualifying for support in developing and producing later or related systems.

Consequently, Aerospace was chartered as a private, nonprofit corporation under the laws of the State of California, and was given the responsibility for long-term systems engineering and technical direction in the field of Air Force ballistic missiles and space systems.

Mitre Corporation, on the other hand, was created to meet the increasingly urgent need of the Air Force for a technically competent organization to do systems engineering in air defense. As noted earlier, this role was offered to the Lincoln Laboratory, but MIT declined the task as inappropriate for a university laboratory. In July 1958, following a long series of meetings between the Air Force and MIT, Mitre was formally incorporated to undertake the vital task of expanding computer technology to be applied in the SAGE system for the air defense of North America. Personnel requirements were met by transferring people from Lincoln Laboratory to the new company, and initial work on the system was done under subcontractual arrangements with MIT.

Mitre has continued its work in defense against air attack, and has since done some diversifying to provide systems-engineering services for other major communications programs.

Throughout the period of the FCRCs' growth, there has been much industrial and congressional criticism about various aspects of FCRC operation and management. Generally speaking, the DoD and the FCRCs attempted to respond to criticism by correcting deficiencies or complying with comments and suggestions. The most restrictive external action is the Congress's imposition of a ceiling on FCRC funding, which has been negotiated with the Congress each year since 1968. Because inadequate allowance was made for inflation, the ceiling forced a steady reduction in the work that the FCRCs can do for the Military Departments. Attempts by the FCRCs to alleviate the corresponding shrinkage by diversifying their services so as to gain new customers outside the DoD have, for various reasons, been generally unsuccessful. Only two, Rand and HumRRO, seem to have achieved some moderate success in diversification.

Concurrently with the evolution of the FCRCs, other organizations (both profit and nonprofit) that perform much the same type of work have grown up. Frequently the work they do, sometimes by virtue of repetitive sole-source contracts, has led to the development of a relationship with the sponsor quite similar to that of the FCRCs.

2.3 Congressional Concern

Official expressions of congressional concern about the DoD's practice of contracting for technical talent in organized groups closely related to the Department began in 1961 in the hearings before the Committee on Appropriations, House of Representatives. To place the year 1961 in perspective, it was nearly 20 years after the FCRCs were started by the Army

and the Navy during World War II--and 13 years after the chartering of Rand as a not-for-profit corporation in 1948.

One primary reason for the emergence of official congressional interest at that time is apparent from the hearings in 1961 and subsequent years. Aerospace Corporation had been chartered as a not-for-profit organization in June 1960, and had quickly reached the funding level of $50 million a year. Almost immediately, Aerospace received a large amount of publicity, and the same was true of the technical-support contractors, which by 1961, as a group, were receiving $250 million in annual support from the DoD.

The tone and themes of congressional comments 10 years ago--too much growth, too great a cost to the government, too little control, and poor-quality products--have been repeated in almost every succeeding year. Recently, three other committees of the Congress, the House Armed Services Committee and the Senate Armed Services and Appropriations Committees, individually discussed these organizations and imposed certain limitations and controls on them. Points of concern are shown in extracts from congressional reports and hearings presented in Appendix C; almost all relate to these main themes. The latest pertinent congressional remarks, from a June 1971 report by a Senate subcommittee, evidence little change from those expressed 10 years earlier.

Clearly, as viewed by the Congress, attempts by the DoD and the FCRCs to respond to congressional concern have not been completely successful.

There has also been criticism to the Congress from industry, both profit and nonprofit, that the FCRCs which make studies and analyses and perform SE/TD are, in practice, doing work that industry should do.

3. CONDUCT OF STUDY

3.1 Initiation

On 16 January 1971, Deputy Secretary of Defense Packard asked the Secretaries of the Military Departments, the Director of Defense Research and Engineering (DDR&E), and the Assistant Secretaries of Defense (Comptroller) and (Installations and Logistics) to conduct a joint review of the RDT&E base, as recommended by the Blue Ribbon Defense Panel, to determine which in-house Defense laboratories and test and evaluation centers are essential to the Department's R&D needs, the goal being to eliminate the nonessential ones and consolidate the remainder across the services. Mr. Packard assigned the overall responsibility for the task to the DDR&E, Dr. John S. Foster, Jr.

Accordingly, Dr. Foster initiated studies of (1) the Defense in-house laboratories, (2) the Defense test and evaluation centers, and (3) the DoD-related Federal Contract Research Centers. He appointed Mr. E. B. Harwood, Deputy Assistant Director (Engineering Management), ODDR&E, as Chairman of the FCRC Study Group. An FCRC Study Steering Group was subsequently formed with the following membership:

OSD	E. B. Harwood, ODDR&E (Chairman)
	E. J. Nucci, ODDR&E (Vice Chairman)
	J. H. Sherick, OASD(C)
	R. D. Simmons, OASD(C) (Alternate)
	J. F. Dietz, OASD(C) (Alternate)
	D. F. Spencer, OASD(I&L)
	G. T. Croskery, OASD(I&L) (Alternate)
	R. D. Cole, Office of the General Counsel (Consultant)
Army	Brig. Gen. G. M. Snead, USA, Office of the Chief of Research and Development (OCRD)
	Col. W. S. Howe, Jr., USA, OCRD (Alternate)
Navy	Dr. W. P. Raney, Office of the Assistant Secretary of the Navy (Research and Development)
	D. C. Hughes, Office of Naval Material (Alternate)
Air Force	Dr. W. L. Lehmann, Office of the Assistant Secretary of the Air Force (Research and Development)
	Col. F. E. Davis, AF/RDG

The Steering Group prepared a study plan setting forth the task elements in the Blue Ribbon Defense Panel's recommendation concerning

the FCRCs, including the need to review each organization and noting the threefold nature of the FCRCs (as described in section 2.2).

3.2 The Study

Essentially, the study was conducted as follows:

(1) A series of briefings was given the Study Group by the primary sponsors of the FCRCs (the OSD, the Army, the Navy, the Air Force) to present from the sponsor's viewpoint the need for each FCRC, its effectiveness, and its management. The content of these briefings was guided by a check-list questionnaire (see Appendix D).

(2) The president or senior officer of each FCRC briefed the Study Group on operations, management and problems experienced from the FCRC's point of view. These briefings, again, were guided by a check-list questionnaire (see Appendix E).

(3) The Study Group held informal discussios with the president or senior official of the Planning Research Corporation, the Stanford Research Institute, and Arthur D. Little, Inc., all three of which do work similar to that of the FCRCs. The aim of these discussions was to determine the impact of the FCRCs on these independent firms working in the same area. (For the main points brought out in these discussions, see Appendix F.)

(4) The Deputy for Engineering, Air Force Aeronautical Systems Command, briefed the Study Group to help toward a better understanding of the efforts (in systems engineering/technical direction) of this in-house activity and compare them with work by the FCRCs for the Air Force Electronic Systems Command and Space and Missile Systems Office.

(5) In addition to these briefings, the Steering Group member from the Office of the Assistant Secretary of Defense (Comptroller) was asked to review congressional testimony of the past several years to determine and summarize the principal points of concern to the Congress.

(6) Three task groups were established, each group to study the FCRCs in one of the three categories identified: the laboratories; studies and analyses; and systems engineering/technical direction. Each task group included a member from each Military Department and one from the OSD staff.

Task Group I, headed by the Army member of the Steering Group, reviewed the six FCRCs doing studies and analyses--ANSER, Rand, CNA, HumRRO, RAC and IDA.

Task Group II, headed by the Navy member of the Steering Group, studied the FCRCs engaged in systems engineering and technical direction--Aerospace and Mitre.

Task Group III, headed by the Air Force member of the Steering Group, was concerned with the technology laboratories--Lincoln Laboratory, ORL, APL/UW, and APL/JHU.

To supplement information obtained in the briefings, each task group, or its representative, visited the specific FCRCs of its assignment to take a first-hand look at their facilities, management and operation.

(7) In addition, for reference purposes, participants in the study used reports of previous FCRC studies, other materials available in the DoD, and documents provided by the FCRCs. A list of these references is given in Appendix G.

4. DISCUSSION

4.1 Initial Clarification of Part of the Blue Ribbon Defense Panel's Discussion of FCRCs

The Blue Ribbon Defense Panel's discussion of the FCRCs makes one set of specific statements which the study group found were misleading and believes should be commented on initially in the interest of accuracy in later discussions.

> The close ties between sponsor and FCRC often prevent the sponsor from seeking study assistance elsewhere to obtain work better suited to his immediate requirements. It would be highly desirable to provide flexibility, whereby a sponsor could on occasion have research done by another FCRC. That this would lessen the reliance of an FCRC on a single sponsor could only be beneficial. It would soon be evident which FCRCs were strongest and they would be encouraged to become capable of competing successfully within their own ranks.

This did not prove to be the case. Sponsors are not prevented from seeking study assistance from organizations other than the FCRCs, nor do they hesitate to do so. As a general rule, the practice is to place the job where it can best be accomplished--whether by FCRC or non-FCRC. The dollar ceiling on FCRCs has the effect of causing careful consideration of the study support work assigned to an FCRC so that the work is normally, if not uniquely, matched to the organization's capabilities and characteristics. Work is also directed to the other not-for-profit or profit-making contractors whose capabilities are most applicable to the task. There is some evidence that work for which an FCRC might have been best in a free competition was sent elsewhere in part because of the FCRC ceiling.

There are limitations in cross-service use of FCRCs, however, but not primarily for the reason given by the Blue Ribbon Defense Panel. There are two reasons for the limitation, one externally induced and one internally. The externally imposed requirement that the Military Departments and the OSD budget for funds and obtain ceilings for FCRC work from 12 to 18 months ahead of time does interfere with the cross-service use of FCRCs. Budget and ceiling amounts must be obtained on a "level of effort" basis in accordance with previous experienced needs, since precisely defined requirements are not always known at the time of the budget ceiling's approval. This prevents the Military Departments from justifying the use of another sponsor's FCRC for any reason other than "just spreading use of FCRC's around." In spite of this difficulty, more than half of the Army's $25 million for FCRCs in 1971, for example, was used in FCRCs not sponsored by the Army. The same opportunity is available to the other services and the OSD, and is used. For instance, the OSD often uses the capabilities of Rand, RAC, and other non-OSD FCRCs.

The internally induced limitation comes from the counter argument to whether this flexibility can "only be beneficial." The basic advantage of flexibility is to be able to use certain special capabilities existing at certain FCRCs to do certain specific tasks. Fundamentally, it is a case of being able to take special work to the specialist. Whether the added FCRC costs and the administrative burden of marketing and the FCRCs' reduced reliance on a major sponsor are advantageous to the government or to the FCRCs is disputed by some of the FCRCs and some of the sponsors. Both parties cite the value of the close, exclusive sponsor-FCRC relationships that lead to mutual understanding, confidence and trust, and consider these ingredients to be highly important when one organization is dealing with the broad policies and plans and the major operations of another organization. They also cite the danger of creating conflicts of interest and lost objectivity. Competition between FCRCs is not at all regarded as clearly beneficial, and must be considered case by case.

4.2 The FCRCs' Work

4.2.1 Studies and Analyses: The six FCRCs that perform studies and analyses were created to meet the need for objective analysis of critical Defense problems. Since their establishment, other profit and nonprofit organizations have arisen that can do much the same type and quality of work. Both these and the FCRCs have been used extensively by the OSD and the Military Departments, but, owing to the type of contractual arrangements between the FCRCs and the government, Defense sponsors could initiate FCRC studies of urgent problems as they arise more rapidly than would be possible if the other groups had been used. This flexibility, however, has been diminished in recent years by the ceiling on funding for FCRCs; at times new work can only start if work already in progress is stopped.

After their first years, when the major problems for which they had been established had been addressed, these FCRCs' abilities were employed to help solve new organizational and operational problems of significance to the DoD. The FCRCs developed expertise in various areas that matched the continuing problems of sponsors in such fields as logistics, resource analysis and allocation, force structure, training, etc. The DoD made good use of their capabilities in annual programs, and the FCRCs were always able to respond quickly to sudden unforeseen requirements. By adjusting their organization and capabilities over the years, the FCRCs have grown well suited to the evolving requirements of their sponsors. As a group, they constitute a valuable asset to the DoD, and the services plan to use them as long as possible, just as they will continue to employ the non-FCRC organizations.

4.2.2 General Systems Engineering/Technical Direction: Like the FCRCs that do studies and analyses, the Aerospace and Mitre Corporations fall into the category of organizations created for a special purpose in connection with the prosecution of major new systems. The capability desired of them was not available in the civil service laboratories at the time, and in general has not since developed in the Military Departments. Moreover, the capability was not readily available through normal commercial channels without running the risk of great difficulties with real or imagined conflict of interest.

Two counterexamples should be mentioned--NASA's development program and the Special Projects Office in the development of the Polaris system. In both cases there was heavy commercial involvement in the management of systems engineering. After an initial period of difficulty in persuading the contractors to work constructively together, NASA has been able to conduct its development operations as a team effort with various commercial firms. This may be due in part to the fact that no large-scale production was involved. While the Special Projects Office relied heavily on its prime contractor for systems engineering and integration, the Office itself was uniquely able to provide general technical and financial direction. This in-house capability was arranged through (1) a strength of staffing that could probably not be currently duplicated by any of the services without emasculating many other development efforts and (2) a degree of independent fiscal authority that is no longer possible within the envelope of current DoD fiscal practices.

Since they were formed, both Aerospace and Mitre have modulated their tasks, the complexion of their work, and to some extent their management methods. This is to be expected, as the specific tasks for which they were originally created have been accomplished. Although their patterns of operation are different in detail, each has evolved methods of carrying out its tasks of systems engineering that are effective and efficient for their subject areas--electronics, communications and surveillance for Mitre; and missiles and space systems for Aerospace. Each has the strength of a demonstrated capability to be flexible in regrouping for work on major new systems; each has earned general acceptance by the organizations with which it deals; and each has learned to make effective use of its "outside" position in gaining access, where necessary, throughout the complicated service organizations without having to work its way laboriously through all the echelons. The DoD has generally not been able to arrange for similar freedom of action by its in-house technical organization, a fact that tends to reserve for those activities a worthy and essential but nonetheless different role. A related feature of the in-house laboratories is that, as technological creators and producers, they tend to be regarded as competitors by those with whom they have to coordinate when they fulfill a general systems-engineering/technical-direction (SE/TD) function for some development.

The role of Aerospace and Mitre, to provide general SE/TD for the development of major high-technology systems, remains essential. It is pointless to say that the function could not be provided by another instrumentality, but it must be said that its transfer to another type of performer could be accomplished only at the expense of incalculable (but considerable) lost time, additional cost, and technical error as new teams learn to work together to do the things that have been shown by the experience of Aerospace and Mitre to be necessary.

Several years of arbitrarily imposed ceilings and the difficulties that arise from increasing requirements for detailed planning and for task commitments far in advance of the time when the work will be done have now resulted in the accumulation of demonstrably harmful effects. The flexibility of the FCRCs and their capability to tackle the major interdisciplinary problems for which we need them has been impaired. Indeed, the difficulties of manipulating the funding ceiling among them has sometimes made them appear undesirable choices when the assignment of new and potentially large tasks is considered.

Yet these organizations were created exactly because it was felt that the highly structured, organized and controlled government organizations already in existence couldn't do the necessary job. The trend toward detailed justification and control is forcing the FCRCs inevitably in the direction taken by the special-purpose organizations of World War II, the NDRC laboratories, as they evolved into standard civil service activities, which (as has already been pointed out) are excellent--but for a different function. The reputed advantages of very detailed control are not only ephemeral in nature but wasteful to the government.

There is every reason to be careful that these corporations, created for the DoD, remain its creatures and do not inadvertently, in support of their corporate existence, invade other domains of activity. Thus, a clear understanding and statement of their uses and functions are mandatory. Control over the envelope of their DoD use is a powerful tool; an annual ceiling on total funding of an organization is useful if inflationary growth is recognized and accommodated. But, to counter the trend toward a stifling overconstraint, the DoD must be allowed to manage the FCRCs freely within a total envelope, must be able to entertain the possibility of major new assignments for them, and must be excused from planning their work in detail as much as 18 months before it is to be done.

These factors, in conjunction with a reasonably detailed but brief examination of the problems of converting GSE/TD organizations to the Civil Service, have led the Group to formulate the recommendations regarding the continuance of Aerospace and Mitre as FCRCs, the continued use of a ceiling in the form of an adjustable upper bound on annual funding, and the restoration of internal flexibility in the FCRCs' operations.

An additional explanation is required concerning the recommendation about the future of the Aerospace Research Laboratories. It is quite clear that those laboratories are in several ways a valuable adjunct to the prime Aerospace function. They are organized as an entity within Aerospace, while in contrast Mitre accomplishes its modest independent research and its project-supporting technological work with small groups and individuals spread throughout the various subdivisions of the company. It is also clear that the total annual cost of running those laboratories is an infinitesimal fraction of the cost of the SAMSO programs for which Aerospace has important responsibilities. There are valid questions, however, about how the function could be improved to provide greater support to the basic Aerospace mission, as well as to the DoD at large; there are questions about implications for the future with respect to the various modes of exploiting laboratory achievements; and it is necessary to carefully examine the relative benefits of the several alternative ways under which the laboratories could continue to operate. It was not possible within the allotted time of this study to perform the necessary in-depth review and gain the understanding that this complex problem deserves. For these reasons, the Group has recommended that the Aerospace Research Laboratories be studied further, either as a follow-on to this study or as a separate effort.

4.2.3 The Technical Laboratories: The technical laboratories have a common history. At the onset of World War II, the United States faced the need to translate the science and technology of 1940 into operational systems and subsystems as rapidly as possible in order to survive. The universities, as a major repository of the nation's technical capability, were asked to build teams to do this. After victory in that war, several of those universities and the military services agreed that continuing this work was to their mutual interest. Thus, Lincoln Laboratory, though not formed until 1951, is a direct descendant of the MIT Radiation Laboratory of World War II. The APL/UW arose from the VT-fuze effort of that period at the University of Washington; and the APL/JHU was already working on fleet air defense during that war.

Not all of the universities felt that the continuation of their wartime work was to the long-term benefit of their fundamental educational objectives. Harvard University terminated its wartime underwater research, and the group split up into two units, the first moving to New London to become what is now the Naval Undersea Systems Center, the second moving to Penn State to become the Ordnance Research Laboratory.

Since their inception, all of these laboratories have worked chiefly on applied research in the physical sciences or in engineering. Past experimental work has brought forth new devices or pieces of equipment or new techniques. The laboratories have used these techniques, along with state-of-the-art devices, to put together laboratory working systems that prove or disprove a concept or provide parametric data. On occasion, a

laboratory working system has become a one-of-a-kind operational system, and the laboratory has operated it. At other times, the expertise and technical know-how gained by a laboratory's staff on a working model they designed and developed have been used in a technical commitment or direction role by the systems organization of a Military Department to acquire production hardware.

But the work of the laboratories has remained overwhelmingly of a creative engineering nature, and all these FCRCs have evidenced self-limiting and self-pruning characteristics. Lincoln Laboratory spun off the Mitre Corporation in 1958 when the SAGE air defense system made the transition from development (i.e., creative engineering) to systems engineering and the installation of an operational system. The ORL and the APL/UW turned over their torpedo development and acquisition programs to the Naval Ordnance Systems Command when the creative engineering was completed, and were subsequently involved only insofar as their technical expertise was necessary to the successful completion of the programs.

All these laboratories have evidenced the discipline imposed by their parent universities and have avoided the appearance of abuse. The salaries of laboratory staff are held at levels comparable to those of faculty and administration members of like stature, which are quite comparable with civil service scales. Organizational structure is subject to similar control. The Pennsylvania State University and the University of Washington are state schools whose operations are annually scrutinized by state governing bodies, while the Johns Hopkins University and MIT are openly reviewed by their trustees. The common ancestry of the Naval Undersea Systems Center and the ORL provides a ready comparison of their relative growth, the DoD in-house laboratory having grown consistently more than the FCRC. The growth and decline patterns of the other laboratories among the FCRCs show clearly that there has not been any attempt to use the university organization as a means of circumventing government manpower controls.

The DoD has found university laboratories to be highly productive performers of appropriate research and development. Over 100 universities have Defense contracts or grants, and several of these are closely allied with a Military Department or Defense Agency. Some were initially categorized as FCRCs but were subsequently dropped. All, including the laboratories, do research and experimentation, build prototype devices, or prove out technical concepts. None can be characterized as "captive companies," a term used by Congressman Mahon in defining the FCRCs. The Group found it difficult to rationalize the characterization of the four laboratory FCRCs by any of the critical criteria expressed by the Congress as having the kinds of problems of primary congressional concern. It would appear that an initial DoD categorization, which was based on a questional interpretation, has simply been continued from year to year and should be corrected.

4.3 Management Control of FCRCs

The single problem cited by sponsors and FCRCs alike was the effect of the obligational ceilings imposed by the Congress on total FCRC efforts and occasionally on a specific FCRC or elements of its program. These FCRC ceilings are currently established after the RDT&E Program Budget requests are presented to the Congress. Congressional committee reports furnish guidance to the DoD in establishing specific FCRC ceilings. The problems and disadvantages noted by the sponsors and FCRCs are as follows:

Ceiling Problems

(1) Inflation effects: In recent years the Congress has generally failed to approve ceiling increases that correspond to cost growth due to inflation, and in several cases has even cut the ceilings below constant expenditure levels. Several years of continued attrition in real ceiling have reduced the available capability of the FCRCs and have, at the same time, driven up the overhead fraction of total expenditures.

(2) Reduced management flexibility: Implementing fixed ceilings requires the establishment of a management system within the DoD that complements the usual funding controls. This adds another constraint on the flexibility needed by the service sponsors in availing themselves of FCRC capabilities. When all funds under the ceiling specified for an FCRC have been allocated, a sponsor may be forced to place new and important high-priority tasks with a less competent performer, regardless of the availability of funds appropriated for the work. Only through an awkward double negotiation involving both funds and ceiling, with accompanying arbitrary cancellations and shifts of work, can a new task be undertaken by the FCRC.

Another facet of reduced flexibility arises from requests by the congressional committees for the citation of budget lines that will support work to be done by the FCRCs. The budget justifications are prepared so far in advance (as much as 18 months) of the actual work performance that the consequent precision in planning frequently leads to estimating errors. As a result, considerable labor on the part of management is later required to explain the deviations of actual experience from statements in the budget estimate justifications.

(3) Reduced competition: These complications of handling ceiling restrictions have the net effect of inhibiting true technical competition for work among the FCRCs. That is, the driving question in the assignment of work to one FCRC or another may not be their relative competence or cost factors but rather the simple availability of "ceiling." This has become such a dominant issue with most of the FCRCs that their working-level managements are sometimes discouraged from trying innovation or attempting new approaches to Defense problems, because they are convinced that the ceiling restrictions would make any such change too difficult.

In view of the foregoing problems, the Group considered alternative methods of control that could ameliorate their effect.

Alternatives

(1) Manpower ceilings: The use of ceilings in terms of professional manpower was considered. While offering relief from the effects of inflation, it poses another management problem--an imbalance toward high-salaried positions with fewer support personnel than is optimum. It does not relieve the flexibility situation. DoD in-house laboratories have had manpower ceilings before, and preliminary experience with Project REFLEX indicates the superiority of monetary ceilings. The REFLEX laboratories are able to make dollars the true control mechanism, hiring or firing to get the right mix of engineers, technicians, and clerical and other support personnel that will do the job within the money available.

(2) Removal of ceilings: The complete removal of funding ceilings was considered. This would eliminate the artificial restrictions on flexibility and competition and would permit management to match budgetary, quality and time constraints to the job to be done. It would change the problems of inflation, flexibility and competition into fiscal problems--which would in many ways be the preferred option. It was recognized, however, that the general congressional attitude is likely to require continued management constraints of some type, and the removal of all ceiling restrictions is unlikely to be a popular solution.

As a variation to the complete removal of ceilings, the Study Group looked into the feasibility of separating FCRCs' efforts into two categories of work, one consisting of long-range institutional-type work and the other, short-range tasks. A ceiling could be applied to the first type of work, while the shorter range efforts would not have a ceiling constraint. After considerable review and analysis of efforts actually under way in the studies and analysis FCRCs, the Study Group found that the work was not in fact divided in such a manner and that the Services consider their work to be of the task type. While it appeared that some of the work could be considered long-range service-oriented studies, it was felt that any attempt to arbitrarily break these efforts into two categories would involve a variety of judgmental factors and that such a procedure could easily be abused--or, at least, appear to lend itself to abuse. This alternative was therefore considered unsuitable. This problem is discussed further in Annex G to the report of Task Group I.

(3) Single DoD ceiling: The alternative judged by the Group to be most realistic is the continuation of ceiling limitations on FCRC expenditures, this to be in the form of a single total for the DoD's entire FCRC effort. This type of control would enable the OSD and the Military Departments to apportion the total ceiling amount according to their acknowledged needs. The sponsors within the Services should then be free

to place their work at the FCRCs that are best for the jobs without having to maneuver within the constraints of ceilings on individual organizations. This alternative would allow the FCRCs to engage more freely in a quality competition for all DoD tasks, as advocated by the Blue Ribbon Defense Panel.

5. FINDINGS AND CONCLUSIONS

The following is a summary of the Study Group's findings and conclusions, based on those of the three task groups.

5.1 FCRCs for Studies and Analyses

. The six FCRCs for studies and analysis that logically fall into this general group (CNA, RAC, Rand, ANSER, HumRRO, IDA) vary greatly in the type of work they do, their organizational structure, and their management, both by the FCRC itself and by the sponsoring organization.

. While certain of the capabilities that were peculiar to the studies and analysis FCRCs at their beginning are no longer unique to them and can now be obtained from non-FCRC organizations, the FCRCs do retain a history based on experience, knowledge and sensitivity that is essential to studying military-peculiar problems. This capability is not available in industry at large.

. Statements that the studies and analysis FCRCs do not produce quality products were not substantiated, since those products are accepted by the general research community and result in the customer's ultimate satisfaction. If this were not the case, the sponsors would go elsewhere, for there is no "protected funding source" for FCRCs.

. The most serious problem unique to these FCRCs, the one that raises the greatest obstacle to their broader use by their sponsors and other DoD agencies, is the congressionally established dollar ceiling for them. It places on these FCRCs an additional constraint that is not applied to other organizations doing the same kind of work. On the other hand, FCRCs do operate on an annual funding basis within the constraints of the congressional ceiling, as contrasted to individual task-type contracts characteristic of non-FCRC organizations.

. The central feature of these six FCRCs is this ceiling on annual funding. There are good reasons for such ceilings, with their implications regarding annual level of effort and company size. In one respect, the ceiling provides a beneficial discipline, because it forces the users to ensure that, within the limited funds available, the FCRC is assigned only that work most appropriate for it to accomplish.

. The Study Group concludes that strict dollar control (i.e., ceilings) should be retained for those organizations that choose to continue their present relationship to the DoD as FCRCs.

5.2 FCRCs for Systems Engineering/Technical Direction

. Each of the SE/TD FCRCs (Aerospace and Mitre) enjoys a high degree of confidence on the part of its sponsor and a sense of dedication and achievement based on many years of corporate memory and close association in the top management areas of the Defense community.

. Only the Air Force has elected to make major use of this kind of FCRC, and then only in the areas of missiles, space and electronic air defense functions. The Army has not chosen to establish this type of mechanism for their programs. The Navy, on the other hand, with established in-house expertise, has elected to use either the in-house laboratory or the special projects office approach, both staffed by government employees to perform the SE/TD functions.

. The kind of work done by these two FCRCs is, in principle, noncompetitive with industry for two prime reasons: (1) They were established and intended to be operated so as not to compete, and (2) virtually no profit-making industry will accept the required hardware-exclusion clause for the specific project and all future related projects.

. Mitre Corporation is well managed and has so far weathered the changing Defense budget environment. Its relationship to the Air Force's Electronic Systems Division is a well-defined and functional one under which both organizations are comfortable and mutually responsive.

. Aerospace Corporation continues to carry out its assigned mission with a high degree of success. Its working arrangements with the primary Air Force sponsor, the Space and Missile Systems Office (SAMSO), is characterized by a high degree of integration of the two organizations, which undoubtedly strengthens both in their assigned functions.

. The functions that Aerospace and Mitre have performed over a period of years require a considerable free exchange of data and information among Defense contractors not found between competitive hardware producers.

. Their technical staffs, although adaptable to meeting changing requirements, are subject to many of the aging problems that beset in-house activities. This has become more acute in recent years as a result of dollar ceiling restrictions and the resultant forced reduction of technical staffs, which will eventually destroy their effectiveness.

. The Aerospace Research Laboratories have been subjected to several reductions in size under the pressure of funding ceilings. If this continues, the laboratories' present capability could be degraded past the point of utility.

. The present climate (compatible government salaries, a surplus of scientists and engineers in the civilian economy, decreasing Defense budgets, etc.) is a good one in which to review the future of Aerospace and Mitre in terms of continuing them in their present form.

5.3 The Technical Laboratory FCRCs

. Each of the four technical laboratories (ORL, APL/JHU, Lincoln Laboratory, and APL/UW) is hardware oriented and carries out high-quality research, experimentation and engineering demonstration in product areas of critical importance to the DoD.

. Each of these has been associated since its beginning with a university, and the university-laboratory interaction and relationship have increased markedly in the past few years. This long-time association has resulted in a self-pruning, self-regulating, self-critical form of laboratory control comparable to that imposed by any ceiling that the government may establish.

. The FCRC laboratories' operation, carried out under the constraints of the universities and their governing bodies, has been free of the "excesses" that were the subject of many congressional concerns relating to the other classes of FCRCs. For example, salaries in these laboratories have been either comparable to, or lower than, those under the civil service; their growth has been less than that of civil service laboratories; they have seldom been criticized for poor work but rather have been the source of many outstanding developments.

The four FCRC laboratories differ primarily in scale and in the longer term nature of their work from the many universities with which we have contracted to perform research or experimentation, build prototype devices, or prove out technical concepts.

. The four technical laboratory FCRCs reviewed by the Study Group are an existing effective, economical adjunct to the technology base of the United States, and should be continued and used as needed in the same manner that in-house and other laboratories are used. A congressionally imposed ceiling, in the sense that it is an effort to preclude or limit possible abuse or special privilege, does not seem necessary to the university-associated technical laboratory FCRCs. Under present circumstances, including this country's psychological mood, it is most unlikely that these four FCRCs could or would be allowed to expand out of control if the ceiling were eliminated altogether. FCRC problems would be considerably clarified if these four technical laboratories were removed from the list, with the understanding that some form of long-range planning would be undertaken by the DoD sponsor and the laboratory and its associated university.

6. RECOMMENDATIONS

Having studied the Federal Contract Research Centers in response to the Blue Ribbon Defense Panel's report, the Study Group offers the following recommendations:

(1) That action be taken by the Department of Defense, in conjunction with the appropriate congressional committees, to remove from the list of FCRCs the four technical-laboratory organizations--ORL, APL/JHU, Lincoln Laboratory, and APL/UW.

(2) That no changes be made to the present form, mission or use of a ceiling as a method of controlling:

(a) FCRCs for studies and analysis--IDA, RAC, Rand, ANSER, HumRRO and CNA; and

(b) FCRCs for systems engineering/technical direction--Mitre and Aerospace.

(3) That the FCRCs' capabilities for studies and analysis and for systems engineering/technical direction be made more easily and widely available to all DoD agencies by requesting the Congress to authorize annually one total dollar amount for the DoD's FCRC effort. This amount should include an adjustment for annual inflation.

(4) That an in-depth review be made of the Aerospace Research Laboratories to determine:

(a) the optimum method of sustaining the necessary technical competence in support of Aerospace's prime function; and

(b) the advantages and disadvantages of alternative methods of operating the Aerospace Research Laboratories.

APPENDIX A

Federal Contract Research Centers
Reported to the Subcommittee of
the Committee on Appropriations, House of Representatives,
May 1963

Secretary of Defense:
- Weapons Systems Evaluation Group (Institute for Defense Analyses)
- Support for ARPA (Institute for Defense Analyses)
- Logistics Management Institute
- Hudson Institute

Department of the Army:
- Rocket and Propellant Laboratory (Rohm & Haas, Inc.)
- Thiokol Project (Thiokol Chemical Corporation)
- Army Mathematics Center (University of Wisconsin)
- Electronics Research Laboratory (Stanford University)
- Human Resources Research Office (George Washington University)
- Special Operations Research Office (American University)
- Prevention of Deterioration Center (National Academy of Sciences)
- Research Analysis Corporation

Department of the Navy:
- Allegany Ballistics Laboratory (Hercules Powder Company)
- Thiokol Project (Thiokol Chemical Corporation)
- Ordnance Aerophysics Laboratory (Convair Division, General Dynamics Corporation)
- Electronic Defense Laboratories (Sylvania Electric Products, Inc.)
- Applied Physics Laboratory (Johns Hopkins University)
- Applied Physics Laboratory (University of Washington)
- Hudson Laboratories (Columbia University)
- Naval Biological Laboratory (University of California)
- Ordnance Research Laboratory (Pennsylvania State University)
- Laboratory of Insulation Research (Massachusetts Institute of Technology)
- Arctic Research Laboratory (University of Alaska)
- Electronics Research Laboratory (Stanford University)
- Human Resources Research Office (George Washington University)
- Research Laboratory of Electronics (Massachusetts Institute of Technology)
- Columbia Radiation Laboratory (Columbia University)
- Control System Laboratory (University of Illinois
- Electronic Research Laboratory (University of California)
- Center of Analysis (Franklin Institute)

Department of the Air Force:
- Aircraft Nuclear Test Facility (Convair Division, General Dynamics Corporation)
- Space Technology Laboratory (Thompson Ramo Wooldridge, Inc.)
- Lincoln Laboratories (Massachusetts Institute of Technology)
- Physical Research Laboratory (Boston University)
- Aerospace Corporation
- ANSER (Analytic Services, Inc.)
- Defense Metals Information Center
- Mitre Corporation
- Rand Corporation

APPENDIX B

Federal Contract Research Centers
Reported to the Subcommittee of
the Committee on Appropriations, House of Representatives,
1964

Department of the Army:
- Mathematics Research Center (University of Wisconsin)
- Human Resources Research Office (George Washington University)
- Special Operations Research Office (American University)
- Prevention of Deterioration Center (National Academy of Sciences)
- Research Analysis Corporation

Department of the Navy:
- Applied Physics Laboratory (Johns Hopkins University)
- Applied Physics Laboratory (University of Washington)
- Center for Naval Analyses (Franklin Institute)
- Hudson Laboratory (Columbia University)
- Ordnance Research Laboratory (Pennsylvania State University)

Department of the Air Force:
- Space Technology Laboratory
- Aerospace Corporation
- Lincoln Laboratories (Massachusetts Institute of Technology)
- Mitre Corporation
- Rand Corporation
- ANSER Corporation
- Electromagnetic Compatibility Analysis Center
- International Telephone & Telegraph Communications Systems

Defense Agencies:
- Institute for Defense Analyses
- Rand Corporation
- Hudson Institute

APPENDIX C

Congressional Concerns Relating to FCRCs
Extracts from Congressional Reports[1]

Extract 1

Contracting for Administrative and Technical Services

The practice of governmental agencies contracting with various corporations and organizations for technical management, scientific evaluations and administrative and management services is increasing at a rapid rate. In the judgment of the Committee, the government is moving toward a chaotic condition in its personnel management because of this practice. Some hard decisions must be made in regard to this mushrooming phenomenon before tremendous injury results to vital Defense programs of other Departments and agencies of the federal government. The Committee believes the procedures now followed are creating considerable additional costs for the taxpayer.

The Committee is concerned about the entire field of all such contracts, whether they are with non-profit or with profit-making organizations, but wishes in this report to speak more specifically in regard to the use of non-profit organizations which provide specialized technical and scientific support for military research and development activities. The Air Force uses such services to a much greater extent than do the Army and Navy. These non-profit organizations contract either entirely or almost entirely with the federal government. The employees of such organizations are paid indirectly by the taxpayers to the same extent as employees under civil service are paid directly by the taxpayers. The pertinent major difference is that their pay is higher. Laws have been enacted by the Congress to regulate salaries of civil service employees. No such laws protect the taxpayers from the payment of excessive salaries to employees of non-profit organizations with government contracts. To a considerable extent the use of contracts with non-profit organizations is merely a subterfuge to avoid the restrictions of civil service salary scales. The Committee considered the adoption of a limitation which would prohibit the payment of salaries in these organizations substantially in excess of applicable federal pay rates. However, it was felt that such drastic action would bring about delays in vital military programs now under way and create further confusion rather than eliminate it.

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[1]Throughout the extracts in this appendix, the underscoring has been supplied.

It is noted that the build-up of these organizations has not been accompanied by corresponding reductions in the number of military and civilian personnel on the government rolls. It would be too much to expect military and civilian personnel to perform all of the scientific and technological work which must be performed in the defense effort without a marked reorientation of the present organization and personnel procedure. However, military and civilian personnel on the payroll should be competent to do the jobs assigned to them or they should be removed from the payroll. When essential management functions are performed by contract personnel, the value of the military and civil service employees assigned to particular management functions affected is considerably lessened, and this fact should be taken into consideration in the staffing of defense programs.

It is hoped that the appropriate legislative Committees of Congress will pursue their reviews of these problems with which we are confronted with a view toward enactment of corrective legislation. Although of special significance to the Defense Department, the problem involves other areas of government.

The Committee insists that the Secretary of Defense establish and announce a realistic policy with respect to this problem prior to the presentation of the next annual Defense estimates. In the absence of any such policy, the Committee expects to recommend in the next annual Defense Appropriation bill that severe restrictions be imposed on these and other similar corporations and organizations.

The Committee has taken the specific action of recommending a reduction of $5,000,000 in the budget request of $35,200,000 for the Aerospace Corporation for fiscal year 1962. This corporation is one of the newest of the non-profit organizations working for the Air Force. It is in a special category due to the fact that it was established by request of the Air Force. The Committee feels that the salaries paid by the Aerospace Corporation are excessive, that its overhead costs are too high, and that it plans to employ too large a staff. The Air Force should either be able to obtain its required services from Aerospace Corporation for $30,200,000 or find another method of coping with the problems involved.[2]

[2]Report of the House Appropriations Committee on DoD Appropriations for FY 1962, House Report 475, 23 June 1961.

Extract 2

Contracts for Technical and Management Services

The Committee recommends a reduction of $5,000,000 in the $166,039,000 estimated by the Air Force to be the amount which would be obligated in contracts with organizations such as the Aerospace Corporation, the MITRE Corporation, Rand, the Space Technology Laboratory, and others in fiscal year 1963. This action allows an increase of almost $7,000,000 more than the amount provided for fiscal year 1962.

In the report accompanying the Department of Defense Appropriation Bill last year, the Committee expressed its concern over the continued increase in the size and cost of contracts with non-profit corporations and protested the high salary levels paid by many of these corporations. The Committee insisted that the Secretary give close attention to this problem. Subsequently, the President announced that the Bureau of the Budget had been directed to make a study of the use of non-profit corporations by the federal government and related problems. It was expected that this report would be completed by March 1, 1962, but it has been delayed and has not yet been submitted. The Department of Defense awaits the results of the recommendations of this study as do the other departments of the government as well as the Congress. The value of such organizations to the Air Force is not denied, but the Committee feels that the continuing growth in contracts for such technical and management services pending further review of the requirement is not advisable. A part of this problem is the danger that significant decision-making responsibility which rightfully is the duty and privilege of government officials may be contracted out.[3]

[3]House Report No. 1607, 13 April 1962.

Extract 3

Federal Contract Research Centers

For a number of years, the Committee has expressed considerable interest in the continued growth of the so-called Federal Contract Research Centers. To a considerable extent, these special contract organizations were developed to supply urgently needed, highly skilled scientific and technical talent for the planning, executive, and evaluation of the complex and costly ballistic missile development programs. A generalized justification for establishing and expanding these contract facilities was the fact that the Department of Defense did not have within its own organization the scientifically qualified talent required to accomplish the highly complicated effort within the short period of time available to meet national security objectives. While the original need for, and the accomplishment of these specialized activities is fully understood and appreciated, the circumstances which provided the original justification to pay a premium price for this type of effort are more or less behind us. The Department of Defense has had ample time and experience to have improved its in-house capability. The Congress has provided salary increases for federal employees in order to make their wages more nearly comparable to those paid by industry. There is, therefore, some reason to question the need for continuing the high-cost effort provided by these organizations at the levels to which they have presently grown.

The Committee has, this year as in past years, been provided with certain information with respect to the Federal Contract Research Centers, generally relating to financial support from Research, Development, Test, and Evaluation appropriation accounts. Such data are not complete since substantial amounts are provided to these corporations from other appropriations. When next year's budget is presented, the Committee will require more extensive data and justification for the Federal Contract Research Centers.

It is understood that the Department of Defense now has under study the nature and extent of the programs planned for assignment in the current and future years to these Centers, and that the study contemplates adjustment of the size of such facilities in consonance with the projected workload. The Committee believes that such a critical evaluation could well result in a downward adjustment in the size of these contracts in view of the apparent decline in urgent requirements. The Secretary of Defense is encouraged to pursue this study.

The Committee recommends a reduction in the funds requested by the Army in this area since an increase above previous years' levels of funding was indicated. No reductions have been recommended for the Navy and Air Force since the total funding of the effort being allocated to this area

by those two Services indicates a reduction. The Committee will undertake a more detailed scrutiny of this area next year and hopes that the Department of Defense can show more reductions in funds so allocated in the fiscal year 1967 budget.[4]

Extract 4

Federal Contract Research Centers

The Committee reiterates its long-standing position that the growth of the Federal Contract Research Centers with which the Department of Defense contracts should be carefully regulated. Information requested by the Committee and supplied by the Department of Defense (see pages 112 and 113 of Part 5, Hearings, Department of Defense Appropriations for 1967) indicates that a significant increase in this area was requested only by the Air Force. The recommended funding for the Centers by the Army, the Navy, and the Defense Agencies is at approximately the same levels as that approved last year.

Since the Army, the Navy, and the Defense Agencies have substantially complied with the Committee's intent, no reductions are recommended in their budget estimates in this area. A reduction of $3 million is recommended in the request of the Air Force. The prior approval of the Committee should be obtained before any additional funds are reprogrammed for Federal Contract Research Centers above the amounts justified to and approved by the Committee.

The Committee had its Surveys and Investigations Staff make a detailed study of the Institute for Defense Analyses. The study revealed a number of failures to comply with existing Department of Defense regulations in contracting with that organization and revealed certain unwise expenditures. Testimony indicated that some of the practices which were criticized have been discontinued, that contract negotiation and auditing functions have been improved, and that the documentation and cost analysis requirements of the Armed Services Procurement Regulations are now being fully met. In view of these assurances, and in view of the slight reduction in the funds requested for the Institute of Defense Analyses, the Committee has not recommended a reduction in the funds requested for this organization.[5]

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[4]House Report No. 528, 17 June 1965.

[5]House Report No. 1652, 24 June 1966.

Extract 5

Federal Contract Research Centers

In the past year, the Committee has continued its surveillance of Department of Defense contracts with Federal Contract Research Centers. The Surveys and Investigations staff of the Committee was requested to study several of these organizations in depth and has reported its specific findings. In general, it is reported that a better job is currently being done in following the Armed Services Procurement Regulation both in making and in auditing contracts with Federal Contract Research Centers. Still, these continue to be high cost organizations. Personal compensation remains high. Fees are allowed which enable the organizations to expend funds for purposes for which reimbursement would not be allowed under the Armed Services Procurement Regulations and which would not be allowed in the Federal Government. In some instances, real estate is acquired and held in excess of obvious requirements. In other instances, proper contracting and auditing procedures are still not being followed.

The Committee's examination of some of the work requested of, and done by, these organizations indicates that not all of it has been necessary nor has all of it been of a quality superior to that which could be achieved within the Government.[6]

[6]House Report No. 1735, 18 July 1968.

Extract 6

Repeatedly, the Committee has pointed out, both in the hearings and in reports accompanying Defense Appropriation Bills, several areas in research and development in which unnecessarily high costs are incurred. One of these areas is the support of Federal Contract Research Centers (FCRCs). A grand total of $303,686,000 is budgeted for FCRCs in 1969 in all appropriation accounts. Although no specific reduction in this amount is stated, the Committee feels that a part of the general reduction recommended should be applied to this area. A very careful review of the requirement for work assigned to FCRCs should precede all such assignments. A careful analysis of the usefulness of studies and reports performed by the FCRCs is indispensible to proper management in this area. The Committee believes that too much of the effort assigned FCRCs does not make a real contribution to national defense.[7]

Extract 7

MR. MAHON. I want to lay this matter to rest in order to move into other subjects.

I am pleased that you seem to be aware of the fact when these so-called nonprofits are utilized, you do not have the normal controls of the competitive market and the profit motive that you have in industry. It is a very difficult problem with which to cope.

One of the concerns I have personally, and I think the committee shares this concern, is that unless someone puts his foot down hard these kinds of operations will get almost completely out of hand. The thing could just keep growing and growing and growing and growing. I believe you share that feeling somewhat.

DR. BROWN. I do, Mr. Chairman. I think some combination of competition and Government regulations is necessary here as in other areas. Although I believe strongly in the competitive system, it is not a panacea either because, if you look at the defense industry as such, it is not a normal competitive system. The Government is the only purchaser. You have all kinds of proliferation and poor management as a result.[8]

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[7]House Report No. 1735, 18 July 1968.

[8]House hearings on DoD FY 1964 Appropriations, 9 May 1963.

Extract 8

MR. SIKES. Could not the Navy perform this work in-house without the Center for Naval Analyses?

Admiral COATES. We used to. We could, though I think not nearly as well. When we are talking about projects and future procurements that run up into hundreds of millions, or even billions of dollars, I think we should take a very cold calculating look at them and I believe that is best done by a group of people away from the pressures of the daily business of the Navy who are experts in the field of analyses.

MR. SIKES. Is one purpose of this Center the avoidance of civil service salary controls?

Admiral COATES. No, sir; not at all.

MR. SIKES. Does that enter into it?

Admiral COATES. No, sir; it does not.

MR. SIKES. You can pay higher salaries under this contract program?

Admiral COATES. That is true.[9]

[9] House Hearings on DoD FY 1965 Appropriations, 16 March 1964.

Extract 9

Reasons for Reprograming Request

MR. LAIRD. Mr. Chairman, it seems to me that in connection with Mr. Whitten's comments the problem before this committee is the limitation and the effect of it on Air Force actions. This limitation does not apply to the full R.D.T.&E. effort. We have to see what work was done in this program that could have been done in another way by the Air Force through their R.D.T.&E. efforts.

When I look at this limitation, Mr. Chairman, and I see that in the last fiscal year it was $161 million, and we placed a limitation of $166 million for fiscal year 1963, we find that the number of employees were increased from 3,721 in Aerospace Corp. to 4,275; we see the number of employees added at the Lincoln Laboratory, Rand Corp., Analytical Services Corp., Electromagnetic Compatibility Analysis Center and Mitre Corp., all going up. Our limitation was put on this particular appropriation item in order to keep the employee level down.

The Secretary of Defense came in and testified the other day and showed us a great record on the number of civilian employees that he was able to reduce in the Air Force, the Army, and the Navy. Many of these employees were in the regular R.D.T.&E. program. Evidently we are merely shifting them over to the corporation approach. This limitation as far as getting at any employees has had no effect as far as the Air Force is concerned.[10]

[10]House Hearings on DoD FY 1964 Appropriations, 29 March 1963.

Extract 10

Bargaining Power of Air Force with Development-Support Contractors

MR. MAHON. Is it true that to some extent that the Department of Defense in general, and the Air Force in particular, are becoming more or less captives of these corporations? In other words, these corporations are more or less in a position, it seems to me, to write their own ticket. They say, "You want us to do certain highly important work, like penetration aids." They say, "You must do this for us and provide this much money or we cannot do it." The Air Force says, "If you do not do it our program will fail. We are over the barrel. If you want to blackjack us," and I am using this in the most pleasant connotation I can, but, "if you want to blackjack us, OK, we will just have to be blackjacked because you have the know-how, you have the technology, we cannot do it. We do not like this, but what can we do. Therefore, we will go to Congress and ask for the money if that is what you say you have to have to do this highly important job, that is absolutely necessary if we are to hold our own."

* * * * * *

MR. MAHON. Isn't it nevertheless true that these corporations are indispensible to you? If they take their marbles and go home, which they are not about to do, of course, you are utterly helpless for a time because you do not have any immediate substitute.

These people have every advantage. What can you do about it? You have to call on Lincoln Laboratories. You have to work with Aerospace Corp. There is talk about STL being phased out but STL is not going to be phased out. There will be other jobs for STL. They will quit doing one job but they will start doing something else. You have to have them. They know that. Therefore, you have no bargaining position, it seems to me.

* * * * * *

MR. MAHON. But I think you will agree with me that you have to have these corporations or you have to have something else and you do not have something else now so you have to have these corporations, unless you begin to make a long-range plan to turn their work over to industry or to make some other kind of arrangement.

General SHRIEVER. That is correct.

MR. MAHON. So we do not have very much room to maneuver here. We are more or less in the clutches--I am not using this in an unfavorable way--of these coporations. It might be that the alternative of being in

the grasp of industry would be worse but nevertheless we are building up a colossus which is important to us but which more or less leaves us naked to those who make demands upon us.[11]

Extract 11

Duplication of Work by Nonprofits and Industry

MR. MAHON. But doesn't it turn out that actually industry, which has the role of actual fabrication and production, has to have their own engineers and make their own studies and do a lot of work which is in many cases probably a duplication of the work done by the nonprofits?[12]

[11] Ibid.

[12] Ibid.

APPENDIX D

Check-List Questionnaire: Presentations by the Military Departments

1. For each FCRC sponsored, identify specific Service needs requiring the unique or special qualifications of the specific FCRC.

2. For each FCRC, identify the unique or special characteristics of the FCRC specialty. Identify the extent to which these characteristics are present in other organizations. Why is it that these capabilities are not available in-house or in other nonprofit or profit organizations?

3. How is the FCRC work program established and approved?

   . How are priorities assigned?
   . Why are these tasks or efforts assigned to specific FCRCs instead of doing them in-house? Profit contractors?
   . What leeway does the FCRC have in initiating work without specific assignment?
   . How much of this has been done?
   . How do you decide which FCRC? (That is, how does the Air Force decide to use an AF-sponsored FCRC, or to use the Navy APL?)

4. How does the sponsoring agency establish and control FCRC size and capability (i.e., manpower and facilities)?

5. How is task output evaluated and the usefulness of the FCRC's efforts determined?

6. Discuss the use of FCRC output in the last 2 years--who uses them, to what benefit?

7. What actions does the Service take to make FCRC technology products available to the in-house activities and the technical community at large? How can this be improved?

8. What is the nature of the FCRC? Its sponsor relationship? How is it different from that with other contractors? With in-house activities?

9. Have you ideas on how the FCRC's capabilities can be made more available to all DoD sponsors? To other Government agencies?

10. Should the FCRCs compete for proposed tasks of any sponsor? Discuss the pros and cons. How can competition be effected short of formal proposals?

11. What do you do to insure a dynamic FCRC operation in which FCRC projects are turned over to an in-house or other activity as soon as possible so that the FCRC can take on unique new tasks?

12. Comment on how the operation of FCRCs can be improved--by specific FCRC, if you wish.

13. How can the Service accomplish vital tasks if the FCRC were abolished? Discuss this for each FCRC.

14. What is the sponsoring Service's long-range plan for each FCRC?

15. List and discuss problems with FCRCs. Discuss your suggested solutions.

APPENDIX E

Check-List Questionnaire: Presentations by the FCRCs

1. What are the stated objectives of your FCRC?

2. From the FCRC's viewpoint, what are the special characteristics in the sponsor-FCRC relationship? Is it different from that of ordinary contractors? In-house activities?

3. Describe the FCRC's capabilities (e.g., professional specialties, field of competence, special facilities, etc.).

4. How do you evaluate performance and maintain the quality of your products? Personnel? Facilities?

5. How do you evaluate your overall performance?

6. To what extent is work initiated by the FCRC? What is your role in terminating old work and initiating new efforts?

7. Summarize the funding profile for the past 5 years, showing funding by the original sponsor and other customers.

8. Summarize, for the years ending 31 December 1969 and 31 December 1970, the personnel recruited and their departure:

   - Total employment (professional, each year).
   - Number and percent recruitment; number and percent departures.
   - From what agencies (government laboratory, university, industry, etc.) did personnel recruitments come--percentage breakdown?
   - Personnel leaving the FCRC--where did they go (industry, profit company, government laboratory, Service, industry nonprofit, university, etc.)?

9. How much of your work is contracted out? Categorize it by type of work (e.g., technical support, computer services, consultants, housekeeping support, etc.).

10. Categorize the work done in the last 2 years.

11. Were the results of the tasks used by the sponsor and by organizations other than the sponsor? By whom? How? To what benefit? Give examples.

12. What interchange is there with the sponsor's in-house activities and other FCRCs?

13. What is the fee used for?

14. Where does the FCRC get its working capital (e.g., advance payment, fee accumulation, loans, commercial, other)?

15. To what extent has there been accumulation of fees?

16. To what extent has there been investment of fees (e.g., buildings, other)?

17. How much did you spend on independent research in each of the past 4 years? Indicate how these efforts were funded (i.e., fee, direct charge, etc.).

18. Have you ideas on how the FCRC's capabilities can be made more available to all DoD sponsors?

19. Should FCRCs compete for proposed tasks of any DoD sponsor? Please discuss the pros and cons. How can competition be effected short of formal proposals?

20. What do you do to insure a dynamic program, terminating projects as soon as possible in favor of unique new tasks?

21. Comment on how the operations of your FCRC, or all FCRCs, can be improved.

22. List and discuss problems you have in the effective operation of FCRCs, and discuss your suggested solutions.

APPENDIX F

Informal Briefing by Other Organizations

The Study Group was informally briefed by representatives of two large profit companies and one large not-for-profit, non-FCRC organization, all of which receive significant annual funds for performing studies and analyses under DoD contract. The aim of these discussions was to determine the FCRCs' impact on these independent firms working in the same area. On one point the three organizational representatives were unanimous. They complained, in varying degrees of intensity, of "unfair competition" by the "subsidized," Defense-sponsored FCRCs. The strongest complainant, the president of one of the profit companies, claimed that, because of "guaranteed" support of the FCRCs by the DoD, many studies were assigned automatically to those activities without his company's even having a chance to bid. Moreover, he said the DoD pays the bid and proposal costs of the FCRCs' "outside DoD work."

The assertion was made that, beginning with the 1969 letter from the Secretary of Defense to all FCRCs which encouraged their expansion into areas of work outside the DoD's sphere, another factor had been exerting a considerable impact on the non-FCRCs' competitive position--that this expansion of FCRCs directly affects the non-FCRCs by cutting into their normal business opportunities in the fields involved. On the point of the Defense FCRCs' exclusive competency to make DoD studies and analyses, all three representatives claimed that there were few, if any, studies that their staffs could not conduct as well as the FCRCs. The company president mentioned before specifically stated that, because his concern was a profit-making one, any studies it undertook would be performed "more efficiently."

APPENDIX G

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Part II. Reports of the Task Groups

TASK GROUP I

CONTENTS

REPORT OF TASK GROUP I
OF THE
DOD STUDY GROUP
ON
FEDERAL CONTRACT RESEARCH CENTERS

1. Purpose

The purpose of this report is to present the results of the review and analysis performed by Task Group I of the Department of Defense Federal Contract Research Center (FCRC) Study Group. The ultimate purpose of the study is to recommend continuance, changes, or discontinuance of FCRCs. Task Group I was responsible for review, analysis and recommendations concerning the six FCRCs that perform work in operations analysis, systems analysis, general advice and assistance, and long-range military planning. These six FCRCs are:

a. Institute for Defense Analyses (IDA)

b. RAND Corporation (RAND)

c. Analytic Services, Inc. (ANSER)

d. Center for Naval Analyses (CNA)

e. Research Analysis Corporation (RAC)

f. Human Resources Research Organization (HumRRO)

The other six FCRCs were reviewed by Task Groups II and III.

2. Background

a. Definition of Federal Contract Research Centers. As a point of departure the Steering Group of the study defined a Department of Defense FCRC as a private or non-Federal (in legal form) not-for-profit organization:

(1) established at the request of a DOD agency that largely supports it by continued funding;

(2) having the intimacy of relationship with the sponsoring government agency that is characterized by continuous privileged access to data in its specialty field with flexible contract statements of work;

(3) which as a matter of policy, does not compete directly for government business whenever it chooses:

(4) which does not have the right to undertake commercial, non-U.S., and other tasks in its specialty field if these tasks put them in an actual or potential conflict position with work it is doing for the U.S. Federal Government or are at the expense of the established DOD tasks;

(5) which operates under established and approved funding ceilings;

(6) which has the responsibility for conducting its affairs in a manner befitting an organization having quasi-public status;

(7) which is required to report annually to the sponsoring service and is subject to an annual review by the sponsor service; and,

(8) engaged in one or more of four research and development activities: basic research, applied research and development, systems engineering, and technical direction.

b. History of FCRCs.

(1) The FCRCs studied by Task Group I were formed at various times by the individual services or OSD (in the case of IDA), usually at the request or encouragement of the service, to provide a capability that was not present at that time either in in-house agencies or in industry. The specific motives in each case varied but the general motivation was to create (or retain) a group of scientifically and technically oriented professionals capable of providing independent, objective sources of analyses, evaluations, and advice on general and specific national security problems. Origins of these six FCRCs are traceable in some cases to early groups conducting efforts in specific areas that evolved to larger, broader groups and eventually emerged as the corporate entities they are today. The origin period for this set of FCRCs is 1942 (earliest beginnings of CNA when affiliated with Columbia University during WW II) through 1958 (ANSER Incorporated). Concurrently with the growth of FCRCs, other organizations have grown up, both profit and non-profit corporations, that perform much the same type of work as the FCRCs.

(2) Growth of these FCRCs was not essentially any different from the manner of growth of any successful corporation except in the almost exclusive relationship with a sponsoring DOD agency (and the accompanying funding). The successful completion of its work in each area on behalf of the sponsor (customer) encouraged the sponsor to continue and increase the support of the FCRC's efforts in that area, and to encourage the FCRC to examine problems in new areas of the sponsor's responsibility. The continuing years of close contact and involvement of the professionals of each FCRC with its sponsor created in each FCRC an unique awareness of the historical and current organization, operations, procedures, and special problems confronted by the sponsor in reaching and implementing decisions. It should be recognized that the same type of awareness in special areas is cultivated in non-FCRCs as a result of repetitive contracts in those areas.

(3) Throughout the period of growth there has been private and Congressional criticism concerning various aspects of FCRC operations and management. The DOD and FCRCs responded to each new area of criticism with actions to correct deficiencies (or by compliance with Congressional comments and suggestions). The most restrictive Congressional action has been the ceiling on FCRC funding negotiated with Congress since 1968. While the funding ceiling is an effective control on growth, it also results in two distinct disadvantages. The first important impact is that it reduces the flexibility of FCRC operations (e.g., work cannot be undertaken from a customer, despite available funds and capability, unless the customer can furnish the funding within its established ceiling). Secondly, with ceilings established to essentially retain a constant level of funding, the net effect of inflation is a continual reduction in manpower available (e.g., a given level of funding over a period of 5 years, in a 4% inflation per year, results in an accrued 20% reduction in FCRC buying power (manpower)). While the DOD directive of 1969 allowing FCRCs to obtain additional work from non-DOD sponsors up to 20% of their DOD effort was intended to share the DOD FCRC capabilities with other government agencies, this 20% diversification was sought to alleviate this forced shrinkage. However, this diversification to new, non-DOD customers has generally not been successful. As a matter of fact, diversification caused, for many, increased financial and management problems. Overhead increased owing to the management of a greater number of contracts. Marketing for diversification and handling of this very small contract led to higher administrative costs. RAND and HumRRO have achieved moderate success in diversification.

c. Blue Ribbon Defense Panel. The following paragraphs are the total comments, observations and recommendations made regarding FCRCs in the Blue Ribbon Defense Panel Report. They are found on pages 159-160 of the report as part of the "III. Contract Studies" portion of the report that begins on page 158. Following each is a comment, explanation, or observation by the Task Group.

(1) "The Federal Contract Research Centers (FCRCs) are a group of special nonprofit organizations created during and since World War II. Each has a special relationship with some agency of the Federal Government. There are currently 12 FCRCs under the sponsorship of the Department of Defense, with annual funding totalling about $250 million. Based on their principal efforts, they are categorized as: (1) general and continuing research and experimentation in support of military research and development; (2) systems planning, systems engineering, and technical direction of systems development; and (3) operations analysis, systems analysis, general advice and analysis, and long-range military planning."

COMMENT. This statement is factual. Task Group I is concerned with the third category of FCRCs, 6 of the 12, with annual funding totalling about $50 million.

(2) "Originally every FCRC obtained all or most of its financial support from a single sponsor, but some are now attempting, with varying degrees of success, to diversify - to become less dependent on their Department of Defense sponsors, and in their view, less vulnerable."

COMMENT. This statement is factual. The lesser vulnerability sought by FCRCs is mainly from the constraints imposed by Congressional actions and DOD acceptance. The main constraint is the relatively constant dollar ceiling on funding FCRCs.

(3) "The close ties between sponsor and FCRC often prevent the sponsor from seeking study assistance elsewhere to obtain work better suited to his immediate requirements. It would be highly desirable to provide flexibility, whereby a sponsor could on occasion have research done by another FCRC. That this would lessen the reliance of an FCRC on a single sponsor could only be beneficial. It would soon be evident which FCRCs were strongest and they would be encouraged to become capable of competing successfully within their own ranks."

COMMENT. These statements are generally erroneous. Sponsors are not prevented from seeking study assistance elsewhere. In fact, the practice is to place the job where it can best be done, whether at an FCRC or non-FCRC. The study support addressed to FCRCs is normally matched to the particular FCRC having the special available capabilities and those capabilities are easily fully employed. Other work is directed to various non-FCRC contractors with required capabilities in like manner with sole source or competitive procurement.

The requirement for the services and OSD to budget for funds and obtain ceiling more than a year ahead of time interferes with this cross service use of FCRCs. Budget (and ceiling) amounts must be obtained on a "level of effort" basis based on previous experienced needs since precise definitions of requirements are unknown at time of budget (ceiling) approval. This prevents a service from justifying use of another service's FCRC for any reason other than "just spreading use of FCRCs around," except when special requirements are known early in the budget cycle. In spite of this difficulty, more than half the $25 million Army FCRC funds in FY 1971 were used in FCRCs not sponsored by the Army. The same opportunities are available to the other services and OSD and are used. OSD especially uses non-OSD sponsored FCRCs (RAND, RAC, and others).

Whether this flexibility "can only be beneficial" is open to argument. The basic reasons for using this flexibility as indicated above is not from some special virtue, but only because certain special capabilities exist at certain FCRCs to do certain specific tasks. Basically it is a case of taking the special work to the right specialist. Whether the added costs and administrative burden of competition, where competitive capabilities exist, and the reduced reliance on a current sponsor are advantageous is disputed by some of the FCRCs and some of the sponsors. Both sponsors and FCRCs cite the value of the close, exclusive sponsor-FCRC relationships that lead to mutual understanding, confidence and trust, as very important ingredients when one organization is dealing with the broad policies and plans and important operations of another organization. They also cite the danger of creating conflicts of interests and lost objectivity. Competition between FCRCs is not at all clearly "only beneficial" and must be considered on a case-by-case basis.

(4) "Traditionally, there have been close relationships between most FCRCs and universities, and unquestionably the forging of this link to the academic community was a major reason for creating FCRCs. The changing attitudes of university administrations, faculties,and students have already resulted in the severing of a number of long-standing university-FCRC relationships, and others are in imminent jeopardy."

COMMENT. This observation is essentially erroneous. Of the six FCRCs studied by Task Group I, only CNA has a special relationship with a university, and that relationship continues to be favorable and is supported both by the Navy and the University of Rochester. RAND and ANSER never had a special relationship with any university, nor does RAC or HumRRO although both had their predecessor organizations that were offices of universities. There is no strong evidence to indicate that "forging of this link to the academic community was a major reason for creating FCRCs." It appears that FCRCs were established from existing groups with special capabilities, and that some of these groups happened to be affiliated in some way with universities.

(5) "There is little doubt that each FCRC was, when created, the most effective or expedient means of providing certain required capabilities to the Department of Defense. However, both the needs of the Department and the character of some of the FCRCs have changed substantially. The Panel believes that this is an appropriate time to reassess the special relationship of each FCRC and its Departmental sponsor."

COMMENT. This statement is a historical observation and judgment. It is certainly true at least, whether or not the means were the most effective or expedient at the time that FCRC creation occurred. The evolution of FCRCs from their original missions and forms to their current missions and forms (in some cases not changed appreciably) has supposedly matched the changing (and unchanging) needs of their sponsors, since their evolution has been in response to changing customer needs.

(6) Recommendation V-6(d). "Review each Federal Contract Research Center sponsored by the Department of Defense to determine on an individual basis which should be continued with substantially their present form and mission, which should undergo significant changes, and whether they may have outlived their usefulness as FCRCs. The study should also develop the means to make collective FCRC capabilities more widely available to Department of Defense sponsors."

COMMENT. This review has been completed. In addition to this current study the FCRCs have been under constant review on a case-by-case basis and in general for a number of years by Congress, the General Accounting Office (GAO) Office of the Secretary of Defense (OSD), the sponsoring services, and by the National Science Foundation (NSF). The most comprehensive effort is probably that done by the Denver Research Institute for the NSF and reported in 1969. The effort by this current DOD study group has substantiated, in general, the work performed by the Denver group although not necessarily led to acceptance of the interpretive conclusions and recommendations in that report.

3. Conduct of the Task Group I Study

a. Methodology of the Study.

(1) During a three-week period beginning 29 March 1971 the study group heard presentations by each service and OSD and by the president and senior officers of each FCRC. The sponsor presentations dealt with each sponsor's general positions and dealings with whatever FCRC they supported as a customer, including those they do not sponsor primarily. Each sponsor and FCRC presentation responded to a set of questions provided by the Steering Committee (Appendices D and E). The FCRC presentations gave the study group the view from the FCRC of the FCRC-customer relationships.

(2) In the weeks immediately following the presentations the task group made visits (one-half day each) to each FCRC, discussing in more detail the type of work performed, the FCRC view of the value of their work, and the problems faced by the FCRC. Following the visits the task group analyzed the information collected and attempted to identify the appropriate actions to be taken with each FCRC.

(3) The Task Group used for reference available reports of previous studies of FCRCs, documents available within DOD, and documents provided by the FCRCs. Especially valuable was the Denver Research Institute study "Contract Research and Development Adjuncts of Federal Agencies" (1969).

b. Participation.

Task Group I, reviewing the systems analysis group of FCRCs, consisted of representatives of the three military departments and DDR&E. The Army member chaired the group. Each military department member was closely involved with FCRCs of his service previously, and had ready access to other appropriate persons and data. The following individuals participated:

(1) Colonel William S. Howe, Jr., U.S. Army Member, Chairman

(2) Mr. Elidio J. Nucci, OSD Member

(3) LTC Alexander Lavish, U.S. Air Force Member

(4) Commander Ruth Tomsuden, U.S. Navy Member

4. Findings and Conclusions

In response to the recommendation of the Blue Ribbon Defense Panel: "Review each Federal Contract Research Center sponsored by the Department of Defense to determine on an individual basis which should be continued with substantially their present form and mission, which should undergo significant changes, and whether they may have outlived their usefulness as FCRCs. The study should also develop the means to make collective FCRC capabilities

more widely available to Department of Defense sponsors," Task Group I has developed the following:

a. Findings.

(1) The six FCRCs studied have many differences and similarities. They are not the same in organizational structure, type of work, or sponsor-FCRC relationship. (Although HumRRO was placed in this group of systems analysis type FCRCs, in many respects HumRRO is more similar to the laboratory type FCRCs. HumRRO performs human factors research using experimentation, measurement, and evaluation. Tasks are small and carefully specified and are carried out both in laboratory and actual field situations.) They are similar in origin, having been initiated by government action or encouragement.

(2) The internal management of these six FCRCs differs markedly one from the other and their management by the sponsors is on a case-by-case basis. Even within a single sponsor agency the management of two sponsored FCRCs differs.

(3) Formal relationships with universities no longer exist except for CNA-University of Rochester. No such relationships ever existed in the cases of RAND, ANSER, RAC or HumRRO, although the last two independent corporations were formed by reorganization of offices of universities.

(4) Fee paid to FCRCs is a matter of contract negotiation, sponsor policies, and university affiliation. Only CNA receives no fee. The other five receive fee of 3.7 percent (ANSER) to 5.8 percent (HumRRO). Use of fee also varies but primarily it is used for operating capital, to cover disallowed charges, and to support some independent research and pay for proposal work in support of diversification.

(5) Personnel management at FCRCs is almost identical to those of industry in general, granted the differences in the types and sources of professional people required. Salary scales, promotions, recruitment, performance appraisals are comparable with those of other organizations in the same field.

(6) Work performed varies from FCRC to FCRC. The type of work reflects the match between current unmet requirements of the sponsor and current capability of the FCRC. The match reflects evolutionary changes in the FCRC in response to both continuing and changing sponsor requirements.

(7) FCRC programs of work units or projects (studies, research efforts development efforts) are developed by the sponsors in concert with their FCRCs. The program development is the result of adjustments between known sponsor requirements, known FCRC capabilities, available budget and ceilings, and contract negotiation.

(8) Evaluation of product output is basically subjective in nature, not objectively determinable. Internal FCRC and sponsor review, customer satisfaction (and continued support), research community acceptance, acknowledged staff expertise are the primary bases for evaluation. The general

across-services evaluation is one of FCRCs' being "highly valued research and development assets."

(9) Relationships of FCRCs with sponsors are those of generally successful contractor and generally satisfied customer.

(10) Neither the sponsor nor FCRCs have any long- or short-range plans for terminating the FCRC-sponsor relationship, except RAC. On RAC's initiative RAC is attempting to reorganize into a private, for-profit, independent corporation.

(11) The FCRC-sponsor relationship can be terminated by one of the following means (or a combination):

(a) On FCRC initiative by reorganization to a completely competitive corporation, or by dissolution.

(b) By sponsor termination of funding support, either gradually or on a determined date all at once.

(c) By Congressional action to eliminate FCRC support, either gradually or all at once.

(d) By removal from the FCRC list.

(12) The Task Group could identify no benefits accruing from direct formal competition by FCRCs for DOD work commensurate with the necessary increased costs in terms of manpower, dilution of effort and greater instability of their work programs.

(13) Outputs of FCRCs are normally available to all sponsors through various committees and documentation centers.

(14) Problems unique to FCRCs arise mainly from the ceiling constraints; more than normal review and control by sponsors, Congress, GAO, OSD, etc.; and the organizational objectives of the FCRCs that must be violated or compromised in order for them to diversify and compete for non-sponsor business.

(15) Ceiling on FCRC funding by sponsors is identified by OSD based on Congressional actions and comment. Ceiling prevents any growth of FCRCs and since it is a constant dollar level not adjusted for inflation, ceiling is forcing a continual shrinkage in FCRC support available to sponsors.

(16) FCRC effectiveness can be improved by any of the following means:

(a) Removal of funding ceilings.

(b) Provision for inflation in funding ceilings (either by setting a professional manpower ceiling or by increases annually in dollar ceilings).

(c) FCRC action to diversify to maintain or increase the professional man years of effort in order to keep the overhead rate constant or decreasing (except for inflationary effects).

(17) DOD work performed by FCRCs for other than their primary DOD sponsor is programmed as required and is increasing.

(18) Diversification to non-defense work is difficult to achieve because of charter limitations and the limitation on funds available to support bid and proposal effort.

Some of the above findings are reported only because they are responsive to some questions initially raised, or they support the information presented in paragraph 2, "Background." The conclusions listed in paragraph 4b below are based on (7) through (18) above.

b. Conclusions.

(1) These six FCRCs, while they no longer represent a unique capability, form a valuable adjunct to R&D assets. They represent an effective, in-being capability and should continue to be used to the extent of that capability.

(2) The most formidable obstacle to efficient, effective use of FCRCs by their sponsors and other DOD agencies is the ceiling imposed on FCRC funding. While some form of control is necessary, the use of a dollar ceiling reduces the support available to sponsors since it makes no provision for the effects of inflation. Further it reduces the flexibility of reprogramming new advantageous work at FCRCs unless ceiling is available.

5. Recommendations

a. No action be taken to eliminate or change any of the six FCRCs studied by Task Group I. (This does not preclude FCRCs from initiating changes, as in the case of RAC's intended reorganization.)

b. Action be initiated with appropriate Congressional committees to obtain relief from the Congressional dollar ceiling on the six FCRCs studied by Task Group I. Preferred action is the establishment of a total ceiling on expenditures by DOD agencies at FCRCs, without any detailed breakout by sponsor or FCRC. This total ceiling should be adjusted annually to compensate for any inflationary trend.

6. Discussion

Separate summaries are attached concerning each of the six FCRCs reviewed. An additional summary expands on the discussion in paragraph a(7) below. The following discussion expands on the findings in paragraph 4 and covers the general FCRC problem in relation to the Blue Ribbon Defense Panel's comments

and recommendations and the problems and positions of the services in administering FCRCs.

a. The Basic FCRC Problem. The background of the current DOD-FCRC relationships is presented in paragraph 2b above. The requirement to review the current need for each FCRC, and identify ways to improve FCRC operations and usefulness is contained in the Blue Ribbon Defense Panel Report (see paragraph 2e above) and in the directives for this study (see paragraph 3a above).

(1) The current state of the DOD-FCRC problem is that there are two types of private contract organizations performing contract studies and analyses for the DOD. They are the FCRCs and the non-FCRCs (profit and non-profit organizations). The differences in their origins and development to date are not really germane to the issues raised by the Blue Ribbon Defense Panel or the study directives. What are germane are the existing differences and advantages, and the alternatives available at this point in time regarding the services' accomplishment of the work now performed by these two groups.

(2) The chief differences in the two groups as far as their relations with DOD are concerned are the manner in which their total DOD programs are developed and the application of a funding limit (the "ceiling") to one group and the effects of that constraint. The FCRCs are more dependent on their DOD sponsors but there is very little difference in the basic ability of the two groups to perform the types of work involved. However, for any specific task one specific organization may be better staffed and have better background knowledge to accomplish that task in a shorter time than the others.

(3) The total annual DOD programs of FCRCs are arrived at by procedures that develop a package of study projects that become part of one or two annual contracts matching capabilities of the FCRC and requirements of the sponsors up to the level of funding available at the time of contract negotiation. Additional projects can be added to the contracts as they (and supporting funds) are identified, but only up to the ceiling allowed for that FCRC. (It is also possible to transfer ceiling in certain instances, but this limits further the work available from the FCRC from which ceiling is transferred.)

(4) The total annual DOD program of a private contractor is the accumulation of all the individual contracts obtained by the contractor through competitive and sole source (often repetitive) DOD procurement actions. Add-ons to these contracts are usually possible but limited to some percentage of the basic contract cost. There is no upper limit to the amount of total business obtainable by the contractor from DOD sources, since there is no ceiling established for these organizations.

(5) Much of the study group's discussions centered around the "ceiling" problem. This was appropriate since most of the problems of administering FCRC have had their origin in "ceiling." "Ceiling," as involved with FCRCs, is an arbitrary control. It is applied to elements of budget requests that are based on estimates of requirements. Because of the

arbitrary nature of ceiling very little relief from its bad effects may be realized in any way but complete removal. Variations either don't give relief, or they are obvious evasions of the basic purpose of the ceiling control.

(6) The most frequently mentioned alternative to the current ceiling, to continue ceiling with an adjustment for inflation, is only reasonable if a given level of funding is first established as the "proper" level, nothing to do with what future years' requirements are. Breaking the element under control into two parts as has also been suggested, one subject to the control, one not, or mixing up ceiling and contractual procedures (tasked jobs controlled—institutional uncontrolled or sole source controlled—competition uncontrolled) most certainly will lead to labeling individual tasks using subjective judgment. Reaction of anyone on a Congressional committee to such suggestions is bound to be suspicion of the procedure for classifying individual efforts. A line of suspicious reasoning might be -- "When in doubt that an FCRC can compete for a study, call it 'institutional' and give it to them under the ceiling," or, "Say it isn't 'institutional' and let them compete for it if they have a high probability of winning. This will save the 'institutional' ceiling for other work."

(7) Examination of the six studies and analyses FCRCs' work program formulation reveals that very limited portions of the resources provided FCRCs are used for FCRC-initiated work. Almost all assigned projects are tasked to the FCRCs with work statements as detailed as possible for the nature of the work to be performed. Although previously some FCRCs may have specialized in the conduct of large, long-term projects to consider matters of long-range security problems, such is no longer the case. Further discussion of this point is contained in an attached summary.

b. Service Positions and Problems

(1) The principal advantage to the services in having FCRCs is the ease with which work on specific tasks can be started. The administrative burdens inherent in adding a task to an FCRC contract are far less in time and effort than in negotiating a new contract. This frequently allows the service concerned to meet requirements that are extremely time dependent or critical.

(2) The greatest disadvantage to the services under the existing situation arises from the ceiling imposed on funding FCRCs. Funded, approved projects that arise frequently are not assignable to an FCRC even though it is the best place to get the work done because no ceiling is available. Only by altering that FCRC's current program through wasteful cancellation or curtailment of work already begun can the FCRC be given the task.

(3) The services' general position is that FCRCs are valuable national research and development assets. FCRCs have all the advantages and capabilities possessed by non-FCRC contractors and are easier and more economical to administer. The services will continue to use FCRCs appropriately, as long as they retain their competence and responsiveness and it is favorable economically to do so.

(4) This favorable economic advantage may be lost unless the ceiling constraint is adjusted or the FCRCs can so diversify as to maintain their total working professional staff at least at the same level as now. This constant staff level allows the overhead burden to be applied with acceptable impact on the average man-year cost. If the ceiling is held at a constant dollar level and no non-DOD business is developed at a given FCRC, the total number of staff supported must dwindle to balance inflationary effects. The overhead burden under this steady staff shrinkage will eventually drive the man-year cost to an uneconomical level. At that point the services would be forced to discontinue support of that FCRC.

(5) At the point that a service must discontinue support of an FCRC and the FCRC cannot continue operations, a serious setback would occur in the programs currently involved at the FCRC. All work would have to be stopped and cancelled or transferred to another contractor. The negotiation time, learning and orientation process for the new contractor, and the development of expertise on the given program within the new contract organization all represent time and dollar losses. The services do not want to incur these losses.

c. Alternatives. Several alternatives are available to resolve the FCRC problem associated with the six FCRCs reviewed by Task Group I.

(1) The "no action" alternative, if continued indefinitely, will probably lead to the situation just described (para 6b(5) above). No definite prediction of how long this alternative could be followed can be made by the Task Group. It should be recognized that "no action" has been the result of previous service and DOD attempts to obtain relief from the ceiling.

(2) Continue and repeat action in the budget cycle and Congressional hearings to obtain relief from the ceiling as it now exists. Removal of the ceiling would eliminate the problem. Adjustment of the ceiling by conversion to a constant man-year level of support or by increasing the dollar ceiling annually would stabilize the problem. However, both of these would probably increase total funds spent at FCRCs and may not be acceptable to Congress. The total might not increase depending on what cuts were made by individual services in their FCRC programs (there have been cuts, e.g., Air Force support of Project RAND). More likely, in view of the current "requirements that cannot be placed at an FCRC because of ceiling," the total would rise.

(3) Negotiate with the appropriate Congressional committees to establish a single, total ceiling on expenditures by DOD agencies at FCRCs to be adjusted annually to compensate for any inflationary trend. No further breakout of ceiling by either sponsor or FCRC would be made by Congressional action. Such a control would stabilize the amount of FCRC support available to DOD, allow OSD in consultation with the military departments to apportion the total ceiling to sponsors, and be responsive to the recommendations of the Blue Ribbon Defense Panel. Sponsors could place projects at any FCRC best suited to perform the work provided the required capabilities were not already engaged. FCRCs could compete more freely for work from any service. Separate ceiling for

each Service and OSD would accomplish the same ends without requiring special budget procedures between the services and OSD for ceiling apportionment.

(4) Consolidate certain of the FCRCs to eliminate overhead in administrative and general support areas (management, publications, computer facilities, space). This is probably not feasible since the strong resistance of these private corporations to loss of identity and control could only be overcome by strong pressure from DOD amounting to coercion (or blackmail). The end result unless the ceiling problem is addressed would be to prolong the time before the ceiling crushes the FCRCs out of business.

(5) Encourage and assist FCRCs to diversify to non-DOD customers, even to establishing separate unrelated capabilities to maintain total staff level. This could lead to eventually removing the corporations from the FCRC category, eliminating the FCRC problem.

(6) Encourage and assist FCRCs to reorganize to completely independent corporations, an action that presumably would remove them from the FCRC category. RAC is currently attempting this act. The results of the RAC experience should be closely watched by the DOD-FCRC community.

REVIEW OF INSTITUTE FOR DEFENSE ANALYSES

1. Service Position and Nature of FCRC

The Institute for Defense Analyses (IDA) was established based on a recognized need for specific unbiased independent point of view and review of scientific and technological problems at the OSD level. IDA is currently supporting DDR&E, WSEG, ARPA, DIA, ASD's (ISA and SA) totalling approximately 90% of their effort with 10% support to other organizations.

IDA has a set of special features. These include:

-Excellent communications with the sponsors and physical proximity to ODDR&E
-Operates on DDR&E-ARPA-OSD level. Objectivity assured by IDA's not accepting Service tasks.
-A commitment to Defense
-A thorough understanding of Defense issues
-No hardware bias- "Nothing to sell"
-Unique, sensitive, private role relative to WSEG (Weapons Systems Evaluation Group)
-Quick response- can quickly form multi-discipline teams
-IDA people can be assigned full-time to specific task
-Every IDA report is evaluated as to quality and adequacy

While industrial organizations have some of these attributes, the very nature of such organizations precludes their providing the most essential elements. For example: - In-House capability response is not quick; It is difficult to form full-time cross-discipline teams; all have hardware interest, cannot always devote full-time to a task. Industrial organizations have profit motives, hardware interests, contracts not amenable to quick-reaction task assignments, may not have the depth of knowledge or intimacy with defense issues. Universities are too institutional and academic.

2. FCRC Relationship with Sponsors, Universities, and Other Government Agencies or Laboratories

IDA has a very close relationship to its sponsors, having in-depth knowledge of the sponsor's role, responsibilities and problems. It organizes and conducts its business to serve the sponsor effectively. IDA studies provide inputs for decision making, policy development or provide a better understanding of the problem for further definitization.

From 1956 the IDA has provided the principal contractor support to WSEG providing civilian scientific and technical personnel for WSEG joint military-civilian studies. These studies are performed by integrated military and civilian study teams tailored for the particular study tasks. The military members of the teams are selected from the senior colonels or Navy captains of the four military services who are permanently assigned to WSEG, and who provide a wide variety of operational and technical experience; specific knowledge of their parent Service's problems and capabilities; and, by virtue of their permanent, joint assignment, can be counted on to make objective contributions to the study effort. Their military operational expertise is complemented by the interdisciplinary, scientific-technical personnel furnished to the study teams by IDA. To maintain the contractor's responsibility, a project team works normally under a project leader designated by the contractor, and is subject to technical direction and review of its work by the contractor's complete supervisory organization. Special technical review panels are established as necessary from outstanding specialists in the study field, employed as consultants to the contractor. In addition to their principal function as full study participants, the military study team personnel arrange through WSEG for access to, and provision of, all Defense data necessary to the project, and for contact with all appropriate Defense agencies. Thus, military considerations and the best available information are incorporated in the study during its preparation. In addition, when the contractor completes and submits his study to WSEG, it is subjected to an independent review by senior WSEG personnel to assure practicality and operational feasibility from a military viewpoint, and the resultant WSEG comments form an integral part of the completed study. It can be seen readily that contractor support to WSEG must be free of any possible service or industrial bias in order to provide objective, unprejudiced, and rigorous analyses to support our JCS and OSD customers. Independent and clearly unbiased contractors with the high level of expertise needed by WSEG for this work are difficult to acquire, and the arrangements necessary to maintain proper security for sensitive information and provide for the joint civilian-military working relationships WSEG requires, are also difficult to establish. For these reasons, WSEG feels that it must continue to depend upon a non-service-oriented Federal Contract Research Center such as IDA for principal civilian analytical support.

IDA has a division located close to Princeton University in the mathematics and communications research area. It provides an excellent opportunity to attract bright Ph. D.'s in these areas.

IDA works closely with the DoD laboratories and other FCRC's with free interchange of information for accomplishing the specific task.

3. FCRC Program Planning - IDA

The IDA's basic program for the ARPA/DDR&E work is planned in an annual proposal which is negotiated for manpower level. This part of the program (about 43%) consists of broad, generally continuing tasks with flexibility for sub-tasks. An additional 34% portion is the WSEG program which is established as a level of effort (manpower level) and tasks are established on a case-by-case basis. These are usually 6- to 19-month tasks. Additional OSD tasks are established to account for about 90% of the effort with 10% going to other organizations.

IDA indicated that program planning is difficult in view of the time lag between budget submission and release of appropriations (15 to 18 months) and inability to predict the nature of short-term priority tasks relating to the DDR&E and ARPA efforts. They claim that the principal difficulty is in determining the specific type of specialists needed.

4. IDA Personnel Management

Area	Years	% Recruitment	% Departure
Industry	1969	21.5	17.0
	1970	38.5	9.1
Universities	1969	6.2	8.5
	1970	3.8	18.2
Res Inst and Non-Profit	1969	18.5	14.9
	1970	11.5	10.6
Government	1969	15.3	17.0
	1970	7.7	21.2

The above chart indicates the 1969, 1970 recruitment-departure statistics of professional people at IDA relative to Industry, Universities, Research Institutions (Non-profit) and Government. For 1969 basically the same percentage recruited from each area returned to the same area. In 1970 the departures back to industry were substantially lower than the recruitment. Substantially higher percentage returned to Universities and to Government. The departure to

non-profits, while slightly lower than the recruitment, remain roughly the same.

While the 1970 figures are greatly influenced by the Defense reductions, the statistics do not support the belief that the personnel at the IDA FCRC are especially oriented to one of the four areas.

5. Types of Work Done

IDA work is exclusively studies with no hardware effort. IDA studies are in support of the OSD level and not oriented to any Service. The work is done by highly specialized people. Examples of the type of work done are: (1) Evaluation of a Weapon System from an OSD viewpoint - greater objectivity than can be obtained from a Service review (e.g., Air-to-Ground Missiles (Condor); (2) Assistance to DDR&E in developing the Area Coordination Papers on Defense Suppression, Fleet Air Defense, Battlefield Surveillance missions; (3) Improved Implementation of Geneva Convention for PW's in Undeclared Wars; (4) Control of Export of Computers; (5) SALT studies. Studies normally range from 6 months to 1 year in length. All work is relevant to policy problems not only in technical content but also timing. In many studies the objective is not to derive solutions to a problem but to develop a better understanding for use in arriving at decisions, for use by negotiation teams, etc.

Work contracted out is mainly for consultants and computer services.

6. Evaluation of Product Output

A written evaluation is prepared for each IDA report or paper after publication by the sponsor and forwarded through DDR&E to IDA. Sponsors additionally indicate evaluations informally by discussion with IDA management and staff members.

7. Fee and Its Utilization

Fee is used to provide the flexibility needed for a research organization. The accumulated fee is used to cover costs not recoverable as contract reimbursements and to increase capital. The largest portion of fee received is retained as capital to finance fixed assets, to provide a reserve that assures some stability and continuity. This is especially important in times of crisis when contracts are

not renewed or are delayed or when programs are reduced on short notice. Contract termination clauses and other contract guarantees cannot provide the kind of assurance of continuity that is needed; IDA accumulates fee as capital for that purpose.

8. Funding Ceiling

The net effect of funding ceiling (for continued level or reduced budget) and inflation results in a significant reduction in available manpower to the FCRC. With essentially the same budget for 1970, 1971 ($13.223 million and $13.214 million) the personnel on board 1 January 1970 was 302 and on 31 December down to 269.

9. FCRC Competition

Not all FCRC's have capability in the same areas; this is assured by the special purposes for which each FCRC is established. Accordingly, we cannot in most cases consider competition. Where there is some commonality of capability both the FCRC's and sponsors may wish to exploit these areas. In context with the IDA mission, the OSD, JCS through WSEG, frequently elect to have some work which could be done by IDA, done by another FCRC or by a profit or non-profit organization.

Competition among FCRC's would have several advantages (e.g., greater range of talent to choose from, stimulation of new ideas, forcing function for improved quality and proficiency). However, in a competitive operation you would not have stability of FCRC's--this stability is now supported by relatively level annual funding. Ceilings have fostered competition by forcing sponsors to consider different FCRC's and non-FCRC's in establishing annual programs and funding.

Competition of FCRC's would have disadvantages (e.g., increased costs and expenditure of resources tied to competition, reduced responsiveness, risk of conflict of interests). Also, with broad competition the entire concept of FCRC's designed to support a particular sponsor will be destroyed. With competition, the prime sponsor's effort may lose primary emphasis, with FCRCs' giving more favorable treatment to secondary sponsors.

10. Availability of FCRC to More of the DoD

This increased availability must be controlled by the principle that the FCRC was established to provide continuing competent and

objective advice to the primary sponsor, and that it will continue to do so uncluttered by conflict of interest. Arrangements can be made to accomplish a Service task if IDA, the DDR&E and alternate sponsor agree that there is no conflict of interest. Normally potential conflict of interest is presumed if IDA works directly for a Service; where agreement indicated above is reached, the task funds are transferred to OSD and the OSD establishes the tasks.

Since the nature of IDA is committed to support the OSD level and not the Service level, it is in most cases not desirable to utilize IDA for Service-oriented work. Here it would be preferable to do the work at FCRC's where the Services are primary sponsors (i.e. RAND, CNA, ANSER).

11. Availability of FCRC Outputs to More of the DoD or Other Agencies

Approximately 90% of IDA reports are put into the Defense Documentation Center and are available to the technical community on a need-to-know basis. ARPA screens reports to determine which go to DDC. Unclassified reports are sent to the Assistant Secretary of Defense (Public Affairs) for security clearance and made available to the public.

12. Diversification to Non-Defense Work

IDA is committed to Defense interest and so is composed of specialists in defense-oriented disciplines. Further, non-defense work is not oriented to the latest defense technology. Diversification to non-defense work is not encouraged except in the area of international studies.

For the above reasons, the IDA has not taken advantage of the 20% diversification permitted by SecDef. Established to serve the DoD, IDA has no long-range plan and will propose to phase out when the DoD need no longer exists.

There are other problems related to diversification. Proliferation of sponsors results in time and resources spent trying to interest and/or satisfy too many. Costs and resources to manage the many small non-defense tasks are not commensurate with advantage to be gained.

13. FCRC Problems - IDA

IDA has indicated the following problems:

(a) Congressionally imposed constraints and budget actions
- Dollar ceilings in a time of inflation in effect reduces staff levels.
- Late receipt of appropriations and abrupt funding changes disrupt stability of an organization owing to a time lag in increasing or decreasing personnel.

(b) It is recognized that IDA work would suffer if long-term planning were a primary consideration; it is likewise true that studies are not of optimum quality if formulated on an ad hoc basis with short deadlines for completion.

(c) Non-defense efforts are small, historically, and pose large overhead costs owing to the increased administrative burden.

14. Suggested Means for Improving FCRC Operation (IDA)

IDA has suggested the following as means for improving FCRC operations:

(a) Adopt a Congressionally approved two-year funding with the out-year reviewed annually.

(b) Convert the current dollar ceiling to a manpower ceiling which will solve the inflation problem.

(c) Plan substantial portions of work with 4 to 6 months' lead time to facilitate personnel management and obtaining the right kind of people for the particular task.

(d) Need small amount of Bid and Proposal for non-defense proposals.

(e) More of the DDR&E/ARPA efforts should be established through WSEG to provide better interface between technology and requirements.

RAND

1. Service Position

The Air Force-Rand relationship is one of the oldest of any service with a policy research organization, and over the years it has been a most fruitful venture. The reasons which led the Air Force to encourage the creation of Rand in 1946 are still valid.

By using Rand, the Air Force can depend on a steady flow of new ideas, concepts and analytical tools. It can call on the best academic minds on short notice and be sure that these people are already familiar with the long history of aerospace problems. It can assume correctly that Rand will provide an independent cross-check of Air Force positions. And it can assume that Rand, lacking the profit motive, will pursue a matter only for what it is worth in analysis, not for its potential value in the marketplace.

The fruits of this long and close relationship have been too many to enumerate here. The influence on Air Force strategic war planning and doctrine have been truly historic in their importance. Rand studies have found dollar savings in management, logistics, manpower and acquisition. They have developed new tools of analysis and management which remain of continuing value to the Air Force and DOD.

After a number of assessments over the years of Project RAND, the Air Force believes that the relationship will remain useful well beyond its actual cost as long as the Air Force's portion of Rand remains independent, professionally first-rate, closely aware of Air Force needs, and dedicated exclusively to the study of Air Force present and future problems. We expect the relationship to continue and to improve.

2. Primary Characteristics of Rand:

Rand is a 25-year-old organization doing analytical policy research in national security and domestic fields. It has a total staff of 1100, of which 500 are professionals. The corporate headquarters and most of its employees are in Santa Monica, California; about 85 employees, including about 50 professionals, are in Washington, and 50, including 25 professionals, are in New York in the New York City-Rand Institute. Rand has research contracts totaling about 27 million dollars for the current fiscal year. The largest single client is the Air Force, accounting for $11 million, or over 40 percent of the total. Some 35 percent of the work is in other national security categories, including almost $7 million worth for ARPA and miscellaneous smaller contracts with ISA, AFTAC, DASA, DDR&E, Navy, NSC, AEC, CIA, etc. The remainder of the program, about 25 percent, is in the domestic area under a variety of contracts with federal, state and local governmental bodies. Interdisciplinary national security research is the paramount concern of the corporation, and the Air Force work, called Project RAND, is the central focus of that effort. Some 50 academic disciplines are represented among the professional staff members. About 26 percent of the professionals are

educated in the physical sciences or engineering, 24 percent in mathematics, 22 percent in economics and other social sciences and the rest in a variety of disciplines, from law to industrial management to history.

3. Rand Relationship With:

Sponsor. The principal sponsor of Rand is the Air Force. The relationship is a close one, formalized by regular meetings between the Air Force Advisory Group and the Rand Management and Board. They meet jointly to review and shape the research program. Less formally, Rand and Air Force relations are broad and deep, based on mutual trust and centering on Rand reports, briefings and conversations about its research and on Air Force supervision and use of the research. The relationship has improved significantly over the years as both Rand and the AFAG have deliberately brought the research program to bear more directly on the major broad problems facing the Air Force. Rand is given access to Air Force proprietary information and is encouraged to be open and independent in its reporting.

The Rand relationship with its multiple secondary DOD sponsors varies with the sponsor, but in general it is characterized by close and free exchanges during the genesis of a project, close working cooperation during the research process and frank and independent reporting of research results.

Universities. Rand draws many of its professionals from the universities, uses numerous university consultants, and, in general, bases its professional standards on those of the best universities.

4. Rand Program Planning

The Air Force program is planned by the AFAG and Rand Management and Board. Priorities are set, and manpower resources allocated. Air Force Offices of Primary Interest and Offices of Corollary Interest work with Rand researchers on details of the program.

5. Personnel Management at Rand

Rand attracts top flight professionals by offering them a chance to research the most important national security problems for the most important defense agencies in a relatively stable, professionally high-standard environment at pay levels generally comparable to those in government and in the best universities.

Recruitment and Departures. Recruitment is, in general, the responsibility of the heads of the research departments and is largely from universities (46 percent) and industry (29 percent). Departures are to universities (25 percent), industry (28 percent), government (12 percent) and involuntary (22 percent). The involuntary departures are largely the result of reductions in the Air Force level of support in the past couple of years.

Differences Between Rand and Other FCRCs. On personnel management, Rand appears to have policies similar to those of other analytic FCRCs, many of which are modeled on Rand.

6. Types of Work Done

The Work Falls into Four Broad Categories:

a. Analysis that provides policy alternatives. This is the dominant share of the work.

b. Immediate quick-response assistance on urgent operational issues. This is secondary, but of considerable importance to the Air Force.

c. Innovations in research methodology.

d. Ground-breaking technological research.

Within these categories, Rand is a pioneer in systems analysis, simulation for defense policy study, computer tools, costing and technology applications. Rand work on strategic, tactical and weapons acquisition problems has been basic to the decision-making process among its clients. Usually these problems are not easily defined and consequently not neatly packaged at the outset. Therefore, implicit in Rand's research is the task of providing problem definition along with the requirement product of alternative solutions.

Work Contracted Out, 1970:

a.	Consultant Fees and Expenses	$1,958,530
b.	Printing and Publication Costs	309,683
c.	Maintenance Services	65,089

7. Evaluation of Product Output

One can cite Rand projects which have resulted in specific client savings greater than the cost of Rand, but the essential value of Rand's work lies in independent, knowledgeable and continuing work on policy alternatives. There is no way to put a price on the work or to apply purely objective measurement. One good indicator, however, is the volume of requests for Rand research beyond that possible under the FCRC ceiling. The requests indicate that Rand quality is respected, and that Rand is the first choice of many DOD offices for priority research. Specific request for additional work in this fiscal year total several million dollars, about $3 million worth of which represents high-priority work--needs mostly of offices which do not share in the Rand ceiling.

8. Fee

Rand has earned $18 million in fees on total business of $360 million since the corporation was founded. About half was used to finance Rand-sponsored exploratory research on national problems, the rest to supply working capital, for acquisition of facilities and for certain operating expenses.

9. Ceiling

The over-all effect of the ceiling has been to limit the amount of important defense research performed by Rand. The ceiling forces a number of potential

DOD clients, particularly new DOD offices, to turn to secondary organizations for some work where Rand would be the first choice. The Air Force Project RAND budget is set by an assessment of the top priority work Rand could do and wanted to do and by over-all budgetary restrictions. The purpose of the ceiling--to provide a limit on growth and to facilitate close control and supervision of the FCRC--has, in the case of Project RAND, been provided in other ways. The Air Force itself has tailored the Project RAND budget, and the research is supervised through close interaction by the AFAG and Rand Management. Rand Management practices are open to Air Force--and DOD--observation. More flexible, but equally close, supervision is better suited to the needs of the multiple clients of Rand. In Rand's view, if ceilings are necessary then they should be better managed to insure the ceiling enhances rather than undermines the FCRC capabilities.

10. Competition

It is Rand policy to refuse to compete formally on the basis of price, but to make its services available, on the basis of unique or superior professional competence, for priority research best suited to it, in areas where other organizations, profit and not-for-profit, in-house, industry, university and other FCRCs also work.

11. Availability of Rand Outputs to More of the DOD

Rand research results are broadly available throughout the Department of Defense and other government agencies, military, contractors, industrial and academic researchers and commercial institutions. Rand work should continue to be made available to all DOD elements.

12. Diversification to Non-Defense Work

Rand began to diversify beyond the original Project RAND contract in 1949 at the suggestion of the Air Force. It remained almost entirely a national security research corporation, however, until the late '60s when its domestic programs began to pick up momentum. Non-defense diversification has not affected Air Force or other defense work and is considered to be a secondary, supplementary part of Rand's public service.

13. Rand Problems

The principal Rand problems stem from the shrinkage of the research staff and program forced by the recent reductions in Project RAND funding and by the ceiling which has limited Rand work for other DOD elements. Rand research is directly relevant to the priority needs of its clients, and management practices are understood and approved by the DOD clients. The clients, particularly the Air Force use and appreciate the research. As long as the relations are close and open -- as long as Rand maintains its research standards, future possible problems outside of budgetary restrictions--would appear manageable.

14. Suggest Means for Improving Rand's Operations

We need new ways to determine the size of Rand's DOD support. Stability of the staff turnover is conducive to good research. The dollar limitations and reductions of the past few years have been disruptive to Rand and have tended to work contrary to the interests of the clients who want quality competition in research. Rand should not grow suddenly, and Rand has taken steps in the past to curb its own growth. But slow growth in areas where Rand has a competitive advantage in doing priority DOD research is desirable. Direct dollar restrictions, if they are necessary, should allow for inflation and for new and important work. Restrictions on the size of the research staff would be more desirable than restrictions on funding. Rand has been a cost-effective resource for its clients. It has worked in areas where in-house and other corporate or university research cannot supply the same experience, skill, independence and responsiveness. Its long history of moderate growth has been controlled and has, in fact, been reversed. Its management practices are sound. Its principal objective is to serve the national interest and DOD and to maintain high standards of research and professional excellence.

ANALYTIC SERVICES, INC.(ANSER)

1. Service Position

Since its inception, ANSER has contributed very critically to the advocacy process of the Air Force. Originally established at the request of the Director of Operational Requirements and Development Plans (AF/RDQ), DCS/R&D, and still sponsored by that office, ANSER has extended its work to include support of the Director of Reconnaissance and Electronic Warfare (AF/RDR), DCS/R&D, and a few lesser clients. ANSER's support of these two Air Staff offices comprise 98% of its business.

The nature of the business of these Directorates is making decisions affecting the composition of future forces of the Air Force. These decisions must be made on the basis of a comprehensive assessment of weapon-system characteristics that are timely and objective and include the best available analytical expertise. The integration of a proposed system into the force structure, the current business environment, and the visibility of Air Force needs require that the Directors have a competent technical resource readily available to assist in their decision-making process. ANSER has fulfilled that need and continues to do so in an exemplary manner.

ANSER's value lies in the quality, experience, continuity of effort and technical expertise of its personnel, and analytical skill in the kinds of systems and cost-effectiveness trade-off analyses required by OSD from the Services. Being free of the institutional bias of large policy-making groups, they provide a fresh, independent insight into development planning problems. Additionally, since they are relatively free from daily pressures of the user, they can address these problems in a more searching and comprehensive manner.

The Air Force plans to continue to utilize ANSER in substantially their present form and mission. In doing so, it will attempt to stabilize the professional base from which it draws such support, in order to continue to be able to receive the benefits derived to date. When ANSER's abilities and contributions are viewed in the aggregate, no alternative to ANSER's assistance is practical; and no other course of action for the Air Force appears logical.

2. Nature of ANSER

ANSER is an independent, nonprofit research corporation organized in 1958. ANSER responds quickly and directly to continuing Air Force needs with objective, high-quality, technical studies and advice on problems which Air Force development planners and decision-makers must address within established--frequently short--deadlines.

As of 31 March 1971, ANSER had 52 analysts and 8 consultants on its technical staff and a total employment of 86. About 98 percent of ANSER's current work is for contract sponsors in the DCS/R&D, Hq USAF.

3. Primary Sponsor Relationships

ANSER is unique among the FCRCs because of its day-to-day contact and close working relationships with its contract sponsors, and because its research program is almost totally in response to direct task assignments by the Air Force.

ANSER's relationship to the DCS/R&D Directorate has avoided the inadequacies that were experienced in other contractual arrangements; e.g., lack of objectivity, limitations on access to sensitive and proprietary information, lack of continuity of effort, deficiencies in timeliness and relevancy of results, and inability to attract and retain personnel of the quality required.

ANSER frequently provides needed, but difficult, communications on analysis subjects between DOD in-house study groups and also, because of its independence, often plays the important role of "devil's advocate" in raising issues that otherwise would be difficult to surface because of institutional bias.

4. Program Planning

Although some of ANSER's projects are initiated by the Air Staff and some by ANSER, most are defined and initiated only after thorough discussions between the Air Staff and ANSER. Although DCS/R&D officers are authorized informal short-term ANSER assistance, formal procedures exist for assigning major tasks requiring more than two man-weeks of ANSER technical effort. Each ANSER study has assigned to it an Air Staff project officer, and many studies have Air Force personnel assigned as full-time working members.

Project priorities are adjusted through the day-to-day contacts between the staffs of ANSER and its contract sponsors, attendance at AF/RDQ and AF/RDR staff meetings by ANSER's President, monthly Program Review meetings of senior AF/RDQ and AF/RDR officials and ANSER Management, and Project Status Reports submitted periodically by ANSER.

5. Personnel Management

Its personnel comprises ANSER's only important asset, and ANSER's trustees and management are dedicated to achieving continuing growth in the quality of ANSER's staff. Recruiting is designed to provide a spectrum of skills and amount of experience. With regard to mixture of skills, ANSER's primary criterion for each member of the technical staff is analysis ability. However, because of the complexity and sophistication of today's weapon systems, ANSER must have on its staff persons trained in mathematics, physics, economics, the social sciences, and most kinds of engineering. As of 31 March 1971, 13 of ANSER's analysts had Ph.D. degrees, 21 had master's degrees, and 17 had bachelor's degrees. The analysts averaged 39 years of age, 16.2 years of experience, and 5.3 years at ANSER. ANSER has no formal policy on personnel turnover. Turnover results from a combination of such factors as (1) available funds (2) changing needs, and (3) voluntary departures. Turnover of

analysts for the last two years has been 17 lost and 19 hired, giving a rate of about 17 percent per year. Analysts hired came mostly from universities (53%) and industry (37%); those who departed went mostly to industry (53%) and Government (30%).

6. Types of Work Done

ANSER provides advice on and analyses of mission areas, technical feasibility, cost-effectiveness, and resource allocation. The Air Force uses ANSER's results in Concept Formulation Package/Technical Development Plans, Capabilities Master Plans, Area Coordinating Papers, Development Concept Papers, and advocacy to the OSD of major weapon system developments.

7. Evaluation of Research Products

The quality and usefulness of ANSER's products are evaluated by the Air Force on a regular basis. The Program Reviews and Project Status Reports afford formal opportunities for project appraisals. Continual scrutiny of ANSER analyses occurs because they are important inputs at each level of the coordination and approval process for development programs within AF/RDQ, AF/RDR, DCS/R&D, the Air Staff, the OSAF, and the OSD. In addition, senior Air Force officials meet with ANSER management and Trustees at each Board meeting, and on other occasions, to discuss the quality and usefulness of ANSER's products.

The results of ANSER's research are reported orally and in documents, whose primary distribution is selected by AF/RDQ and AF/RDR with ANSER's assistance. Secondary distribution, when not precluded by security considerations, is through the Defense Documentation Center. Because the defense analysis community has access to most of ANSER's products, ANSER's technical capability is regularly assessed by peer groups. These appraisals almost uniformly have been outstanding.

8. Fee.

Fee is a normal and reasonable contractual provision which permits ANSER to achieve the independence essential to the flexibility and objectivity which are the basic reasons for the Air Force's decision to contract with ANSER for technical assistance.

The amount of ANSER's retained earnings at the end of fiscal year 1970 was less than at the end of fiscal year 1964. Of its total earnings since its founding in 1958, ANSER has used approximately 52% for self-sponsored research, 4 percent for educational assistance to upgrade the abilities of its employees, 6 percent to cover salaries and overhead not charged to contracts, and 5 percent for disallowances and miscellaneous costs not submitted for reimbursement. The remainder--about one-third of ANSER's total earnings--is used for working capital.

9. Ceiling.

Its almost exclusive dependence on Air Force funding imposes special pressures on ANSER. The need for ANSER's assistance has always exceeded

resources that ANSER could make available under its contract funding. Thus, ANSER has had to exercise great flexibility in adjusting to changing work priorities and to forego some research projects which could be best done by ANSER. Moreover, while ANSER has been very successful in attracting and retaining qualified analysts, a constant funding ceiling would adversely affect personnel recruitment and retention.

ANSER is satisfied that its work is addressing time-urgent Air Force problems, its special capabilities are being utilized effectively, and its working relationships with its contract sponsors are excellent. However, ANSER's operations, especially in the long-term, could be improved through increasing the certainty of ANSER's being funded at a level commensurate with the needs of its contract sponsors and the cost-effectiveness of its work.

10. Competition

Formal competition in the sense of preparing detailed proposals would, in ANSER's case, be generally undesirable because manpower would be diverted from identified, urgent tasks for the Air Force. Competition for the kind of assistance ANSER provides can best be effected as it is now, through informal comparison by sponsoring agencies or potential sponsoring agencies of the capabilities and operating costs of qualified organizations, both FCRCs and others. ANSER has frequently suggested that tasks considered for it be assigned elsewhere.

11. Availability of Products

ANSER's products enjoy wide use in the Air Staff and elsewhere in the Air Force, the other Services, the JCS, and the OSD, as well as in analysis organizations in the Government, industry, and the universities. Secondary distribution generally is through the Defense Documentation Center. Presentation of results in classified and unclassified symposia and professional meetings and journals is encouraged.

12. Diversification

ANSER's work for contract sponsors other than DCS/R&D has been minimal. For example, during the last two years only about four percent of ANSER's total research, sponsored and self-sponsored, has not been for DCS/R&D.

Currently, ANSER has a small contract from the Defense Intelligence Agency to assist in a special resource allocation problem and a small sub-contract from the Johns Hopkins University for analyses supporting health services planning. In addition, ANSER conducts a modest self-sponsored research program that has been focused principally on transportation and health services subjects. This self-sponsored research has been financed exclusively from ANSER's retained earnings and the expenditure level in recent years has exceeded fee earnings.

13. ANSER Problems

Guidance and direction resulting from the successive layers of review comprising the advocacy process causes some lost motion and disruption of ANSER's overall study program. A clearer statement of requirements from each layer prior to initiation of a study could possibly eliminate or minimize this inefficiency.

14. Improvement of Operations

ANSER adjusts its operations to the changing needs of the Air Force and is convinced that its operations are efficient and its capabilities are being utilized effectively by the Air Force. Considerable effort by ANSER and the Air Force should continue to be given to reducing administrative burdens on ANSER. Especially for small organizations like ANSER, administrative activities detract significantly from time available for the technical work that is the reason for the organizations existence. Otherwise, it appears that the only feasible way to improve ANSER's operations significantly is to increase the certainty of ANSER's being funded at a level commensurate with the needs of its contract sponsors and the cost-effectiveness of its work.

CENTER FOR NAVAL ANALYSES (CNA)

1. Primary Characteristics

The Center for Naval Analyses (CNA) is a non-profit organization affiliated with the University of Rochester and situated in Arlington, Virginia. It has been engaged in operations research, systems analysis, engineering and economic studies since 1942 to improve the management and operations of the Navy. CNA has no laboratories and it does not produce hardware. In addition to the conduct of various types of studies, one of CNA's greatest assets is the work of its representatives in the field with the operating commands of the Navy and Marine Corps. In this approach, CNA is unique among the FCRCs. CNA now has 44 analysts on long-term assignments (one to five years) dispersed among the fleets and shore installations of the Navy and Marine Corps. They constitute over 20 percent of CNA's professional staff.

In addition to its full-time field assignments, CNA provides 21 scientific analysts to the various staffs in the Office of the Chief of Naval Operations (OPNAV). They provide part-time assistance to OPNAV on matters that go beyond the resources available to the OPNAV staffs themselves. These formal Scientific Analyst arrangements, together with the great amount of informal assistance that CNA constantly provides, are made possible primarily because of the mutual trust and confidence that has developed and by CNA's close proximity to the Pentagon and other Navy offices. CNA makes itself available whenever urgent problems require its analytical resources and experience.

The Navy considers CNA to be invaluable and irreplaceable. They apply a high degree of professional competence to the immediate and long-range problems of the Navy. Experts in various disciplines are capable of fresh, imaginative approaches. They are people who are intimately familiar with the Navy, who work with the Navy, go to sea with the Navy--who understand our operations, our philosophy, our goals for the future. Yet, as an independent organization, CNA may ask new or unpopular questions with a large measure of freedom.

2. Relationships

The CNA is responsive to the Scientific Officer and Deputy Scientific Officer with respect to planning, coordination, progress and quality of analyses and studies. In addition to the close communication link between OPNAV and CNA in the development and coordination of an overall program, the Navy through its contracting Officer and CNA Policy Council maintains a number of management controls that would not exist relative to another contractor or, for the most part, over an in-house activity. CNA is funded on an annual basis, with the general understanding that funding will be continued over some period of time. This long-term arrangement gives the sponsor the direct benefit of an independent quality staff to provide a stable base of expertise in a mix of resources and respond quickly when required.

Through most of its history, CNA and its predecessor organizations have had university affiliations. The present Rochester/Navy relationship has been most successful, and CNA has benefited greatly from university support and review. The university is firmly convinced that private organizations such as CNA play a valuable role within the Department of Defense and that universities can enhance this contribution by adding their own standards of research and criteria for critical review.

3. Program Planning

The Director of Navy Program Planning serves in the key role of Scientific Officer to CNA. He is supported by a Deputy Scientific Officer, who is also the Director of Systems Analysis, and by a Marine general officer, who is the Deputy Chief of Staff for Research, Development, and Studies.

The contract requires that the Scientific Officer and the President of CNA reach agreement on an annual program of study. A special feature of this contract specification is the distribution. At least 72 percent of the resources are devoted to studies initiated by the Navy; as much as 23 percent can be applied to studies initiated by CNA in areas of interest to the Navy, and 5 percent to unclassified research on the Rochester Campus.

The portion of the study program initiated by the Navy is developed from four sources:

- Requests from various staffs in the Office of the Chief of Naval Operations, or Headquarters, Marine Corps--in short, the users
- Requests from field commands of the Navy or Marine Corps
- Suggestions from the CNA staff, and
- Recommendations from the Systems Analysis Division (OP-96) in the Office of the Chief of Naval Operations or from the Office of the Deputy Chief of Staff (Research, Development and Studies) in the Office of Commandant Marine Corps.

A list of prospective studies suggested by these sources is prepared and reviewed, first by CNA, then jointly with the Deputy Scientific Officer (OP-96) of the Office of the Chief of Naval Operations, or with DC/S (RD&S) of the Marine Corps.

Studies approved for the program are assigned priorities based on their urgency to the Navy and the availability of analysts in CNA.

The results of studies conducted in a study year are evaluated, and decisions are made about the value of continuing individual efforts through part or all of the next study year. In this manner, both CNA and the Navy have explicit opportunities to recommend the termination of studies and redirection of resources to more critical needs. This ability to make specific trade-offs between existing and new study efforts helps to maximize the value of the program.

The method of formulation of the study program permits the Navy to focus attention on important areas that match the available capabilities of CNA. Furthermore, the provision that enables CNA to initiate studies has permitted CNA to exercise independent judgment in its selection of issues for consideration. The resources applied to CNA-initiated studies have, in practice, amounted to only 5-10 percent, however, in contrast to the 23 percent permitted. The reason is largely that many CNA suggestions for studies have been recognized by the Navy as appropriate and desirable.

As mentioned above, the contract does provide for 5 percent of the funding to be applied to an unclassified research program, of interest to the Navy, at the University of Rochester. The content of this program is negotiated annually between the University and the Office of Naval Research.

4. Personnel Management

The quality of CNA's performance is, of course, ultimately dependent on the quality of its staff. From the formal education standpoint 157 of the 200 professionals hold graduate degrees--75 of these doctorates. This high quality partially accounts for the fact that over the past two years CNA has attracted 45 percent of its new hires from universities (students) and an additional 7 percent from university faculties or staff. New hires from private industry accounted for 28 percent with the remaining 20 percent coming from the government and other sources. These new hires represented 14 percent of the CNA staff while the termination rate during this same period was 17 percent. Most of the terminations went to private industry and the federal government. The turnover rate is a combination, of course, of management and personal decisions, as influenced by the funding level.

5. Types of Work Done

CNA concentrates on four types of research. First are tactical analyses of forces and systems already in use by operational commands. These analyses include valuation of the operational performance of weapons and systems, development of methodologies to design and test new tactics, and evaluation of specific operations.

The second category comprises questions of resource allocation. These are designed to help the Navy choose among alternatives for improving future capabilities. These studies look at both the operating forces and the support establishment. They develop for the user a full range of the choice available to him and evaluate these alternatives in terms of both their effect on operational performance and combat capability, and their budget implications over an extended period.

Third, CNA conducts studies of systems performance, in which the physical sciences and engineering dominate other consideration. These analyses look at the relation between the technical characteristics of systems and their performance in an operational environment.

The fourth class of analyses comprises special short-term studies undertaken at the specific request of the Navy because of a specific, important need

that cannot wait for the completion of longer term research. These studies draw heavily on current and past research undertaken by CNA and on the competence that has been built up over the decades.

Thus, CNA serves two critical research needs. One consists of analyses for use in management decisions dealing with the application and development of Naval capabilities; the other is analytical assistance to the Navy's operating forces to enhance their present operational capabilities through more efficient use of their resources.

Very little is spent with subcontractors or consultants. In fact, subcontractors and consultants are used to supplement CNA expertise only when temporary professional services or special technical skills are required in the performance of a study or project. Since the University of Rochester assumed management of CNA in August 1967, only $15,000 of Navy funds has been spent on subcontracts and $85,000 for outside consultants.

b. Evaluation of Product Output

The provisions of the CNA contract and the procedures established by the University, CNA, and the Navy provide for full and rigorous review of research in CNA.

The Board of Overseers, acting for the University, sees to it that research in CNA meets the exacting standards of the University. Membership on the Board is based primarily on each member's ability to evaluate the quality of the research; some members, however, are chosen for their special ability to evaluate the management of CNA and thus ensure the efficient use of Government funds.

Internal review at CNA is effected in several ways. Ultimate responsibility for CNA's research lies with the President, who discharges his review authority through the Senior Scientists. Informal meetings are scheduled, as necessary, for discussion of the questions under review.

When a project is complete, the same process is followed, but with more formality. There is usually a briefing to the reviewers, who include the group director and frequently the President, so that they may assure themselves that the final report says what the project, in its briefing, believes are the most important points to be made. Following the briefing, there is a final consideration of the significance of the research, its correctness, and the effectiveness of the final report.

The Navy conducts its review in several ways.

A Navy Project Officer is assigned to each study. He reports regularly on the planning, progress, and quality of each study. An Advisory Committee is formed for each study initiated by the Navy. The committee is composed of senior Naval officers and civilians, who are briefed periodically by study groups and project officers.

Working papers prepared in the course of a study are frequently distributed for review and critique by the Navy. The resulting comments are taken into account as the work proceeds.

Study reports in draft form are reviewed by Advisory Committee members and cognizant officers in the Office of the Chief of Naval Operations. CNA then reviews the comments to determine whether changes should be made in the final study report.

Though the various forms of review keep the Navy fully informed, CNA alone is responsible for the analytical content and conclusions of every study. Where there are differences of opinion, the Navy discusses these differences in a letter, which is bound into the study report.

Under the procedures agreed upon in 968 with the Navy Department, CNA distributes studies promptly to a predetermined list of qualified recipients, once the Navy has provided its endorsement, with or without qualification. CNA is thus assured of independent dissemination of its findings, as well as critical review by professionals in comparable organizations.

7. Fee

The Rochester/Navy contract does not provide for the payment of any fee or profit. All research is performed on a strictly cost-reimburable basis, subject to the Armed Service Procurement Regulation applicable to non-profit educational institutions doing work for the Government.

This general principle of not charging any fee is followed in all CNA contractual arrangements, including non-defense efforts.

8. Ceiling

Ceiling is without a doubt the most significant problem facing CNA and its OPNAV sponsor. As CNA has demonstrated its ability to perform a unique and valuable service to the CNO and his staff and to operating commands, there has been increasing recognition that certain existing Navy programs would be best performed by CNA. A ceiling adjustment of 2.6 million has been sought for FY-71. This increase is still under Congressional consideration. However, it is doubtful that it will receive the required favorable determinations from the four committees involved.

9. FCRC Competition

The purpose of competition is to enable consumers to choose among producers. But the producers must be, to some degree, interchangeable. For DOD to benefit from FCRC competition, the FCRCs would have to be substitutes for one another. CNA is, of course, highly specialized in Naval matters which would serve to limit its competiveness in other areas. On the other hand, this specialization makes it uniquely responsive to the Navy's needs.

Though there are undoubtedly specific research areas in which more than one FCRC could perform well, most of the FCRCs are fairly specialized organizations, and opportunities for substitution are limited.

Moreover, extensive competition among FCRCs would certainly affect stability of funding, which has permitted the development and maintenance of special expertise. It would end the intimate client relationships that have been built up over the years, and would seriously affect the other benefits that the FCRCs bring to the service sponsors, particularly the long-run, independent, objective responses.

There is already professional competition between every FCRC and every other organization that performs research for the sponsor, both within the sponsoring agency and outside. If the quality or cost of the work done by the FCRC suffers by measurement against the yardstick, there is less demand for the services of the FCRC.

The benefits of competition, in sum, are available under the present arrangement.

10. Availability of Output

CNA studies are widely distributed, and include both the conclusions reached by CNA and the comments of the Navy. Wherever possible unclassified reports are distributed to even wider audiences.

These procedures, which enable freedom of inquiry to exist within a structure of comprehensive review, have proved effective.

A Master Distribution List (MDL) has been agreed upon by the Navy and CNA. It includes all services and all FCRCs. If a study has not been initially distributed to someone on the MDL, a request for such study is promptly filled.

11. Diversification to Non-Defense Users

The University has provided CNA $100,000 to use in the preparation of proposals for non-defense work. It had been hoped that diversification into work for other agencies would provide new stimuli for the staff and act as a buffer against the effects of sudden changes in funding. Unfortunately, diversification has proceeded far more slowly than anticipated. Non-defense efforts accounted for 2% of CNA's funding in 1969 and 3.8% in 1970. For 1971, it is estimated that these efforts will be at about the 2% level.

12. CNA Problems

Ceiling restrictions, which have been discussed previously, represent the most significant problem facing CNA. In addition, the FCRCs have undergone a long period of shrinkage. This trend has been almost independent of any sponsor's intention to channel additional funds to a given FCRC. In the past three years, CNA has been faced with increasing demands for services and a gradual reduction of available resources. They have, therefore, had to undertake fewer studies than the sponsor wanted.

FCRCs are no longer as stable as they once were. This lack of stability has a significant effect on an organization's study program.

The staff is affected, too. If instability continues, along with the prospect of further erosion, the attempt of the FCRCs to attract better scientists will inevitably become more difficult, and those who are attracted will operate under the real danger of being caught in a cutback.

13. Suggested Means for Improving Operations

In addition to providing a method for ceiling relief, a funding method that will take into account inevitable inflation would provide a more stable atmosphere.

It is recommended that DDR&E coordinate a thorough program of communication and education about the FCRCs. The service sponsors are already working hard at this, but their efforts have focused on the need for the specific research performed, and less on the unique contributions of the FCRCs. DDR&E would appear to be in an excellent position to build on the work of the sponsors and to emphasize the real need for the FCRCs.

Once the report of this study has been reviewed by Congressional committees, CNA would welcome visits by members of Congress and their staffs. They want an opportunity to show them what they do. If their research and management cannot withstand close scrutiny, that fact should be made clear.

It is felt that clear communication and understanding lead to confidence and respect. These ingredients are essential to an environment in which the FCRC research programs can flourish.

RESEARCH ANALYSIS CORPORATION (RAC)

1. Service Position

The Army considers RAC to be a valuable research and development asset and has continued to support RAC as an FCRC to the limits of available funds and ceiling. At the same time the Army has taken no steps to discourage the present RAC-initiated effort to lose RAC's FCRC status by reorganizing into a completely independent profit corporation. If the reorganization effort fails RAC can continue in its FCRC relationship with the Army.

The Army is currently formulating the program of study projects for Work Year 1972 (September 71 - August 72) to be contract negotiated with the present corporation. If the reorganization is accomplished the contract with its annual program as it exists then will be transferred to the new corporation and over a period of several years the FCRC-type contract arrangements will be phased out. The new corporation will have to compete increasingly for Army business and business from other sources. All Army contracts with RAC will be negotiated as with any other independent contractor. It is not unlikely that RAC will receive some sole source work as do other contractors, but many of the studies will have to be competed for on the open market.

The Army will continue to use RAC whenever RAC appears to be the contractor best staffed and most capable of providing the best return on research dollars available to support specific research tasks.

2. Primary Characteristics of RAC

The Operations Research Office of Johns Hopkins University (1948-1961) was reorganized into the independent corporation, RAC, in 1961. RAC continued to support the Army in operations research and systems analysis since that time from its offices in McLean, Virginia. In recent years RAC has maintained a staff of approximately 500, including over 200 professionals, to conduct a research program costing approximately $10 million (85% Army, 10% other DOD). The facilities of RAC are typical of organizations of its type and include an in-house leased CDC 6400 computer facility, a complete in-house technical report production facility, and an extensive library and map center.

At least 30 disciplines are represented on the RAC professional staff with capability in over 40 general study areas. This type of staff permits RAC to attack problems in almost every area of Army and national interest. Heavy concentrations of RAC's capabilities lie in the fields of logistics, force structure, personnel and cost analysis.

3. RAC's Relationship with:

Sponsor. The Army sponsors approximately 85% of the RAC effort. Continuous contact is maintained between the Army sponsors of individual studies and the RAC analysts performing the work. Study Advisory Groups review the work done on each study on at least a quarterly basis.

RAC enjoys the greatest possible access to information sources because of its non-profit FCRC status. Many years of continuously supporting Army study programs have provided both Army and RAC personnel with a knowledge and understanding of each other that allows relatively easy resolution of problems arising in study efforts.

Universities. RAC is not connected formally with any university. Some staff members are hired from universities, some continue to teach while employed by RAC, and some leave RAC to go to the universities. Research standards are maintained on at least the same level as at universities.

4. Program Planning.

Annually a program of studies to be conducted at RAC is formulated in the Army staff and major commands. Formulation of the program involves matching important Army study requirements to the capabilities known to be available at RAC and in line with anticipated cost and available funding and ceiling. Contract negotiations between RAC and the Army then lead to the initial program for that work year. Ten percent of the initial program is designated for RAC-initiated research on problems of interest to the Army. Normally, available appropriations do not permit an initial program of the magnitude to completely use all anticipated ceiling. Additional studies are added subsequently as funds become available until the authorized ceiling is reached (usually about halfway through the work year). Any further additional or unforeseen study effort can only be added by curtailing or eliminating some other effort already begun.

5. Personnel Management at RAC.

There are no particularly unique personnel problems at RAC other than those tied to the type of personnel employed. The largest portions of professional staff come from industry, universities, and government, and go to those same places when they leave RAC. Two-thirds hold advanced degrees, about a quarter hold doctorates.

6. Types of Work Done.

Throughout each work year, in addition to the programmed and added studies, RAC is frequently called upon to provide analysts or special consultant support to high-level policy groups of the Army, OSD, and other national executive offices. However, most of the Army program is devoted to analysis of important Army problems with the objective of concurrently developing: new analytic processes to be used by the Army; models (including, but not exclusively, computer simulations) for solution of Army problems; and better operational procedures and planning methods.

A number of complicated force structure, logistic planning, and personnel policy procedures have been automated and refined as a result of past RAC programs.

The work performed frequently must be started with very little precise definition. The familiarity of RAC personnel with Army procedures and

organizations that has developed from long, close association is an important factor in the success of problem definition, frequently the first step toward solution of the Army problem.

7. Evaluation of Product Output.

RAC performs internal review of all output to insure that high standards of research are maintained. Army sponsors evaluate each project after completion. The most genuine appraisal is reflected in the continuity of sponsors' returning year after year with new problems they desire RAC to attack. An overall review of performance reports would show several failures and a number of outstanding successes over a period of years, with the bulk of the output being just what the sponsor had requested, a useful, professional quality product of research.

8. Fee.

A fee of approximately 4% is added to the RAC cost to allow for operating capital, asset acquisition, independent research and to cover disallowed costs.

9. Ceiling.

The authorized ceiling at RAC has been approximately $8.3 million since 1968. The ceiling prevents any growth in the Army-DOD sponsored RAC program and since no provision is made for inflation, each year the number of technical man years of support to DOD dwindles by about 5%.

10. Availability of Outputs to Other Services.

RAC output is generally available to all of DOD, other government agencies, and defense contractors. However, since RAC is engaged mostly in solving or assisting in specific Army problems the outputs are not frequently directly applicable outside the Army.

11. Diversification to Non-Defense Work.

RAC has been generally unsuccessful in diversification since its primary capabilities lie in defense areas and they are not easily transferred to non-defense client requirements.

12. Means for Improving RAC's Operations.

RAC has initiated action to reorganize to a profit corporation in order to divest itself of FCRC status and not be subject to ceiling. Whether this action, if completed, will enable RAC to obtain more total work than it now does cannot be objectively predicted.

HUMAN RESOURCES RESEARCH ORGANIZATION (HumRRO)

1. General

HumRRO conducts behavioral science research in the field of training methods, requirements for training devices, motivation and leadership. It is the only DOD FCRC that specializes in this field. Almost all of its program support since 1951 has come from the Army sponsor although recent success in obtaining non-DOD clients through diversification efforts shows 20% of the 1971 program to be non-DOD sponsored.

The Army has recently tried, unsuccessfully, to obtain an increase in the ceiling for HumRRO. This action highlights the Army's requirement for the type of work done by HumRRO and the Army's regard for HumRRO as the most capable organization to do this work. It also demonstrates that the Army will continue to use HumRRO as long as it retains its capability advantage over other contractors and as long as funds are available.

2 Primary Characteristics of HumRRO

The most unique feature of HumRRO as compared to other FCRCs is collocation of HumRRO divisions at five key Army installations and the work done in conjunction with US Army Human Research Units at those posts. The system of contractor-Army unit teamwork insures the relevance of HumRRO work to Army problems and promotes liaison and utilization of HumRRO output.

HumRRO was reorganized in 1969 as an independent corporation after 18 years as the Human Resources Research Office of The George Washington University (1951-1969). Since 1953 the annual effort at HumRRO has been 100-120 professional man years.

HumRRO research is conducted at its central offices in Alexandria, Virginia, and at appropriate military installations (usually the five research divisions located at major Army posts). Most HumRRO work is sponsored by US Army Continental Army Command (CONARC), and Deputy Chief of Staff for Personnel (DCSPER). OSD(M&RA) is also an important client.

3. HumRRO's Relationship with:

Sponsor.

Until 1967 HumRRO worked only for the Army. Recently multiple sponsorship has developed and the Army share of the total HumRRO program is about 75%. Continuous contact is maintained between the appropriate Army sponsors and HumRRO, and military personnel and units participate directly in varying degrees in the individual work units of the HumRRO program. In many cases this direct participation is by the Army Human Research Units with the field divisions of HumRRO.

Universities.

HumRRO is not connected formally with any university. From 1951 to 1969 it was an office of the George Washington University. Many of its personnel come to HumRRO from universities and others go to universities when they leave HumRRO. Research standards are kept at least even with those of universities.

4. Program Planning.

The Office, Chief of Research and Development establishes the HumRRO work program through a worldwide requirement system followed by review and negotiation. This process adjusts the program to meet priority requirements within funding limitations. HumRRO's capability to initiate research of its own choosing is limited to less than 5 percent. The current funding level of $3.5M is not sufficient to meet current Army requirements. This factor and the ceiling, together with the nature of the Army's requirements, control and stabilize the size and capabilities of HumRRO.

5. Personnel Management at HumRRO.

There are no particularly unique personnel problems at HumRRO other than those tied to the type of personnel employed. The largest portions of the professional staff come from the universities and industry and go to those same places when they leave HumRRO. The great majority of the 140 professionals have advanced degrees in psychology and related sciences; over 50 have Ph.D.'s.

6. Types of Work Done.

About 5 percent of the HumRRO program is devoted to Technical Advisory Service (quick response consultation without exhaustive experimentation). The bulk of the 1971 program supports Training Technology (35%), Training Management (20%), and Individual Training and Performance (18%). Over three-quarters of the program is in work units designed to provide specific information aimed directly at an Army problem.

7. Evaluation of Product Output.

Outputs are reviewed internally by HumRRO for adherence to university standards of professional research. The Army reviews the output and usefulness of HumRRO products quarterly at staff conferences among OCRD, the FCRC, and the DA staff proponent. An Army Human Factor Research Advisory Committee (AHFRAC) annually reviews the output of HumRRO and the usefulness of the output.

8. Fee.

A fee of approximately 5 percent accrues to HumRRO from its contract work to allow for operating capital, asset acquisition, independent research and to cover disallowed costs.

9. Ceiling.

The authorized ceiling at HumRRO has been approximately $3-3.5M since 1968. Attempts to increase the ceiling to allow additional work at HumRRO in FY 1971 have been unsuccessful.

10. Availability of Outputs to Other Services.

HumRRO output is generally available to all DOD, other government agencies and defense contractors. The general applicability of HumRRO's work has aided its diversification efforts.

11. Diversification to Non-Defense Work.

HumRRO has approximately 20 percent of its 1971 program with non-DOD sponsors. HumRRO has been more successful in this area than most other FCRCs (RAND has had similar success).

12. Means for Improving HumRRO's Operations.

None identified. HumRRO suggested avoiding reprogramming once research begins, but this prevents application of HumRRO capabilities to high-priority Army problems as they arise.

SUMMARY ON INSTITUTIONAL RESEARCH

The six FCRCs studied by Task Group I, the studies and analysis types, contrary to some apparent widespread beliefs do very little self-initiated work void of service guidance or direction on "broad problems of a general nature in national security planning and policy." They are almost entirely tasked or otherwise guided to perform studies and develop models and techniques to overcome problems in both narrow and broad service problem areas. For instance, RAC in FY 70 did a study on the "Impact of C5A" that was only a part of the in-house, coordinated effort by the LDSRA (DCSLOG Class II study agency) to prepare the Army to take appropriate advantage of the additional air cargo capability that will exist when C5A enters the inventory. They are doing another study, outgrowth of the C5A study, to develop and transfer to Army agencies models for determining specific items to be shipped routinely by air to maximize cost savings ("Routine Economic Airlift)."

Both of these studies represent important work, well done and useful, and necessary. They are not broad areas, policy making, strategic, etc. They were not done as institutional efforts, they were tasked to RAC by sponsors as are almost all studies. Further, they are typical, at least in their nature, if somewhat smaller in dollar cost then some larger projects.

The work performed at the other FCRCs studied by Task Group is "tasked" equally as thoroughly as RAC. There appears to be no basis for or utility in distinguishing between "tasks" and "institutional" efforts in order to arrange ceilings applicable only to "institutional" efforts.

RAC institutional research funds amount to 10 percent of the initially negotiated annual program, approximately $600,000 per year. (This is about 8 percent of the total annual program.) RAC selects projects and advises the Contracting Officer who approves the list based on "potential interest to Army" or "increases RAC capability to support Army projects." To date, no IR projects proposed by RAC have been disapproved by the Army.

The $600,000 is allocated by RAC to various IR studies. Most are less than $100,000, the effort is spread throughout the various RAC departments, and the overall intent appears to be:

a. Providing a project to a valuable analyst for whom no project exists in the current program.

b. Investigating areas that may rouse interest in the Army staff and be the "seed" of next year's program efforts.

c. Further special areas such as non-linear programming in order to increase RAC capability to support existing efforts and draw new efforts.

d. Conduct a study (or part of a study) that was decremented from the annual program because of priority. This complements a above and is done because of RAC interest in the area and to maintain and encourage sponsor interest for future years.

Except in rare instances, usually as a result of a direct request from high-level Army staff or Secretariat personnel, RAC is not involved in "high level national (or even Army) security planning." RAC, in both tasked and institutional work, addresses important Army problems within large areas such as logistics, force planning, etc.

HumRRO is oriented toward many small projects in the behavioral sciences area especially those touching on training methods and techniques. No broad areas of planning or policy are involved. No significant institutional projects are in HumRRO's program.

ANSER is completely tasked and supervised by the Air Force. It is ANSER's responsibility to provide timely analyses and operations research for concept formulation, cost-effectiveness studies, technical evaluations and development planning of USAF weapon systems and equipment in all mission areas. These studies are assigned by the Director of Operational Requirements and Development Plans and the Director of Reconnaissance and Electronic Warfare, Deputy Chief of Staff/Research and Development, HQ USAF, and the study results are used directly in planning and development of USAF weapon systems to meet operational requirements. No part of its approximately $1.7-million program is "institutional"; it is totally tasked.

In the case of IDA, more than 90 percent of the time, the sponsor requests a task be performed and acceptance by IDA after discussion, etc. follows. IDA has about a 5-percent "Central Research Program" (about $600,000 annually), for "tasks" (as IDA put it) that are initiated solely by IDA.

RAND and CNA also are heavily tasked with almost no work really conducted freely as institutional, long-range, heavy effort projects. Although the contract with CNA permits up to 23% of the funds to be used for CNA-initiated tasks, this provision has been largely ignored.

The Air Force Project Rand portion of Rand's research program is organized in the following manner:

I. RESEARCH ON AIR FORCE PRIORITY ISSUES ---------- 70%

Strategic Studies Program
Tactical Studies Program
Logistics Studies Program
Systems Acquisition Studies
Manpower, Personnel and Training

II. OTHER RESEARCH ---------- 21%

Applied Sciences and Engineering
Mathematics Theory and Application
Information and Data Processing
Air Force Overseas Missions
Analysis Methodology

III. SPECIAL ASSISTANCE, PROGRAM FORMULATION, LIAISON --------- 9%

The project represents 43% of Rand's total business. The core of the Project Rand work is contained in Part I above and is established at regular meetings of the Air Force Advisory Group (AFAG) and Rand and adjusted periodically during close discussion between Rand representatives and AFAG members, and Air Staff Officers of Primary and Secondary Interest. These issues tend to be the policy planning variety having long-term implications. For example, the priority issues include such things as contributions of specific forces to deterrence of attacks on the U.S. and our NATO allies; new concepts, doctrines, and strategies for strategic forces; allocation of tactical resources among ground forces, air superiority, interdiction, and close air support, etc.

Part II is devoted to research not specifically included as an integral part of the designated priority programs. It includes work directed to Air Force interests and needs not within the above five issue areas, but it also includes the work necessary to build skills, acquire new background knowledge, and develop new methodology.

Part III encompasses efforts in response to requests for assistance that Rand receives direct from various Air Force elements. Often these studies are time urgent and are based largely on research and experience already accumulated.

These three program parts in turn translate into 73 individual projects which are prepared in proposal form for evaluation and endorsement by an appropriate functional office of the Air Staff. The Air Force does not set aside any portion of Project Rand for "institutional" type research. All Rand research under Project Rand is tied to some Air Force element having primary interest in the work being performed.

Rand work performed for OSD, ISA and ARPA is specified by the client or suggested by Rand. In either case Rand is required to present a detailed proposal which is negotiated before work is actually initiated. No significant amount of institutional effort is included in these programs.

REPORT OF TASK GROUP II

CONTENTS

REPORT OF TASK GROUP II
OF THE
DOD STUDY GROUP
ON
FEDERAL CONTRACT RESEARCH CENTERS

Task Group II was assigned responsibility for those Federal Contract Research Centers engaged in systems engineering/technical direction, the Aerospace and MITRE Corporations. The task group visited these activities and was briefed by their top management and program staff. A tour of facilities was provided along with demonstrations of singular projects currently being prosecuted for the Defense sponsor. In addition, briefings were provided to the FCRC total panel by both the service sponsor and the individual FCRC. This combined exposure, plus available documentation, formed the basis for task group analysis for both activities.

It was generally concluded that each FCRC had, as its basis for existence, its ready capability to undertake work assignments of prime importance within its mission envelope and of priority interest to its service sponsor.

These activities enjoy both a high degree of confidence from the sponsor, and a sense of dedication and achievement based on many years of corporate memory and close association in the top management areas within the Defense related community. Their unconstrained relationship afforded a considerable free exchange of information within the defense contractor community undertaking efforts on behalf of their service sponsor. The technical staffs, although adaptable to meeting changing program requirements, were nevertheless subject to many of the aging problems which beset the in-house activities. This problem has become more acute in the past several years as a direct result of dollar ceiling restrictions and its impact on staffing policy.

MITRE CORPORATION

The MITRE Corporation must be discussed while keeping in mind its similarities to and its differences from the Aerospace Corporation, since both organizations were created in response to a specific need of the time. That is, the government in both cases needed an organization to undertake the task of systems engineering and technical direction for urgent, high-priority programs that could not be readily managed by organizations otherwise in existence at the time. The two organizations have developed in somewhat different directions, although both have evolved into forms that fit the needs of their particular technical areas: electronics, communications, and surveillance for MITRE, and space systems and missiles for Aerospace.

MITRE is well and carefully run. It provides direct and essential support to the Electronics Systems Division of the AFSC under a management arrangement that makes it very clear what the tasks are and why MITRE is the appropriate organization for the task, rather than some other. Although this pattern has a somewhat arms-length flavor, the task group had the impression that relationships between the

corporation and its principal sponsor were more comfortable and thus, in the long run, more productive than would be the case with a less carefully spelled out interaction.

The completion of the original task for which MITRE was formed left MITRE with a very strong team that has proved invaluable to the Air Force on a variety of similar, although smaller, problems. The general decline of budget flexibility and the difficulties of maintaining institutional strength under the complexities created by the imposition of arbitrary FCRC ceilings have combined to urge MITRE toward diversification to related fields where its talents can be put to good use. This effort has been moderately successful, although the "stigma" of being an FCRC has hampered diversification within the DoD, and the shortage of R&D money in other Federal Departments has slowed diversification outside the DoD.

MITRE carries out a small fraction of its work in an independent Research and Technology Program that is largely scattered throughout the several divisions of the company and serves several functions. One of these is to maintain the technical vitality of the staff, another to provide

direct technical back-up when required for the GSE/TD tasks undertaken, and another to capitalize on the occasional piece of new technology that comes out of the program. The company feels strongly that this sort of work is essential and values its flexibility to a marked degree, in part as an avenue to diversification. There is no reason to disagree with that view; the activity is prudent and useful to the company's prime support of the Air Force. However, the size and the strength of the program are not such that the principal sponsors can count on MITRE as a regular source of new technology.

The steering group has considered at some length alternatives to continuance of MITRE in its present form to provide the type of assistance to ESD that is and will remain essential. No alternative is attractive, and none is recommended. If for reasons not considered by the task group some change is mandatory, it is probable that the conversion of the present MITRE Corporation into a profit-oriented firm could be accomplished with the least loss of competence and disruption to the staff. A possible problem with such a change might be loss of some acceptability in the firm's relationship with commercial firms

when MITRE acts on behalf of the government in carrying out its task. Inasmuch as the corporation has already found that trust and acceptability are not automatic but must be earned throughout a period of responsible association, it seems likely that conversion to a profit corporation would not, in fact, cause substantial damage to the firm's acceptability.

FINDINGS:

MITRE Corporation has so far weathered the changing defense budget environment and is a well managed operation. Its diversification efforts have enabled it to retain its essential capability and readiness to handle Air Force requirements. Its relationship to the ESD of the AFSC is well defined and provides a functional relationship under which each organization seems mutually comfortable and responsive. No distinct problems of significance are apparent.

RECOMMENDATION:

That the basic mode of operation of the MITRE Corporation be continued as heretofore.

Aerospace Corporation

The Aerospace Corporation, like MITRE, was created to fulfill a special technical function, the oversight and management of urgent programs with a high content of new technology. The Corporation has done a good job in its prime mission, as measured by the demonstrable successes of the Air Force space and missile system programs on which Aerospace has worked. Also, as in the area in which MITRE works, the major effort for which the Corporation was created has peaked for the moment, and the firm is making serious efforts to diversify. Part of the reason for relaxation of the need is that the technology associated with space programs and long range ballistic missiles, although constantly developing new facets, is much more familiar to government and industrial managers, and the required management procedures for such programs are much better understood by both government and industry. Quite aside from the preceding comment, the need for the capability represented by Aerospace continues at the moment, and will continue into the foreseeable future. Thus the capability of Aerospace is a valuable asset to the government.

In common with MITRE, and indeed with some other FCRC's, Aerospace has a peculiar strength in its rather anomalous position relative to the Department of Defense organization and to the Defense contractors with whom it works. Since it neither conceives nor produces hardware, it is nominally without a vested interest in anything but the quality and cost of the systems with which it deals. Without a profit motive in the usual sense, it is at least marginally more acceptable to Defense contractors in terms of candor, and the disclosure of proprietary information. As an "outside" organization with strong ties to very high levels in the government, it is not tightly constrained to operate through the usual Defense command and communication channels, and can thus more easily and quickly do what is necessary for the prosecution of its tasks.

Unlike MITRE, a significant factor in its creation was a desire to respond to specific Congressional complaints that the heavy involvement of the TRW Corporation in the management of space and missile systems raised grave questions of conflict of interest and perhaps propriety. Having been created in this milieu, the organization has come under attack from another set of Congressional critics

for allegedly excessive management salaries and other poor practices, including apparently the charge that it is not profit-oriented. The organization is to be complimented for having largely succeeded in suppressing any paranoid tendencies.

Also unlike MITRE, there is very little flavor of an arms-length relationship with its principal sponsor, SAMSO. The relationship is very close, and Aerospace represents a large fraction of the staff competence available to SAMSO. This very closeness, which helps to make Aerospace effective in the community in which it operates, at the same time would make it rather difficult to identify with great precision those tasks and functions which would have to be transferred to another performer if such a move were to be effected. The estimate of the task group is that any such disengagement would be extraordinarily disruptive to the day-to-day work being carried out by Aerospace.

The reductions in budget for some of the programs to which Aerospace has regularly been contributing, outside of the various special projects in which the company is engaged, coupled with the difficulties of the

administration of FCRC ceiling, obviously raise the question of whether the corporate capability is so valuable that it should be supported with a careful view toward institutional stability. The fact that the corporate identity appears somewhat hazy makes an accurate assessment of that question difficult from the information available to the task group.

Various alternatives to the present mode of operation of the Corporation can easily be listed. They include:

a. Continuation in the present mode, with some attention to institutional stability;

b. Continuation in the present mode, but allowing the size of the organization to fluctuate entirely with the Department of Defense market for its services, tempered by what diversification outside of the Department of Defense the Corporation can promote;

c. Conversion to Civil Service status with special terms of reference that would attempt to allow it flexibility in hiring and firing of personnel and broad ranging access thoughout the Department of Defense similar to what it now enjoys;

d. Withdrawal from the current closeness of relationship with the sponsor, but otherwise continuation in the present mode; and

e. Conversion to a profit-oriented company.

From the information available to it, the task group concluded that alternative (a) was obviously most likely to preserve for the Department of Defense the competence that is essential to the principal sponsor. Each of the other alternatives presented either serious difficulties in implementation, or serious probable hazards to continuation of effective support to SAMSO.

Alternative (c), conversion to Civil Service status in some form, is discussed more thoroughly later in the report. A study adequate to support a decision based on the rational advantages and disadvantages of such a conversion would take several months. Lacking such a detailed study, the task group could make no serious present recommendation concerning that alternative.

Aerospace Research Laboratories

The task group paid particular attention to the Research Laboratories at Aerospace, since they have been

substantially reduced in size under the pressures of both budget and ceiling problems. This trend exists at a time when there is some enthusiasm in DOD for capitalizing on several of the technological advances that have been achieved in the Laboratories.

As at MITRE, the performance of a certain amount of research and technology work within the Corporation has several constructive purposes, such as the maintenance of technical vitality within what is basically a management organization, the provision of quickly responsive technical consultative services for assigned systems, and, as a bonus, occasional substantive technical advances. Also, as at MITRE, the research group is not large enough under the present constraints to allow the Air Force to depend on the group for regular technical advances in some fields.

The Research Laboratories are organized as a separate entity, and there are some technical areas where solid creative competence has appeared in the midst of what is basically a scientific support activity. A salient feature is that by policy and under the constraints of available resources, laboratory personnel know a priori that they will not be able to pursue their advances far enough to permit full exploitation. That is, they will

have to turn over their most successful ventures to other organizations for further prosecution.

The Aerospace Corporation could obtain scientific consultative services through other mechanisms, although probably not with similar convenience. It is difficult to determine accurately how much the presence of the Laboratories contributes to the maintenance of corporate technical vitality, although it is certain to help in some measure. If possible, it is clearly to the corporate advantage to continue the operation of the Laboratories, although their ultimate viability may be in question if they can never follow through on their achievements.

While it is easy to see the advantages of continuing the operation of the Research Laboratories in the present mode, there are other possibilities that might either remove some of the ceiling and funding difficulties or make it simpler to capitalize on what they have done. Some of these possibilities include: conversion of the Laboratories to the Civil Service with some DOD organizational location; isolating the Laboratories from the Aerospace line management and having them report to the Aerospace Board; separating the Laboratories from Aerospace and forming an independent profit or not-for-profit company;

reaching an accommodation with a local university for the operation of the Laboratories. Each of these presents some problems in how the present function of scientific, technological, and consultative support to the Aerospace Corporation could be continued; and each of them, in permitting growth in the Laboratories with more responsibility for down-stream development, raises certain policy questions about how such a laboratory would complement the existing base of DOD laboratory competence.

The task group felt that the issue of the Laboratories was of sufficient moment to deserve a more detailed examination of the alternatives and their implications with a special study to follow the present study of the FCRC's.

FINDINGS:

Aerospace Corporation continues to carry out its assigned mission to the Air Force with a high degree of success. Its working relationship with SAMSO is extremely close and cooperative and greatly strengthens the effectiveness of both organizations in the accomplishment of the assigned space and missile systems programs. The Aerospace Research Laboratories, although a contributor in meeting

the technology requirements in support of space and missile system programs, has been subject to a continual reduction in size under the pressure of budgetary ceiling. A continuation in this direction can seriously degrade the presently available capability past the point of utility.

RECOMMENDATION:

1. That the basic mode of operation of the Aerospace Corporation be continued as heretofore; and

2. That the Research Laboratories of the Aerospace Corporation be subject to further, in-depth study to determine:

a. the optimum method of sustaining the necessary technical competence in support of the prime function of Aerospace

b. the advantages and disadvantages of alternative methods of operating the Research Laboratories.

CONVERSION OF GSE/TD ORGANIZATIONS TO THE CIVIL SERVICE

Since all organizations engaged in GSE/TD work must at times act as agent for the government, one of the obvious possibilities for the future of both MITRE and Aerospace is conversion to Civil Service status, so that, in fact, they will be part of the government. This possibility warrants special consideration here in view of the maturity of both those organizations, and the common determination that the function they perform is one that will be required for the indefinite future.

As previously noted, both organizations were created for a special sort of purpose. They were a new instrumentality to perform a DoD function, and to get the job done they were given unusual, if not unique, working relationships with both their sponsoring organizations and the contractors who were performing tasks for the sponsors. Historically their creation was a typical action of the government when it is faced with a serious new problem. The NDRC, the Manhattan Project (AEC), and more recently NASA have all created special technical organizations to face new technical challenges, each with a set of special privileges and

arrangements lying outside the normal governmental pattern, in order to get the job done.

The relevant experience with conversion of such organizations to the standard Civil Service pattern rests largely on the conversion of several of the war-time NDRC laboratories to in-house laboratories when it was decided that their function should be continued indefinitely. These were successful conversions, but it is significant that they were brought about during a period at the end of World War II when the whole country was going through a massive readjustment, and almost all technical organizations were in a state of heavy flux.

Since that time there have been only minor examples of conversion in the DoD related areas, although within the past few years a large number of individuals employed by contractors in direct support of various government operations have been converted to Civil Service status. The key point here is that they were hired as individuals and not particularly as part of an autonomous organizational entity. Thus, directly applicable experience on which we could base plans of action and estimates of success in conversion is scanty. However, within the last few years there have been two examinations of the problem bearing directly on MITRE and Aerospace. These are a MITRE suggestion in 1967 that the

Air Force try an experimental period of shifting people and tasks from MITRE to a new Civil Service group at ESD, and the more thorough examination of conversion contained in the Terhune Report on Air Force FCRC's. The MITRE suggestion dwelt heavily on the special arrangements that would have to be made to permit the orderly and successful growth of the new group at ESD, but a decision on the suggestion was deferred pending completion of the Terhune Study. The Terhune Report concluded that conversion, on balance, was undesirable because of difficulty in reaching solutions to practical problems of the sort discussed below.

The study group could not devote the time necessary to update the Terhune Report, which would be the first step in determining whether the conclusion about desirability holds with equal force today. Such an update would be lengthy and would require investigation of a complex of details:

Since the talent and experience of the present employees is the prime asset of both these organizations, there must be methods of handling the practical mechanics

of taking care of the people, through a schedule of salary compatibility with the existing Civil Service classification scheme, establishing their rights in existing company retirement plans, and placing them with equitable seniority in the government retirement system. Another set of practical problems will rest on the determination of whether the government should purchase, lease, or otherwise acquire the equipment, special facilities, and ordinary physical plant that are presently in use by the FCRC's, but not owned by the government. Appropriations would have to be secured for the costs of acquiring equipment, facilities, and people, and the personnel end strength of the Service would have to be adjusted to allow for the conversion.

Certain more intangible questions would also have to be addressed. These include a careful study of the job climate for the present employees, so that we could estimate how many might choose not to convert and thus how many we would have to recruit in a timely fashion. Some consideration should be given to the implementation schedule, i.e., should it be gradual,

or sudden -- or should there be a trial period, as suggested by MITRE? Special personnel procedures applicable to the employees of the converted organizations must be considered to see if a form of exempted Civil Service should be sought. Since one of the particular strengths of the FCRC operation is the ability to work outside the normal hierarchical structure of the DoD, a special charter for the intended mode of operation would have to be accepted by the sponsoring Service.

Particular problems in the general governmental climate must be addressed to see how they could be overcome. Examples are: For the past several years there has been steady pressure from both the legislative and executive branches to reduce the Federal payroll, as exemplified by the current intention of the President to reduce the headcount as much as 5% by the end of this fiscal year. The average grade level of the Air Force would rise as a result of adding several hundred highly skilled technical people if the employees were to be included in the General Schedule, and an exemption from the present target reduction in average grade would

be necessary. In the mainstream of the reduction of the DoD budget is the desire to reduce the size or number of active military bases and operating organizations, and to reduce the number of functions performed by the government. To the extent that the more highly skilled FCRC employees would convert to super-grade status in the Civil Service, we would have to contend with the apparent intent of the proposed Federal Executive System to erase all special provisions that apply to scientists and engineers. Perhaps the most intractable of these problem areas rests on the fact that government organizations with radically special privileges and practices are almost always formed during periods when there is substantial reorganization to meet new requirements and solve new problems. The Air Force is not undergoing any such reorganization, and there is no radically new function to be performed here. Thus the creation of a new Civil Service group with rather special features would be faced with more than ordinarily difficult problems.

Updating the Terhune Study's examination of the desirability of conversion of the GSE/TD organizations must eventually lead to the central questions of what

is to be gained or lost by the conversion. As a baseline for what can be expected in performance of an in-house group that operates within the standard Civil Service framework, we have the example of the Systems Engineering group of the AFSC ASD. Comparison with the current characteristics, capabilities, deficiencies, and mode of operation of that group will provide some measure of the worth of the special features that have been assumed necessary above. The basic criterion is whether or not SAMSO and ESD could perform their jobs better after conversion of their support organizations than they could before. Implicit here is the question of whether conversion will improve function, is simply a cosmetic repair, or is essential to preserve competence in the face of unremitting Congressional pressure.

Clearly, the basis for a fully rational decision about whether or not to proceed with conversion must include the best conceivable plan for accomplishing that conversion, complete with a time-table for the necessary special legislation and appropriation support. Addressing the issues discussed above, and constructing

a proposed action plan would constitute a lengthy study effort, as is appropriate for a major decision about the future of DoD assets of such importance and investment value. The present study group does not believe that an update of the Terhune Study would support a change in the conclusions of that study, and the group has therefore not recommended such an undertaking. If a study of this sort were to be directed, the time required for its completion, the assimilation of the results, and the delivery of a decision is sufficiently long that this group believes the peculiar virtue of the existing working arrangements at both Aerospace and MITRE should, for the present, be allowed to continue essentially unchanged.

TASK GROUP REVIEW

OF

SPECIFIC ORGANIZATIONS

BLUE RIBBON PANEL TASK GROUP REPORT ON

THE MITRE CORPORATION

I. GENERAL INFORMATION

A. ESTABLISHMENT

1. Date - Incorporated 21 July 1958[1]

2. Name - The MITRE Corporation

3. Location - Bedford, Massachusetts (01730)

B. HISTORICAL SUMMARY

With the rapid technological advance in the computer sciences during the late 1950's, programs were developed which employed advanced electronic applications to military command and control requirements. Such programs, at that time, were under the jurisdiction of the Air Research and Development Command (ARDC) and the Air Material Command (AMC). The management relationships which evolved from each of the separate programs were closely related to the idiosyncrasies of the particular parent organization and program with little or no similarity of management structure between programs. As the inter-relationships and indeed similarity of efforts were recognized, it became apparent that a centralized management approach was needed within the Air Force.

[1] Certificate of Incorporation of The MITRE Corporation (as amended) through 22 January 1970.

Lincoln Laboratory, as a research center of the Massachusetts Institute of Technology, was, during this period of time, engaged in research studies for Air Defense. From these studies, evolved the concept of a semi-automatic control system. It became evident that a technically competent systems engineering organization was needed once the decision was made to proceed with procurement of the system. MIT declined to accept the task on the basis that such a role was inappropriate for a university laboratory.

In July 1958, following a long series of meetings between the Air Force and MIT, The MITRE Corporation was formally incorporated to undertake this vital role in expanding computer technology for the air defense of North America with the Semi-Automatic Ground Environment (SAGE) system. Personnel requirements were met by the transfer in January 1959 of people from Lincoln Laboratory to The MITRE Corporation. Initial work on the system was conducted under subcontract arrangements to MIT.

Since its establishment thirteen years ago to specifically work for the Air Force on defense against air attack, The MITRE Corporation has continued this work and broadly diversified with the design and development of major systems of national defense.

C. COMMAND SUPPORT

As an Air Force sponsored Federal Contract Research Center (FCRC), the responsible Air Force management agency for The MITRE Corporation is the Electronic Systems Division (ESD), Air Force Systems Command (AFSC), located at L. G. Hanscom Field, Bedford, Massachusetts.

II. MISSION, TASKS AND FUNCTIONS

A. MISSION

The primary mission of The MITRE Corporation has been to provide scientific and technical support to the diverse projects and programs of the Electronic Systems Division in the major areas of systems planning, engineering, and integration specializing predominately in the field of information systems and related technology.

In accomplishing this mission for the Air Force, the Corporation is assigned the responsibility for the accomplishment of specific research and experimentation programs. Such programs have as their objective to insure that technological advances are appropriately incorporated in communication and information systems; and that competence in the fields of technology necessary to support efforts in the areas of systems acquisition and systems research and planning are maintained.

It is reasonable to expect some change during this decade, in the ESD mission in order to meet future requirements for a type of defense that is more responsive, more reliable, and more capable of satisfying the demands of national security than current systems. Accordingly, it is expected that MITRE's role will be to continue applying its professional scientific and engineering skills more broadly, as in the past, to meet these new Air Force needs.

B. TASKS AND FUNCTIONS

In determining and assigning tasks to The MITRE Corporation in support of ESD programs, there are certain fundamental considerations and policy guidance that first apply. These are as follows:

(1) The use of The MITRE Corporation is restricted to selected projects and programs which require unique capabilities and expertise.

(2) The utilization of the Corporation must conform to the established policy criteria for Air Force use of nonprofit corporations.

(3) MITRE's tasks, responsibilities, and products on each project or program must be clearly defined and documented in approved ESD/MITRE Technical Objectives and Plans (TOPs). MITRE's relationship and interface with the contractors on each project or program assigned must also be defined in a TOP and

formalized in an appropriate enabling clause in the existing ESD contract.

Contributions by The MITRE Corporation to programs and systems require that certain clearly defined functions be accomplished. These functions require direct involvement in types of work categorized as systems planning, systems engineering, advanced development planning and technology. During the past year, approxomately 80% of MITRE's total effort was for the Department of Defense with three quarters of this effort for the Air Force mainly in support of ESD. Of total effort for the last five years, MITRE has devoted 44% to systems planning efforts with 41% concentrated in the area of systems engineering and technical direction. Advanced development planning and technology have been allocated efforts of 9% and 6% respectively.

The specific tasks of the Corporation, particularly those associated with systems planning and systems engineering, are too comprehensive to describe in detail in this paper. Some examples of representative MITRE tasks in these areas are:

(1) Assisting ESD in analyzing the enemy threat and potential challenges to the US military posture; in evaluating the capability of present, planned, and hypothetical force structures to meet specific challenges; and in selecting

optimum plans for providing systems of improved capability.

(2) Assisting ESD in formulating Planning Study Requirements, and in technical evaluation of contractors' proposals.

(3) At the specific request of ESD, providing technical direction to contractors performing planning studies and evaluating the results.

(4) Conceiving new system designs based on existing knowledge and predicted advances in science and technology.

(5) Performing system analysis, research, experimentation, simulation, and exercises to evaluate conceptual designs.

(6) Provide preliminary functional specifications for systems proposed for development.

(7) Analysis of system requirements.

(8) Formulation of system performance objectives including reliability and maintainability and the general specification for system performance and design requirements.

(9) System continuity, integration, and technical adequacy of system interfaces.

(10) System trade-offs including cost effectiveness.

(11) System design feasibility and state-of-the-art assessment.

(12) System preliminary design verification.

(13) System phasing and scheduling.

(14) Integration and utilization of engineering documentation.

(15) Technical review of system performance and design requirements specification and end item detail specifications.

III. ORGANIZATION AND STAFFING

A. ORGANIZATION CHART

(See Tab A)

B. STAFFING (As of 7 April 1971)

Professionals	1069
Technicians	139
Mission Support	946
Executives	8
Total Personnel Strength	2162

C. PROFESSIONALS BY DEGREE

(1) Distribution by Level of Degree

No Degree	2%
Bachelors	37%
Masters	49%
Doctorates	12%
	100%

(2) Distribution by Degree Field

Electrical Engineering	38%
Mathematics	17%
Other Engineering	10%
Physics	12%
Others (Operations, Research, Business, Social Science, etc.)	23%

(3) Distribution by Years of Experience

Years	
0 - 4	4%
5 - 9	16%
10 - 14	23%
15 - 19	21%
20 - 24	24%
25 and Over	12%

(4) Total Professional Departures

	Voluntary		Involuntary		Totals	
	1969	1970	1969	1970	1969	1970
Employee Departures	72	36	14	54	86	90
% of Average Strength	7%	3%	1%	5%	8%	8%

IV. REAL PROPERTY DATA (MITRE - Bedford Operations)

FACILITIES

Five Buildings	-	466,325 sq. ft.
Cost of Buildings	-	$9,235,000

LAND

Cost	-	$922,240.00
Size	-	103.4 acres

V. PROGRAM

During fiscal year 1970, the MITRE sales volume was $46.2 million of which work for the Air Force Systems Command's Electronic Systems Division and other Department of Defense agencies represented 78% of the total. Work for other Federal agencies (FAA, DOT, HEW, etc.) totaled 12.3%, with the balance of 9.7% being principally done for state agencies.

Air Force	$28.6 (Millions)
Other DOD	7.5
Other Federal Government	5.7
Others (Diversified)	4.4
Total MITRE Corp	$46.2 (Millions)

FUNDING HISTORY (Air Force Contract Only)

	Air Force Basic RDT&E Program (P.E. 65706F)	Other Air Force Separately Funded Programs	Totals
FY 61	$19.0	$ 5.2	$24.2
FY 62	16.5	12.7	29.2
FY 63	14.6	10.1	24.7
FY 64	14.0	18.8	32.8
FY 65	13.0	16.2	29.2
FY 66	12.5	15.0	27.5
FY 67	12.5	16.0	28.5
FY 68	$12.5	$14.2	$26.7
FY 69	12.5	14.7	27.2
FY 70	11.2	17.4	28.6
FY 71	7.0	17.3	24.3

Funding Profile for Department of Defense Customers Other Than Air Force (Army, Navy, ARPA, DCA, DSPG, etc.)

FY 67	$ 4.6 (Millions)
FY 68	5.7
FY 69	7.0
FY 70	7.5
FY 71	8.1*
Total	$32.9 (Millions)

Funding Profile for Corporate Diversified (Domestic) Work

FY 67	$ 0.2 (Millions)
FY 68	1.0
FY 69	2.5
FY 70	4.4
FY 71	5.4*
Total	$13.5 (Millions)

* Estimated

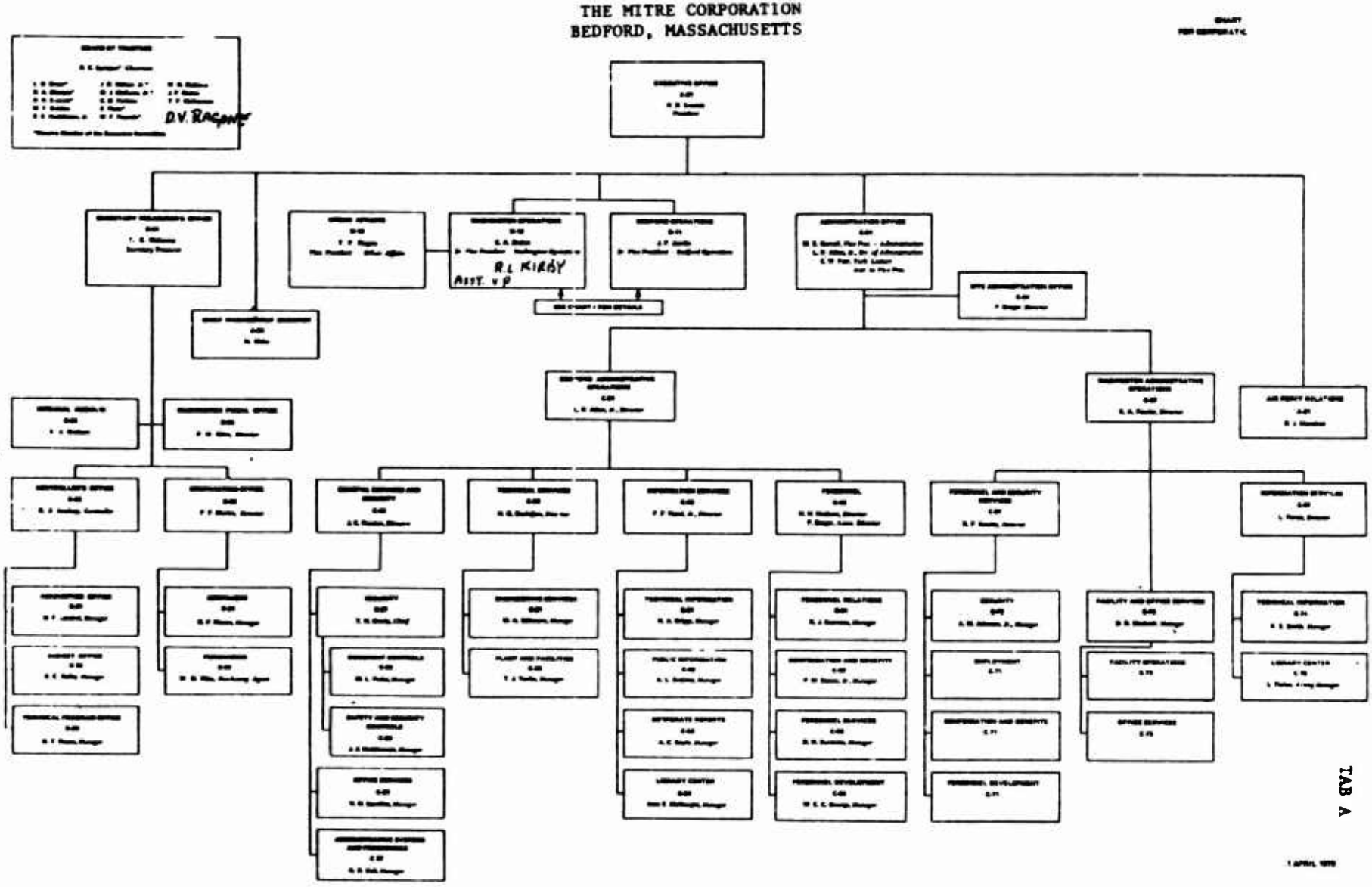
VI. SUMMARY

The MITRE Corporation was created in response to the need for a systems engineering organization to operate during the acquisition of a major air defense warning system. That task was accomplished successfully, and the corporation has gone on to other similar, although smaller tasks, moving toward its current pattern of diversification outside of strictly DoD tasks. No problem of the magnitude of the original task appears likely according to any announced plans of the DoD.

The majority sponsor of the firm's activity is still clearly the Air Force, which governs it relationships with MITRE through a careful and successful set of procedures based on a clear set of principles. The firm is well managed along conservative lines and has earned the respect and trust of those with whom it deals, both inside and outside of the Air Force.

The need for systems engineering competence in the area of MITRE's specialization continues, and some organization of the same or similar capability must exist, although alternative forms are possible. One alternative is

THE MITRE CORPORATION
BEDFORD, MASSACHUSETTS



TAB A

obviously that the MITRE Corporation could convert to a profit-oriented company, a move that has both advantages in its general business acceptability and disadvantages in the legal complications that would be required and possible loss of acceptance by other commercial firms. Still other alternatives would be for the Air Force to turn to a different profit-oriented corporation or to seek an accommodation with a university or a complex of universities.

The capability required does not now exist in any of the alternatives but the first, and it would have to be created with all of the accompanying costs in both time and money. MITRE Corporation has performed efficiently and economically in its system engineering/technical direction role, and the task group concludes that its continuance is in the best interest of the defense establishment.

BLUE RIBBON PANEL TASK GROUP REPORT ON

THE AEROSPACE CORPORATION

I. GENERAL INFORMATION:

A. ESTABLISHMENT:

1. Date - June 1960

2. Name of FCRC - The Aerospace Corporation

3. Location - El Segundo, California

B. HISTORICAL SUMMARY:

The Aerospace Corporation was established by the Air Force as a result of congressional criticism and problems encountered in the use of a profit corporation for support in the ballistic missile field. In order to maintain objectivity in a profit corporation, it was necessary to place a ban on production of hardware by same corporation which performed the system design, and integration functions. Although this hardware ban might be acceptable to a profit corporation for a single system, no corporation was willing to accept the across-the-board ban on production of hardware felt to be necessary to qualify the profit corporation to support the Air Force in development of multiple space and missile systems.

The Aerospace Corporation was chartered as a private nonprofit California corporation with the following purpose:

> "To engage in, assist and contribute to the support of scientific activities and projects for, and to perform and engage in research, development and advisory services or for, the United States Government."

Although the corporation was assigned responsibility in the complete field of Air Force ballistic missile and space systems, the responsibility for the MINUTEMAN program has not been transferred from the profit corporation which had that responsibility at the inception of the Aerospace Corporation.

C. COMMAND AND SUPPORT:

Relationships between the commander, USAF Space and Missile Systems Organization and the President, Aerospace Corporation regarding technical management on those system programs where Aerospace has been contractually assigned the role of performing general systems engineering and recommending technical direction are set forth in Appendix 2A to the Aerospace response to the DOD FCRC Study Group.

APPENDIX 2A

MEMORANDUM OF UNDERSTANDING ON RELATIONSHIPS IN THE CONDUCT OF GENERAL SYSTEMS ENGINEERING AND TECHNICAL DIRECTION

This memorandum sets forth the basic understanding between the Commander, Space and Missile Systems Organization (hereinafter called SAMSO) and the President, The Aerospace Corporation (hereinafter called Aerospace) regarding the performance of technical management by the Air Force and Aerospace on those system programs where Aerospace has been contractually assigned the role of performing General Systems Engineering and recommending Technical Direction (hereinafter called GSE/TD). The matters covered in this agreement are to apply both to system programs for which SAMSO carries the management responsibility and to those under the management of other Air Force organizations resident at SAMSO for which the GSE/TD support is contractually provided through the SAMSO/Aerospace contract. Nothing contained in this memorandum is to be construed as altering or modifying any contractual provisions between the Air Force and Aerospace. In the event of any conflict between the provisions of this memorandum and the said contractual provisions, the latter will govern. The sole purpose is to set forth clearly an understanding between the principals of the basic operating responsibilities and the interface operating relationships between the Air Force, Aerospace, and the agencies and contractors involved.

1. On certain system programs, the Air Force has chosen to contract with Aerospace for the performance of GSE/TD. GSE is defined as that portion of system engineering dealing with the over-all integration of a system, design compromises among subsystems, definition of interfaces, analysis of subsystems, and supervision of system testing, all to the extent required to assure that the system concept and objectives are being met in an economical and timely manner. TD is defined as that process by which the contractor's technical effort is modified, realigned or redirected by the Air Force based principally on recommendations generated by The Aerospace Corporation as a result of general systems engineering analyses, reviews of the contractor's work, exchanges of information on progress and problems and discussions of plans for future work. Aerospace work includes the performance of General Systems Engineering, the appraisal of contractor performance and the submittal of recommendations to the Air Force on a continuing basis as to the Technical Direction which should be given to the contractor(s). These recommendations and the analysis which support them form the principal technical basis upon which the Air Force decides what direction is to be given. All direction to the contractor(s)

is given solely by the Air Force. Aerospace recommendations for modification, realignment or redirection of a contractor's effort which would involve formal contractual implementation are to be accompanied by a written "Technical Recommendation" outlining the reasons for the recommendation and defining the proposed change in appropriate form to facilitate the Air Force's implementation through an appropriate contract modification. The manner in which the Air Force and Aerospace interact with respect to the Air Force's decision on whether or not to implement Aerospace's recommendations is outlined in the subsequent sections.

2. For each program the Commander of the responsible Air Force organization resident at SAMSO will designate an Air Force officer as the System Program Director with over-all management responsibility for all aspects of the program. In this capacity, the System Program Director will act with the authority delegated to him in discharging his over-all responsibility for the conduct and management of his program.

3. The President of Aerospace will designate a Systems Engineering Director for each program for which the Corporation is assigned GSE/TD responsibility to the Air Force for GSE/TD. The Systems Engineering Director will be delegated authority in Aerospace which will provide him control over the Aerospace GSE/TD activities analogous in level and scope to the authority the System Program Director is delegated for over-all program management.

4. As in the case with any contractor to the Air Force, Aerospace manages and directs its internal operations within approved manyears of effort for each program as a separate but related entity, recognizing that its responsibilities interact with those of the Air Force in determining action to be taken with respect to associate contractors and other Government activities. The basic function of Aerospace GSE and recommendations concerning technical direction is the timely identification of all reasonable alternatives and the thorough, complete and competent analysis of these on a system engineering basis in order to provide a sound basis for selection, decision and (where appropriate) implementation by the Air Force. It is the function of the internal Aerospace technical management to insure that this is done on a continuing basis at the highest level of technical validity.

5. The relationships of the System Program Director and the Aerospace Systems Engineering Director is that of a team, representing respectively, the Air Force and Aerospace in their respective over-all program management and GSE/TD roles. While Aerospace works only in technical areas, the division of responsibilities between the Air Force and Aerospace does not involve assigning technical matters exclusively to Aerospace or excluding Aerospace from information on management problems. There must be a close working relationship between the two individuals, one representing the Government, the other Aerospace. Within the scope of the Aerospace contract the System Program Director provides guidance to the Aerospace

Systems Engineering Director. In turn, the Systems Engineering Director, within the allocation of GSE/TD resources agreed to between the Commander of the responsible Air Force organization resident at SAMSO and the President of Aerospace Corporation, carries out the GSE/TD process so as to provide technical analyses, including alternate possibilities, in a timely manner, exercises initiative in technical areas, and provides technical counsel and recommendations to the System Program Director, which serve as the principal technical basis of the Technical Direction to the contractors.

6. The Aerospace Systems Engineering Director will keep the System Program Director continually informed on the results of his system engineering, on his views of the associate contractor's work, and particularly on his recommendations and the background for them. The System Program Director will review the potential effects of the Aerospace technical recommendations on the program, conduct any necessary studies and analyses in his organization, take into consideration all other relevant factors, review his proposed decisions with the Systems Engineering Director, and endeavor to reach mutual agreement on the best course of action and the proper decision for the program. The System Program Director will make his decision as to the direction to be issued. Prior to issuance of all direction, the Air Force will advise Aerospace, at the System Engineering Director level, regardless of the source or basis of the direction. All direction to the contractors will be given by the Air Force. Formalization of direction will be by appropriate contract modification.

7. If the Aerospace Systems Engineering Director believes that the System Program Director's technical decision is not in the best interest of the program, he shall so inform the System Program Director and request a higher level in Aerospace to review it with the Air Force. Whenever practical, implementation of the decision will be withheld pending the review. If not otherwise resolved, ultimate referral shall be to the Commander of the Air Force organization responsible for program management resident at SAMSO and the President of Aerospace. The Commander's decision will be final. In the event that agreement is not reached at this level the objection expressed by Aerospace will be documented and the official Aerospace contract file appropriately noted.

8. Regardless of internal assignment of responsibilities and regardless of where actions initiate, it is important to have a single channel of official communications to external organizations. The Air Force is solely responsible for such communications with other parts of the Air Force, with other Governmental agencies, and, except for purely technical matters, with the associate contractors. Both Aerospace and the Air Force may communicate and discuss technical matters with the associate contractors, and Aerospace is expected to exercise initiative in System Engineering matters. Aerospace will review with the Air Force Program Director all correspondence relating to or mentioning work pertaining

to his program prior to transmittal of such correspondence. The Air Force will inform the Aerospace Systems Engineering Director of all technical correspondence to contractors of the program to which he is assigned prior to issue.

9. The Air Force and Aerospace should carefully coordinate the planning and conduct of meetings involving Aerospace with Air Force associate contractors to provide the best results for the program. Such meetings can be classified into one of three categories described below depending on the purpose of the meeting:

a. Meetings in which the Air Force plans to direct the contractors or negotiate a matter using the results of technical work done by Aerospace and desires that Aerospace be present in a technical supporting role. Such meetings are scheduled and chairmaned by the Air Force in accordance with a plan coordinated with Aerospace.

b. Meetings in which Aerospace is interchanging technical information with one or more associate contractors in order to carry out the Aerospace contractual tasks of general systems engineering, review and evaluation of a contractor's work or formulation of technical recommendations for subsequent submittal to the Air Force. Such technical interchange meetings are scheduled and chairmaned by Aerospace and in each instance are coordinated with the Air Force. The Air Force Program Director will decide whether or not to have Air Force representatives present to monitor such meetings. It is Aerospace's responsibility to keep minutes and to distribute them to the Air Force and the associate contractorBs).

c. Meetings in which the Air Force intends to discuss management or administrative matters with an associate contractor where the subject is either non-technical, so that Aerospace support is not needed, or involves technical matters, at least in part, but Aerospace attendance at the meeting is not desired for policy reasons. Such meetings are scheduled and conducted by the Air Force with coordination with Aerospace as may be required to obtain any technical data needed from Aerospace before the meeting and to avoid potential schedule interference with technical interchange meetings.

10. In programs where Aerospace is performing GSE/TD, the highest Air Force level of organization to whom Aerospace is responsible for work is the Commander of the responsible Air Force organization resident at SAMSO. In presentations and discussions up to and including these commanders, Aerospace may select subjects and speakers as desired. However, in all presentations to any higher level within the Air Force, or to any level outside the Air Force, regardless of when such presentations are made, participation by Aerospace personnel is interpreted as representing the positions of the resident Commander, and of Aerospace. Accordingly such

participation will be carefully coordinated and the Aerospace participants carefully selected by mutual agreement to portray the viewpoints desired.

11. When a GSE/TD role is established for a system program the Air Force will incorporate the enabling clause attached in the associate contractor's contracts to authorize and/or obligate the associate contractors to take certain actions and/or to cooperate with Aerospace in certain defined areas.

12. This policy is supplemented by SAMSO Regulation u75-6 and Aerospace Policy 7.5-. These documents provide policy guidance and procedures for the accomplishment of research and development work on R D D programs where Aerospace is assigned GSE/TD responsibilities.

13. This Memorandum of Understanding supersedes and replaces the Memorandum of Understanding of the same title dated u0 April 1962.

Ivan A. Getting /s/	Samuel C. Phillips /s/
IVAN A. GETTING	SAMUEL C. PHILLIPS
President	Lieutenant General, USAF
The Aerospace Corporation	Commander
	Space and Missile Systems Organization

Attachment: Enabling Clause for GSE/TD

II. MISSION, TASKS AND FUNCTIONS:

A. MISSION:

"To aid the United States Air Force in applying the full resources of modern science and technology to the problem of achieving those continuing advances in ballistic missile and military space systems which are basic to national security." (Appendix 1A to Aerospace Response to the DOD FCRC Study Group)

B. TASKS AND FUNCTIONS:

Specific tasks and functions originally assigned to the Aerospace Corporation are enumerated in the Aerospace Corporation Mission Statement, Appendix 1A to the Aerospace Corporation Response to the DOD FCRC Study Group.

ATTACHMENT TO MEMORANDUM
OF UNDERSTANDING

ENABLING CLAUSE FOR
GENERAL SYSTEMS ENGINEERING AND TECHNICAL DIRECTION

A. This contract covers part of the (number or name) program which is under the general program management of the /enter either "Air Force Space and Missile Systems Organization (SAMSO)" or, "Secretary of the Air Force, Special Projects (SAFSP)" as appropriate/. The Air Force has entered into a contract with The Aerospace Corporation for the services of a technical group which will, under the supervision of /enter either "SAMSO" or "SAFSP (SP-10, SP-7, etc.)"/, be responsible for general systems engineering, appraisal of contractor performance and the submittal of recommendations to the Air Force on a continuing basis as to the technical direction which should be given to the contractors of the (number or name) program including the efforts under this contract.

B. 1. General Systems Engineering is defined as that portion of systems engineering dealing with the over-all integration of a system, design compromises among subsystems, definitions of interfaces, analysis of subsystems and supervision of system testing, all to the extent required to assure that system concept and objectives are being met in an economical and timely manner.

2. Technical Direction is defined as that process by which the contractor's technical effort is modified, realigned or redirected by the Air Force based principally on recommendations generated by The Aerospace Corporation as a result of reviews of the contractor's work, exchanges of information on progress and problems and discussions of plans for future work.

3. In the performance of this contract, the contractor agrees to cooperate with The Aerospace Corporation by responding to invitations from authorized personnel to meetings, by providing access to technical information and research and development planning data (in their original form or reproduced form and excluding financial data), by delivering data as specified on the Contract Data Requirements List, and by discussing technical matters relating to this program. Subject to applicable security procedures, Aerospace Corporation personnel engaged in general systems engineering effort pertaining to work under this contract are authorized access to any technical information concerning work under this contract.

4. The contractor further agrees to accept technical direction as follows:

a. Technical direction under this contract will be given to the contractor solely by /enter either "SAMSO" or "SAFSP (SP-10, SP-7, etc.)" as appropriate/. While The Aerospace Corporation is responsible for

recommending technical direction to the Air Force, Aerospace Corporation personnel are not authorized to direct the contractor in any manner.

b. Formalization of technical direction, where appropriate, will be by issuance of Change Orders or Supplemental Agreements (ASPR 1-201) in the Contract executed by an authorized representative of /enter either "SAMSO" or "SAFSP (SP-9)" as appropriate/ after coordination with an authorized representative of The Aerospace Corporation.

c. The contractor shall comply with technical direction only after it is received in writing, signed by the contracting officer.

Extract from the Aerospace Corporation's Response to the DoD FCRC Study Group's Inquiry

APPENDIX 1A

AEROSPACE CORPORATION MISSION STATEMENT*

The mission of The Aerospace Corporation is to aid the United States Air Force in applying the full resources of modern science and technology to the problem of achieving those continuing advances in ballistic missile and military space systems which are basic to national security. The Aerospace Corporation is responsible for providing the Air Force missile and space efforts with an organization which is objective, possessing high technical competence and is characterized by permanence and stability. The Aerospace Corporation will provide a vital link between the Air Force and the scientific and industrial organitations in the country with a capability and an interest in the ballistic missile and space field. The Corporation, through its unique role, will help to insure that the full resources of the nation are properly applied and that the potential advances in the missile and space field are realized in the shortest possible time.

The Aerospace Corporation is responsible under over-all Air Force program management for advanced systems analysis and planning, research, experimentation, initial systems engineering, initial technical direction and general technical supervision in the complete field of Air Force ballistic missile and space systems. The Aerospace Corporation will work closely with the Air Force in long-range planning, systems analysis and systems comparison studies. It is intended that it will review ideas and concepts generated throughout industry and Government and help insure the proper interaction between military requirements and technical capability. This detailed analysis, together with appropriate supporting experimentation, will provide the soundest possible basis for the initial engineering specifications of a system, including the subsystem requirements, specifications, interactions and interfaces. This initial systems engineering work will provide the basis for Requests for Proposals to the industry.

After a development program has been initiated, the Corporation by virtue of its relationship with the Air Force and its technical capabilities, will have the responsibility, through technical review, monitoring and steering, to insure that technical deficiencies and weaknesses are isolated, that the impact of new data, new developments and modified requirements on total system concepts is properly assessed, and that accordingly appropriate changes are introduced promptly.

*Forwarded by the Acting Secretary of the Air Force on May 24, 1960, to the Chairman of the Organizing Committee of the Aerospace Corporation.

Accordingly, although it is intended that the detailed development systems engineering and detailed technical direction will be the responsibility of normal private industry, special cases may, of course, arise where assumption of detailed systems engineering and detailed technical direction functions by the new corporation may be required by the Air Force. This, however, would be an exception to the normal responsibilities which the Corporation would have in the Air Force missile and space programs. Decisions relative to such exceptions would be made on an individual basis by the Secretary of the Air Force.

In order to properly execute its responsibilities, the Aerospace Corporation must attract and retain personnel of high technical ability. The Corporation will seek through its policies and structure to provide the type of environment that can insure the development and retention of this kind of capability.

III. STAFFING:

The Aerospace Corporation had on board 1613 Members of the Technical Staff (MTS) as of 1 March 1971. Of these scientists and engineers, over 56% have received advanced degrees and approximately 20% have doctorates. The technical work force numbered 290 at the end of 1960 and reached its highest average level (1,906) in 1966. There has been a steady decline in technical population since that time. Average turnover rate has been about 5% since the establishment of the Aerospace Corporation and about 5.3% in 1970. The steady decline in the size of the organization coupled with the necessity of keeping a mature work force makes it difficult for the corporation to hire young, aggressive scientists and engineers. The result of this is an aging population in the MTS.

IV. REAL PROPERTY DATA:

The Aerospace Corporation has invested $6.7M in land and buildings at San Bernardino, California and $12.M in land and buildings at El Segundo, California. Other facilities are provided by the government for corporate use at Cape Kennedy, Vandenberg and El Segundo. Aerospace currently operates three digital computing centers owned

or leased by the Air Force in El Segundo and San Bernardino. In addition, Aerospace operates Air Force laboratory facilities devoted to the fields of electronics, aerodynamics, propulsion, materials, science and plasma. The corporation purchases equipment for its own research program, the largest of which is the solar observatory with its 24-inch telescope and other equipment.

V. PROGRAM:

A. SPONSORS:

Virtually all of the Aerospace tasks are in direct response to contractual commitments to the Air Force. Some of these commitments are directly for the Air Force, and others are for different government agencies who transfer funds to the Air Force and whose needs are then included in the Air Force contract with Aerospace.

B. FUNDING:

Funding of Aerospace activities has always been over 90% from the Department of Defense and is expected to be about 92% in FY 71. Although the majority of the

balance comes from other parts of the Federal Government, there has been a steady increase in non-Federal Government funding which is currently about 2%. The FY 71 estimates are $69.3M for DOD, $4.5M for other Federal agencies and $1.5M for non-Federal Government activities. A detailed funding profile for the past five years is contained in Appendix 7 of the Aerospace Response to the FCRC Study Group.

Extract from the Aerospace Corporation's Response to the
DoD FCRC Study Group's Inquiry

APPENDIX 7A

DETAIL OF FUNDING PROFILE FOR PAST 5 YEARS -FEDERAL FUNDS

Sales by Source of Funding - Last 5 Years

	FY 1966	FY 1967	FY 1968	FY 1969	FY 1970	Estimated FY 1971
	(Dollars in Millions)					
Department of Defense						
USAF *	71.282	73.911	71.148	72.494	64.845	65.473
Army	1.082	1.241	1.662	1.698	2.766	2.373
DASA	--	.092	--	--	.052	.203
ARPA	.235	.554	.371	.224	.668	1.306
	72.599	75.798	73.181	74.416	68.331	69.355
Federal Government (Other)						
NASA	4.554	2.133	.827	.844	3.375	4.043
ACDA	.184	.129	.091	--	--	--
HEW	--	--	.002	.088	.135	.399
CWB	.003	--	--	--	--	--
Geological Survey	--	--	--	--	.002	.095
	4.741	2.262	.920	.932	3.512	4.537
Total Federal Government	77.340	78.060	74.101	75.348	71.843	73.892

* Includes funds for support to DCA and other agencies where funds are covered by Air Force appropriations.

Extract from the Aerospace Corporation's Response to the DoD FCRC Study Group's Inquiry

APPENDIX 7B

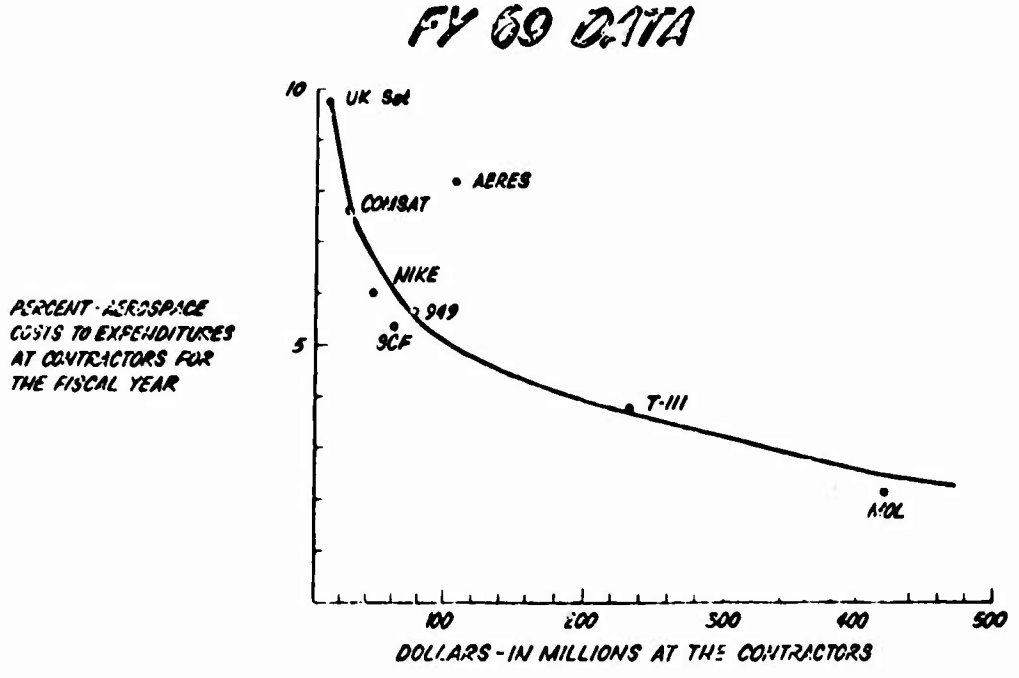
DETAIL OF FUNDING PROFILE FOR PAST 5 YEARS - NON - FEDERAL FUNDS

Sales by Source of Funding - Last 5 Years

	FY 1966	FY 1967	FY 1968	FY 1969	FY 1970	Estimated FY 1971
			(Dollars in Millions)			
Non-Federal Government						
United Kingdom	--	.437	.805	.713	.531	.673
NATO	--	--	.039	.175	.370	.401
NAS	--	--	.147	.042	.025	.224
COMSAT	--	--	--	--	--	.122
Western States	--	--	--	--	.165	.020
City of Los Angeles	--	--	--	--	.026	--
CNES (France)	--	--	--	--	--	.003
Jet Propulsion Labs	--	--	--	.041	.044	.010
Total Non-Federal Government	--	.437	.991	.971	1.161	1.453

C. IN-HOUSE/OUT-HOUSE:

None of the Aerospace Corporation's technical work is contracted out. Aerospace provides technical support in SAMSO in the selection of industrial contractors and contracting out the required work. During FY 71 Aerospace was assigned a system engineering role on SAMSO programs totaling some $1 billion with industrial contractors. The ratio of Aerospace costs to expenditures at the contractors for FY 71 is shown in a chart on p. 9-1, Volume I of the Aerospace response to the FCRC Study Group.



VI. INTERFACE WITH OTHER DOD COMPONENTS AND FCRC's:

The Aerospace Corporation, as a member of the SAMSO/AF/DOD team, shares information regarding concepts and requirements with all elements of DOD. Military program offices have their counterparts within Aerospace and are often co-located for close liaison. Particularly in the areas of research and planning, Aerospace carries out constant coordination with all relevant DOD laboratories and organizations. Particularly close links are maintained with FCRCs such as Lincoln and MITRE, which are maintained with RAND and IDA in the areas of planning.

VII. SUMMARY

For several years, the total annual sales of the Aerospace Corporation have remained nearly constant at approximately $75 million. Of these, about two-thirds, or $50 million, are spent on Systems Engineering/Technical Direction of programs which are sponsored by SAMSO at a total annual cost of some $1 billion; thus the cost to the Air Force for Aerospace's systems engineering work is 5% of the total program cost. Of the remaining roughly 30% of Aerospace's efforts, exclusive of systems engineering,

some 20% is devoted to development planning and technology and some 10% to research which is carried out at the Aerospace Corporation Laboratories; all these latter activities are intended to support the primary systems engineering activities.

From the coarse summary breakdown presented above, it is clear that systems engineering/technical direction is Aerospace's principal role. That such a role is indispensable and exerts great leverage need not be belabored here. There remain two principal issues:

Is Aerospace the appropriate organization to play this role?

Is the current mix at Aerospace between systems engineering and supporting research, technology and planning appropriate? In particular, how should the Aerospace Corporation Laboratories be constituted?

Implicit in these questions is the consideration of alternatives. To maintain focus on the issues peculiar to Aerospace, we bound the alternatives by assuming that neither the Civil Service system nor the treatment

of FCRC's --- save for a more rational approach to ceilings --- changes drastically. While the merit of such changes may be argued, their likelihood is small; moreover, such changes, if they occurred, would extend far beyond Aerospace.

Is Aerospace the appropriate organization to play the system engineering role for SAMSO?

Since SAMSO has effectively no civilian technical staff, the abolition of Aerospace would have to be counter-balanced by the creation of a phantom-Aerospace organized as either a new in-house government activity, a new private corporation, or a new element of an existing private organization. In all three cases, the bulk of the new entity's staff would likely be drawn from the present Aerospace staff. Since the latter two alternatives would be at best only a cosmetic change to the present arrangement with Aerospace, they warrant no further discussion here. If Aerospace were to be federalized, most employees need not receive salary cuts. However, the management structure would be truncated, if not castrated, in the process; emasculated system engineering/ technical direction is presumably impotent. Moreover,

salaries apart, the mechanics of the Civil Service system are not matched to the needs of a dynamic, highly technical organization doing systems engineering on a variety of programs. The few countermeasures (e.g., the Navy's Special Projects Office for Polaris, the Air Force's Aeronautical Systems Division for aircraft) which are sometimes cited are more the exceptions which prove the rule.

On balance, it appears that abolition of Aerospace offers no net advantage whatsoever to the government. It must be noted that i) Aerospace does not provide systems engineering on all SAMSO programs and ii) the brief duration of this study did not permit a detailed evaluation of how well Aerospace is performing its systems engineering role for SAMSO. However, neither of these disclaimers detracts from the major conclusion that:

> SAMSO's current use of Aerospace for systems engineering/technical direction is appropriate and is preferable to other alternatives considered.

> Is the current mix at Aerospace between systems engineering and supporting research, technology,

and planning appropriate? In particular, how should the Aerospace Corporation Laboratories be constituted?

As we have seen above, roughly two-thirds of the Aerospace efforts are devoted to systems engineering/ technical direction with some 20% devoted to development planning and technology and some 10% to research. The crucial point to recognize here is that just as systems engineering exerts considerable leverage on the schedule, cost, and performance of a program, so also do supporting research and technology exert considerable leverage upon ongoing and anticipated systems engineering efforts. Because of their more obviously demonstrable connection with program activities, systems planning and technology fare relatively well: the need for them is recognized and their share of total funding is not so heavily contested. Research, clearly labeled, has more of an uphill struggle, despite the fact that historically, one of the major shortcomings of defense research and development has been the chasm between the researcher and the system designer/ developer. Aerospace, as well as some other FCRC's, has provided a mechanism for bridging this chasm very effectively.

In anticipation of the inevitable call for justification of its research efforts, Aerospace prepared two bulky documents on the accomplishments and cost-effectiveness of the Aerospace Corporation Laboratories. Stripped of their rhetoric and self-serving flavor, these reports make a strong case that the research activities benefit the program efforts both indirectly, on a long-term basis, as well as directly, on a short-term basis, since slightly more than half of the researchers' time is applied to current systems problems.

Aerospace's research activities cost 10% of the Aerospace budget, i.e., less than 1% of the cost of the programs on which Aerospace supplies systems engineering/technical direction. Anyone versed in the development of large-scale military systems recognizes that only a modest amount of ignorance is needed to cause a 1% price increase and that, conversely, timely application of research can frequently produce 1% savings.

We discussed above the disadvantages of abolishing and reincarnating the Aerospace Corporation. The selective

abolition of the research laboratories, with or without reincarnation, has even less to commend it. The disclaimers noted above concerning the entire Aerospace Corporation apply also to the Laboratories. We conclude that:

> The research, technology, and planning activities at Aerospace are not excessive compared to the primary systems engineering/ technical direction efforts. Specifically, the Aerospace Corporation Laboratories should remain an integral part of Aerospace,

REPORT OF TASK GROUP III

FCRC LABORATORIES

TASK GROUP CHAIRMAN

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CONTENTS

FCRC Laboratories

Task Group III was assigned the responsibility for the four university-operated defense laboratories which have been included in the Federal Contract Research Center (FCRC) category. These are the Lincoln Laboratory of the Massachusetts Institute of Technology, the Ordnance Research Laboratory of the Pennsylvania State University, the Applied Physics Laboratory at Johns Hopkins University, and the Applied Physics Laboratory at the University of Washington. The task group received briefings by each of the laboratories and their sponsors within the Services, and visited each laboratory to see work in progress at firsthand.

Conclusions

The major conclusions of the task group are that each of the laboratories is carrying out high quality research, experimentation, and engineering demonstration in product areas of critical importance to their sponsors; that the laboratory efforts are technical as distinct from managerial, and do not fill a management role of the Services; that the laboratory operation, carried out under the constraints of a public or quasi public university, has been free of excesses which might be regarded as inappropriate to an organization in the public domain; that possible alternative arrangements offer no advantages

and present several disadvantages; and that the distinction between these laboratories and those which were removed from the FCRC list by the Congress in 1964 is minor.

Recommendation

The major recommendation of this task group is to remove these laboratories from the list of FCRCs and so notify the Congress.

Background: The university-operated defense laboratories are characterized by a common history. The onset of World War II presented the United States with the need to translate the science and technology of 1940 into operational systems and subsystems as rapidly as possible for survival. The universities were a major repository of the technical capability in the nation and as public or quasi public institutions were asked to build teams to achieve this result. The role of universities in the conduct of the Manhattan Project and the MIT Radiation Laboratory is universally known, but the underwater research laboratories at Harvard University and at the University of Washington, and the operational research and engineering group at Johns Hopkins, were equally important to their more limited domains. After victory was achieved in World War II, several of these universities

and the Armed Services agreed that continuation of this work was in their mutual interest. Thus, while Lincoln Laboratory was not specifically formed until 1951, it is a direct descendant of the MIT Radiation Laboratory and has maintained an outstanding competence in electronics and radar, data processing, and communications, and command and control. Similarly, the laboratories at Johns Hopkins University and the University of Washington are continuations of the World War II efforts initiated at those schools.

Not all of the universities felt that continuation of their wartime work was in the long term interest of their fundamental educational objectives. Harvard University desired to terminate its underwater research efforts undertaken during the war, but the Navy needed to continue the work. In this case, the Harvard group split up into two units. The first unit moved to New London to become what is now the Naval Undersea Systems Center. When the Pennsylvania State University found the underwater fluid mechanics and propulsion compatible with their institutional educational objectives, the second offshoot of the Harvard University group moved and became the Ordnance Research Laboratory at Penn State.

The Product: All of these laboratories have since their inception worked primarily on applied research in the physical sciences or engineering. Past experimental work has resulted in new devices or pieces of equipment. A seven-bladed propeller to reduce noise in torpedoes and IR sensor arrays for imaging the infrared radiations from various objects are examples. These labs have developed new techniques, as in the processing of data or the analysis of fluid mechanics, and used these techniques together with state-of-the-art devices to put together laboratory working-systems which prove or disprove a concept, or provide parametric data. Experimental satellites from Lincoln Laboratory played an essential role in the development of satellite communications systems; experimental torpedoes from ORL and APL-Washington have led to the development of operational torpedoes for the fleet; APL/Johns Hopkins' advanced multi-function radar development is the heart of the Fleet Air Defense system. A listing of laboratory accomplishments is contained in the individual lab reports.

The efforts of these laboratories have been of continuing value to program managers of systems under acquisition and development, but it must be emphasized that this value has come from the technical competence and not from the managerial or

administrative skill of the laboratories. In many cases the expertise of a laboratory has played a key role in overcoming a technical barrier that has arisen in the development of a system. In some cases this barrier has been bridged by directing laboratory effort to the problem after it has arisen, in others the barrier has already been bridged by laboratory development of components or subsystems before the need became a problem. In still other cases, a laboratory has filled a technical function by operating a one-of-a-kind system which they have designed for its effective operation. The management capability of each laboratory has been directed towards its own work, and has not been used to manage programs or systems for the Department of Defense components.

Institutional Controls: All four laboratories evidenced a salary and organizational discipline imposed by their parent university. Salaries of laboratory staffs are evaluated regularly by the same bodies that review faculty salaries, and are held at levels comparable to faculty and administration members of like stature. Organizational structure is subject to similar control. The Pennsylvania State University and the University of Washington are state universities whose operations annually undergo the

scrutiny of state governing bodies; Johns Hopkins and MIT receive similar reviews from their Trustees. Maximum salaries at the four laboratories do not exceed $45,000, and the salary spectrum is comparable.with both Civil Service and university scales. Facilities are provided by Government (Lincoln Lab) or universities and were judged by the task group to be modest but functionally adequate.

The laboratories have all evidenced a self-limiting and self-pruning aspect and have retained their basic nature of a creative laboratory engaged in scientific and engineering research, development and technical consultation and direction. Lincoln Laboratory spun off the Mitre Corporation in 1958 when the SAGE air defense system made the transition from development (creative engineering) to systems engineering and installation for an operational system. The Ordnance Research Lab and the Applied Physics Lab-Washington, turned over torpedo development and acquisition programs to the Naval Ordnance Systems Command when the creative engineering development was completed, and were involved subsequently only as their technical expertise was necessary to the successful accomplishment of the programs. APL/Johns Hopkins developed the concept and prototype of the TRANSIT navigation satellite, but after successful operation of

the prototype provided only technical know-how to the individual contractor selected for production.

A common ancestry of the Naval Undersea Systems Center and the Ordnance Research Laboratory provides a ready comparison of relative growth, an issue which has been of some sensitivity in the Congress. Table I gives the figures of five-year intervals from 1945, when the two groups were together at Harvard, up to 1970.

Table I

	1945	1950	1955	1960	1965	1970
ORL, PSU	58	67	91	82	134	167
New London	73	149	205	216	421	590

These manpower figures reflect both the increased requirement for research and development during the 1950s and 1960s, and the assignments of new ssion or transfer of existing personnel. It is noteworthy that the growth of the in-house laboratory has consistently been greater than the growth of the Ordnance Research Lab, and that clearly there has not been any attempt to use the university mechanism as a means of circumventing government manpower controls.

Alternatives: The task group considered possible alternatives by which the Services could obtain the product of the laboratories. In broad terms, there are two alternatives: The first is to establish in-house laboratories at Service installations, the second is to break the RDT&E programs of these laboratories into subcomponents which can be placed in other universities, in not-for-profits, or in industry. Transfer of the entire operation of a laboratory either to another university or to a not-for-profit corporation was dismissed because the efficiency and quality of work under the existing universities has never been an issue. Transfer in entirety to a profit corporation was dismissed because it would present an unfair advantage to the company selected.

The sole advantage of any alternative was judged to be the removal of the management problems associated with the Federal Contract Research Center tag. These management constraints tend to freeze the size and subject of the research program from 6 to 18 months before the fact, with changes governed more by the availability of "ceiling stamps" than by funds or technical merit. Possible advantages which were considered but not found include cost savings, responsiveness to the needs of the Service, availability of technical expertise to the Department of Defense, and objectivity and integrity.

The disadvantages of breaking up the lab and contracting out pieces would be the destruction of a center of expertise and experience in a technical field critical to the Department of Defense. The memory bank represented by each of these laboratories remembers what worked and what didn't and why. It remembers real, defense experience and not just technical facts. The many resulting research and engineering projects would have to be integrated into an effective program by in-house contract monitors to be effective. The task group did not determine whether the inefficiency of bringing scientists and engineers up to speed on a particular problem and the greater overhead costs necessitated by starting and stopping research projects would be compensated by the benefits of competition on a task-by-task basis. It does judge that the removal of an organization which has been an acknowledged leader in competition with all other organizations would cut productivity.

Alternative a, converting to an in-house civil service laboratory, must be regarded as possible in today's market for science or engineering talent. The $ investment in buildings and capital plant to move the Ordnance Research Lab and APL-Washington requires only military construction; none is necessary

in the case of Lincoln Lab which is located on a government facility, nor in the case of APL/Johns Hopkins which is a completely contained physical plant. The performance of the best in-house labs is competitive with Lincoln Lab, ORL, APL/Johns Hopkins and APL-Washington and we could in time anticipate achievement of equal quality. The existing institutions could be dismantled and restructured into operating in-house laboratories in from one to three years. In view of the Congressional criticism levied at FCRCs as a class of institutions, we could probably get the manpower ceilings. (Nevertheless, the possibility of being told to "take it out of your hide," exists.) In short, at the cost of replacing some existing facilities (estimated ~ $50 million), one year's non-productive operation (~ $100 million) and a successful effort to mold the military construction, manpower spaces, mission, and people together, the transition to a set of in-house laboratories could be accomplished.

Nevertheless, the collective judgment of the task group is that such an alternative which is possible on paper would be unwise in reality. There exists intangible but very real factors which argue for the present arrangement. First, there are a large number of high quality scientists and engineers who simply

prefer to be associated with a university. If these laboratories were to change from university sponsorship, many of the very best people would find alternative employment which would keep them in a university. Second, university professors tend to keep their best graduate students near themselves, and we would lose those top graduate students who are so important to the vitality of the FCRC laboratories. Third, MIT, Penn State, Johns Hopkins and the University of Washington are among the top universities in the country in the subject matter areas in which the FCRC laboratories are engaged, and have attracted the highest quality graduate students in the country to their engineering colleges. Thus, these laboratories bring to the Department of Defense programs a body of personnel who are selected from the top end of the spectrum on a national basis.

The task group judgment is that the present arrangement is more productive than any other alternative. To spend hundreds of millions of dollars to make a change to a less productive alternative does not appear wise.

The first listing of Federal Contract Research Centers, provided to the House Subcommittee Department of Defense Appropriations of the Committee on Appropriations (Mr. George Mahon, Chairman), identified 17 laboratories managed by educational

institutions. This list was presented in 1963 for the FY 1964 appropriations. In the FY 1965 hearings, 10 of these were dropped when DOD took the term "Federal Contract Research Centers" as referring "only to those centers which provide assistance in the planning, development, and executing of RDT&E programs but excludes research organizations performing research and development tasks and those engaged in operating technical facilities." The laboratories which were eliminated from the FY 1964 list in FY 1965 hearings were as follows:

Electronics Research Lab, Stanford University

Naval Biological Lab, University of California

Laboratory for Insulation Research, MIT

Arctic Research Lab, University of Alaska

Research Lab for Electronics, MIT

Columbia Radiation Laboratory,

Control System Lab, University of Illinois

Electronic Research Lab, University of California

Physical Research Lab, Boston University

A further correction was made when the Army Mathematics Center at the University of Washington was removed in 19

While the task group did not visit nor make extensive review of the laboratories removed from the FCRC list, they

have a collective familiarity and understanding of the nature of the research and development conducted by them. The research and development carried out by the university-operated defense laboratories is characterized by the fact that it is technical rather than managerial, that it is creative engineering and science as distinct from routine "job shop" effort, and that it is subject to overall university policy in substantially the same degree.

Neither the FCRC laboratories nor the university laboratories removed from the list could be characterized as "captive companies," the term Mr. Mahon used to define FCRCs in the FY 1965 hearings. University policies toward these laboratories reflect first their sense of obligation to the nation, and second a mutual respect between the Department of Defense and the university. Thus, while there are individual differences in the specific technical work undertaken among these university laboratories, their reason for being and their overall administrative relationships have essentially a common nature. There is a far greater distinction between these university laboratories and those systems engineering/technical direction or"think tank" not-for-profit organizations which are still

today essentially totally dependent upon the Department of Defense. Each university exists as a complete and independent entity without the Department of Defense and would primarily be affected by having to cut out the scope of its educational endeavors if the FCRC laboratory were terminated.

REPORT OF VISIT
TO
MIT LINCOLN LABORATORY
HANSCOM FIELD, BEDFORD, MASSACHUSETTS

In the late 1940's it was recognized that the USSR had the capability to deliver nuclear weapons on the U.S. A series of studies was conducted throughout the Nation concerning the best method of defense against this air-breathing threat. Personnel from MIT were involved deeply in these studies. MIT had developed the "Whi[illegible] computer for the Navy. This computer was the first large-sized digital computer, and planned solutions in response to the USSR threat were based upon the use of large computers of this type.

The unique expertise of MIT personnel and the availability of equipment were recognized by the Government, and on 31 January 1951 a contract was issued to MIT for establishment of the Lincoln Laboratory. The Laboratory was assigned the task of solving the problem of defense against the USSR air-breathing threat. This activity led to the development of the Semi-Automatic Ground Environment (SAGE) air defense system. In the late 50's, after completion of the first operational subsector, it became obvious that the proper course of action was for the Laboratory to divest itself of further activities associated with the installation of the remainder of the operational SAGE system. Accordingly, the MITRE Corporation was formed, primarily from the Laboratory personnel, for systems engineering of the SAGE system.

The Government recognized the value to the nation of the expertise at Lincoln Laboratory and determined that the Laboratory should be continued. It was recognized that the Laboratory functioned best when assigned a specific mission or problem area. Accordingly, in 1961 the chart of the Laboratory was written around two general mission areas. These were:

(a) Space Communications and (b) the observables associated with re-entry of ballistic missile re-entry vehicles. Subsequently, the Laboratory made significant contribution in these areas which have been vital to national defense effort.

The Lincoln Laboratory's mission and broad guidelines are stated below:

"The mission of Lincoln Laboratory is to carry out a program of research and development pertinent to national defense with particular emphasis on advanced electronics. In pursuit of this mission, the Laboratory shall:

a. Exert maximum effort toward the evolution and demonstration of feasibility of advanced electronic concepts and technology in selected national defense areas.

b. Conduct specific programs of research and development in these areas, including the building of necessary components, together with a vigorous continuing program of technology research and development in the fields appropriate to its mission.

c. Produce, or have produced, initial models of Laboratory-developed equipment suitable for field demonstration and test by appropriate military services or agencies, and furnish necessary procurement information and consultation regarding such equipment.

d. Provide technical advice and consultation in areas of its demonstrated competence to the military services and other Defense and Government agencies."

In order to effectively accomplish the mission of the Laboratory, the following general types of work are conducted.

Synthesis and analysis of new concepts

Applied research

Measurement of radio and optical phenomena

Device development

Component or subsystem development

Feasibility demonstrations

Scientific director of experimental programs for DOD

Consultation to Government

The Lincoln Laboratory program is monitored and directed in a manner unique among the Air Force FCRC's. The Joint Advisory Committee, the Executive Group and the working panels composed of "Laboratory Customers" review, adjust and approve the program in the spring and fall of each year. Additional reviews are conducted as appropriate. Generally speaking, the fall review is directed toward establishing the forthcoming two years' program and the spring review is primarily an evaluation of the progress of the approved effort.

The list of contributions to national security by the Laboratory is long and significant. Some of the more important of the contributions include the following:

a. The design and development of an experimental SAGE system which incorporated high-speed digital computers and radar data-transmission techniques. The SAGE was the first large real-time operational system which integrated radars and computers into an information system.

b. Design and development of the concepts and principal components of the Distant Early Warning (DEW) line system.

c. System concept and experimental hardware design of scanning and tracking radars for the Ballistic Missile Early Warning System (BMEWS).

d. Design and development of the Large Aperture Seismic Array (LASA) which detects underground nuclear explosions.

e. Design and development of six experimental communication satellites which demonstrated advanced spacecraft hardware components and subsystems.

f. Design and development of a series of complex advanced satellite communication terminals to include unique modulation equipment.

g. Conceptual design and deployment in space of experimental dipole belt used for communications.

h. Design and development of advanced radars (TRADEX, ALTAIR, ALCOR) and airborne instrumentation for measurements of the observables associated with ballistic missile re-entry vehicles. Study of these measurements have resulted in design of penetration aids (decoys, spoofers, etc.) as well as ballistic missile defense systems.

i. Development and demonstration of the world's first high-powered IR laser radar system for tracking space objects.

As can be seen from the above, the Lincoln Laboratory has provided invaluable contribution to national security during the last two decades. The Laboratory functions much like a "in house" Air Force laboratory in that it conducts advanced research, develops hardware and experimental systems yet maintains a realistic and appropriate balance between the

"ivory tower" and "tin bending" activities. The result has been a record of accomplishment that matches or exceeds other DOD Laboratories.

Suitable alternatives to Lincoln Laboratory were explored; however, no alternatives were identified which offered any significant advantages to the Government. The most likely alternative was assignment of the tasks now being conducted by Lincoln Laboratory to other "in house" Laboratories. It was determined that all "in house" Laboratories would require considerable augmentation in funding and personnel before the new tasks could be properly performed. Further, the primary source of the personnel would be the Lincoln Laboratory. The primary factor contributing to this situation in the DOD efforts to limit the tasks assigned to Lincoln Laboratory to those for which Lincoln is uniquely qualified.

An examination of the number of staff personnel (Figure 1) indicates that during the past 10 years the number has varied by less than 10 percent, demonstrating the management rationale within the Laboratory to remain at a fixed size rather than attempt to grow and serve more "customers." During this period, the Laboratory has been very selective in limiting tasks to those which are along the lines of expertise of the staff. The degrees of the technical staff and their overall fields of competence are shown in Figure 2.

The salary structure of the Laboratory personnel with technical degrees is shown in Table 1. This structure is carefully reviewed and controlled annually to assure that the Laboratory remains competitive in the market in which they recruit. The Lincoln pay structure is approved or adjusted by the MIT Corporation so that it remains consistent with other large MIT Laboratories. Annually, an MIT salary survey is conducted of approximately 20 large laboratories

(such as RCA, Bell Labs, G.E., IBM, A.D. Little, etc.). Traditionally, the Laboratory attempts to remain approximately sixth in this refined statistical study which includes factors such as degrees, experience, age, etc. The Personnel Committee chaired by the MIT Vice President for Administration then reviews the results of the survey and recommends a structure to the President of MIT. Following his review and recommendations, the salary structure is forwarded to the Executive Committee of the MIT Corporation, where it is further reviewed by the Salary Review Subgroup, which is composed of members from industrial corporations. This process assures a fair salary structure consistant with like activities.

The funding history of the Laboratory for the past few years is shown in Figure 3. As can be seen from the data, the internal operating costs have remained essentially fixed when inflation is considered. This trend is consistent with the stability of the number of technical staff at the Laboratory. The external procurement is, of course, dependent upon the projects involved during various periods, since these procurements involve paying for hardware from various contractors.

TABLE 1

SALARY STRUCTURE
FOR
LINCOLN LABORATORY PERSONNEL
WITH
TECHNICAL DEGREES

YEARS SINCE BS	NUMBER OF PERSONNEL	AVERAGE SALARY/MONTH
0	1	$ 893
1	5	893
2	15	979
3	14	1028
4	20	1112
5	14	1386
6	16	1403
7	20	1562
8	23	1576
9	38	1590
10	29	1603
11	36	1667
12	20	1680
13	35	1739
14	23	1864
15	17	1845
16	22	2026
17	18	1739
18 - 22	100	2035
23 - 27	51	2147
28 - 32	18	2192
33 - 37	4	2146
38 - 42	5	1906

FIGURE 1

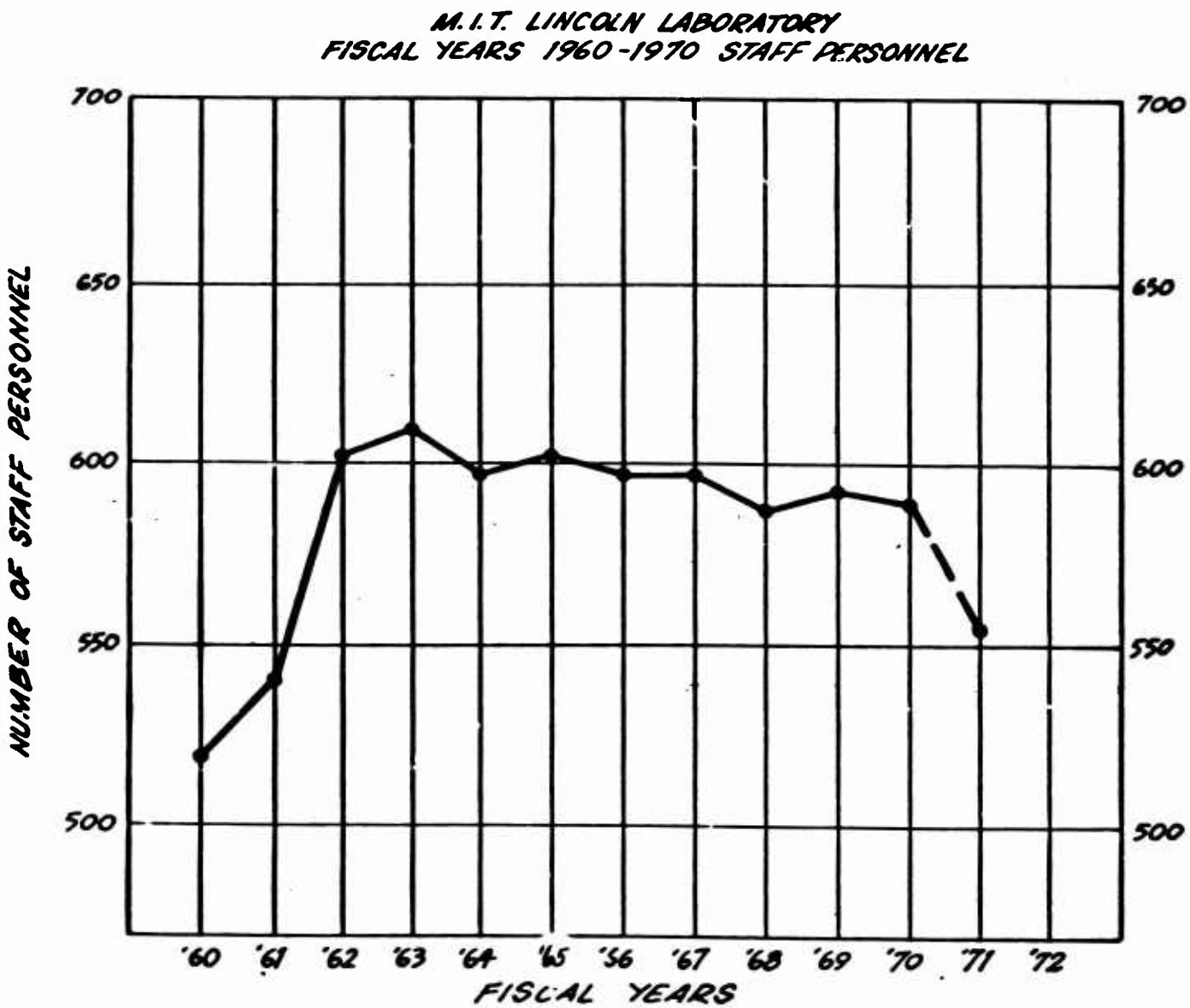

M.I.T. LINCOLN LABORATORY
FISCAL YEARS 1960-1970 STAFF PERSONNEL
NUMBER OF STAFF PERSONNEL
700
650
600
550
500
'60
'61
'62
'63
'64
'65
'66
'67
'68
'69
'70
'71
'72
FISCAL YEARS

FIGURE 2

LINCOLN LABORATORY TECHNICAL STAFF

DEGREES

PhD	42%
MS	29%
BS	24%
No Degree	5%

FIELDS OF COMPETENCE

RADAR AND OPTICAL SENSORS

COMMUNICATIONS

SIGNAL DESIGN AND PROCESSING

DATA PROCESSING

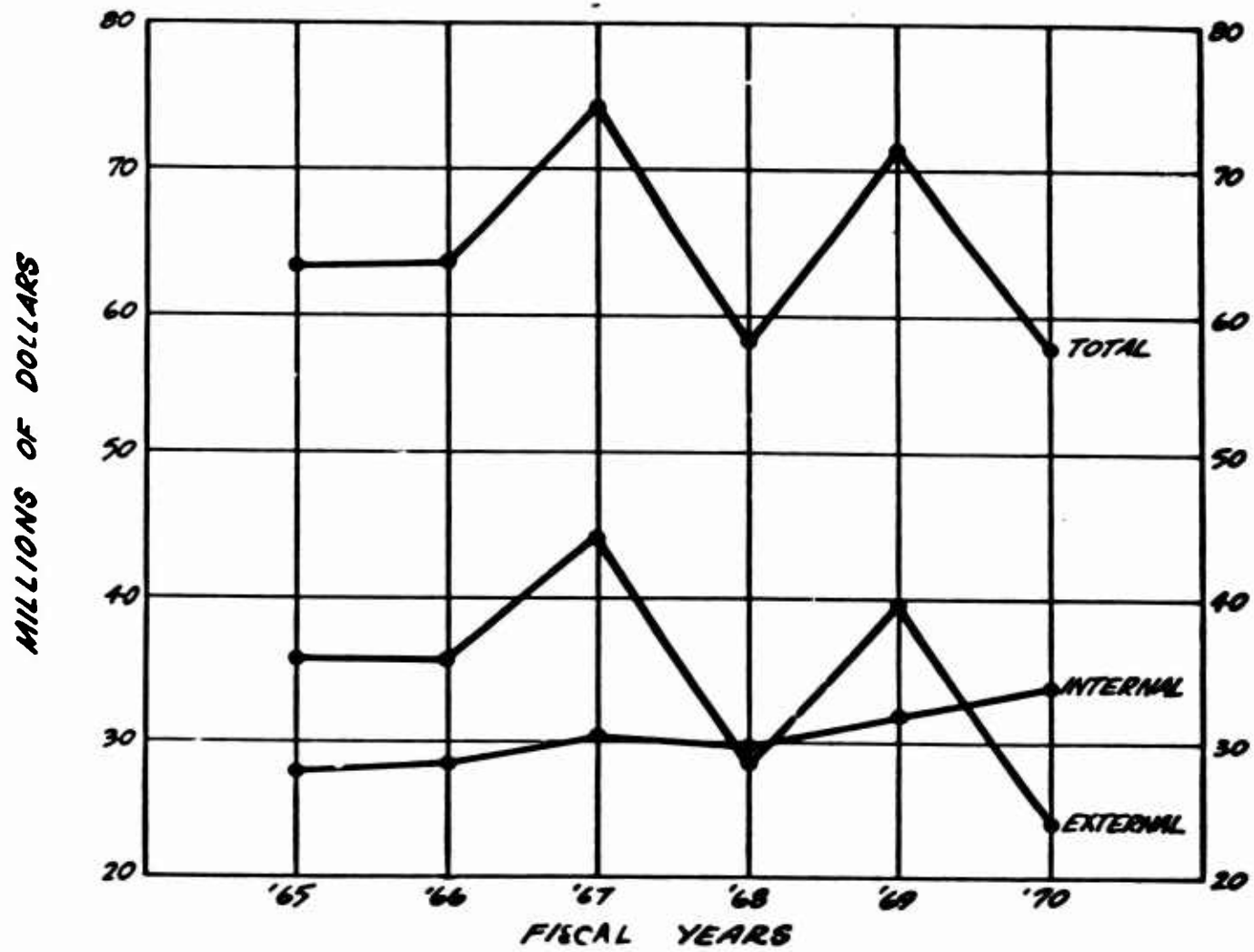
SOLID STATE DEVICES

ELECTROMAGNETIC PROPAGATION

ELECTROMECHANICAL CONTROL SYSTEMS

FIGURE 3

M.I.T. LINCOLN LABORATORY
EXPENDITURES AND NET COMMITMENTS
FISCAL YEARS 1965-1970



REPORT OF VISIT TO
ORDNANCE RESEARCH LABORATORY (ORL)
PENNSYLVANIA STATE UNIVERSITY

14 May 1971

A. HISTORY

1. During World War II, underwater acoustics research was accomplished at the Harvard Underwater Sound Laboratory (NDRC Program). In 1945 this program was split and

a. Hull mounted sonar was combined with the Columbia Laboratory Program and became Underwater Sound Laboratory, New London.

b. Torpedo sonar became Ordnance Research Laboratory, Pennsylvania State University.

The Ordnance Research Laboratory has been in operation since that date with major emphasis on underwater weapons -- particularly torpedoes--and in the general areas of acoustics, hydrodynamics, controls, structures and propulsion.

2. The Navy has a continuing need for qualified personnel and specialized facilities in certain scientific areas required for undersea weapons research and development. The specific areas in which the Ordnance Research Laboratory has a special competence include hydrodynamics, acoustic homing systems, guidance and control systems, noise reduction, and closed cycle propulsion systems. The Navy also utilizes the Ordnance Research Laboratory for technical direction of complete torpedo weapon systems. One of the principal advantages of ORL to the Navy is the availability of University personnel with very special capabilities to the Laboratory and thus to the Navy on a part-time basis when required.

B. MAJOR PRODUCTS/ACCOMPLISHMENTS

1. The Ordnance Research Laboratory has competence in hydrodynamics research not found elsewhere in Navy or commercial laboratories. This is due largely to the availability of the Garfield Thomas water tunnel, which is the largest water tunnel in the western world. The 48 inch diameter test section makes possible hydrodynamic tests on large scale models, and in some cases full-scale components, to determine the cavitation characteristics, hydrodynamic factors which might affect flow noise, drag reduction techniques, propeller designs, pump jet design, and other hydrodynamic factors affecting undersea weapon performance. A highly qualified group of hydrodynamicists is available to operate the water tunnel and to reduce the resulting data into meaningful results for undersea weapons research and development. Although hydrodynamicists are available in other Navy laboratories and in commercial laboratories, the availability of the 48" water tunnel provides a unique facility at the Ordnance Research Laboratory which is not available elsewhere. In conjunction with the academic program of the University, this facility is the training ground for many of the hydrodynamicists in the U.S.

2. The Ordnance Research Laboratory has specialized in acoustic homing systems, including signal processing techniques, to provide reliable torpedo homing under adverse natural conditions or in a countermeasure environment. Historically they have developed the homing system technology for the Torpedo MK 27 Mod 4, MK 21, MK 37, and the Torpedo MK 48 Mod 0/2 currently in engineering development. Present and planned future effort is centered around using matched filter techniques which should provide a much more capable homing system for future torpedo systems. Homing system design capability and signal processing capability are available in Navy laboratories and in industry but it is obvious from the several successful programs at the Ordnance Research Laboratory that they have been able to assemble an exceptionally well qualified group of signal processing experts, transducer design experts, control system experts, and system analysts that have been very successful in conducting the exploratory development phase of acoustic homing systems. There is no attempt to provide expertise in engineering for production at the Ordnance Research Laboratory. Homing systems resulting from ORL work have been engineered for production by commercial activities with the technical assistance of the Ordnance Research Laboratory engineers.

3. The ORL is currently serving as technical director of the Torpedo MK 48 Mod 0/2 program. This assignment results from their previous experience which included the exploratory development of the homing system for the Torpedo MK 48, their basic design of the pumpjet and hydrodynamic configuration being used in the Torpedo MK 48, and their experience in building and operating a working model of a complete torpedo system having the basic characteristics outlined in the Torpedo MK 48 specifications. Other Navy in-house laboratories could have been given this technical direction assignment but would not have the qualified experts already experienced in the specific problems involved in this particular weapon system using this homing system at the start of the engineering development program.

4. The best evaluation of task outputs of a Federal Contract Research Center is a review of the programs which have actually gone into service use. For example, ORL performed development work on the homing systems for the Torpedo 27 Mod 4, MK 34, MK 37, and MK 48, all of which have been in service or are expected to be in service soon. They have developed a pump jet which is used on both versions of the Torpedo MK 48, the cavitation resistant nose shape that has been adopted for the Torpedo MK 48, the wire guidance system which is used in the Torpedo MK 37 and the MK 48 and several other items that have seen their way into fleet use. They served as the Technical Direction activity for the Navy on Torpedoes MK 27-4, MK 39, MK 34, and Mk 48 Mod 0/2.

C. ALTERNATIVE SOURCES

1. The Ordnance Research Laboratory, Pennsylvania State University, has been treated more like an in-house Navy laboratory than like a contractor. Specific work assignments are by letter and may be changed without modification of the contract document as long as financial limitations are not exceeded. The ORL is given technical direction assignments over engineering development contracts performed in industry in the same manner that similar assignments are made to Navy laboratories. ORL is represented on the Undersea Warfare Research and Development Planning Council and other study and advisory

committees as if they were a Navy laboratory. However, the contract provisions in regard to funding limitations, facilities, travel regulations, etc., are just as binding as contracts with any commercial activity. The Navy does not dictate manpower limitations as these are normally determined by the laboratory based on financial resources available and workload requirements.

2. Specific tasks are assigned to the Ordnance Research Laboratory rather than another FCRC, a Navy laboratory, or a commercial contractor on the basis of their qualifications in manpower, facilities, and technical background to meet the requirements although in some cases consideration is given to the desirability of maintaining a somewhat level workload.

3. If the Ordnance Research Laboratory were abolished, the Naval Ordnance Systems Command would be required to transfer work assignments to Navy in-house laboratories, or to Industry. For all tasks there would be some delay and probable increased costs to train new personnel in the specific task, as it is unlikely that many of the present ORL personnel would leave the University to go with the project.

4. An early decision would be required on the feasibility of moving the 48-inch water tunnel. Owing to its size, the final portions of the building were built around the tunnel after it was installed. Moving would be difficult and expensive. Substitute facilities would probably have to be used (NSRDS towing tank, NSRDC smaller water tunnel, etc.) until the large water tunnel could be moved to a new location or could be replaced.

5. Other facilities could be moved to Navy in-house laboratories or could be duplicated in other Navy laboratories.

D. FUNDING/PERSONNEL/SALARY

1. The NAVORDSYSCOM controls the ORL size and capability by means of the annual contract amendments which provide funding and by the annual (more frequent if necessary) letter of instruction which establishes programs and priorities. This is done after discussion between representatives of NavOrd and ORL to review prior progress, proposed schedules and funding requirements, latest Navy requirements, and other factors affecting the program.

2. The manpower and installation or modification of facilities is dependent upon funding.

E. ATTACHMENTS:

1. Funding History and Projection

2. Table 1, ORL Funding Profile

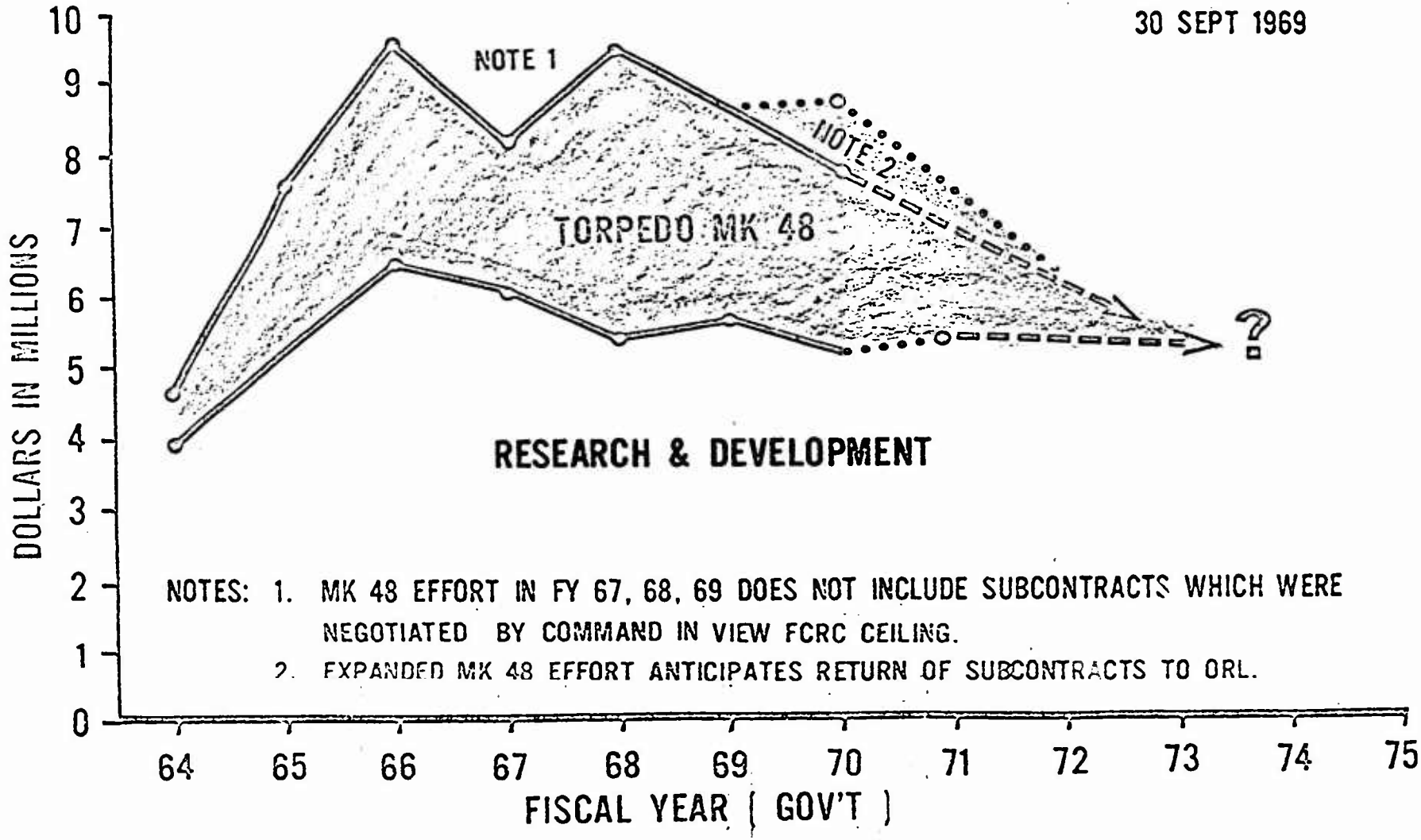
3. Personnel Profile

4. Salary Profile

5. Comparison of Ordnance Research Laboratory vs. Underwater Sound Laboratory.

ORDNANCE RESEARCH LABORATORY
PENNSYLVANIA STATE UNIVERSITY
FUNDING HISTORY & PROJECTION

30 SEPT 1969



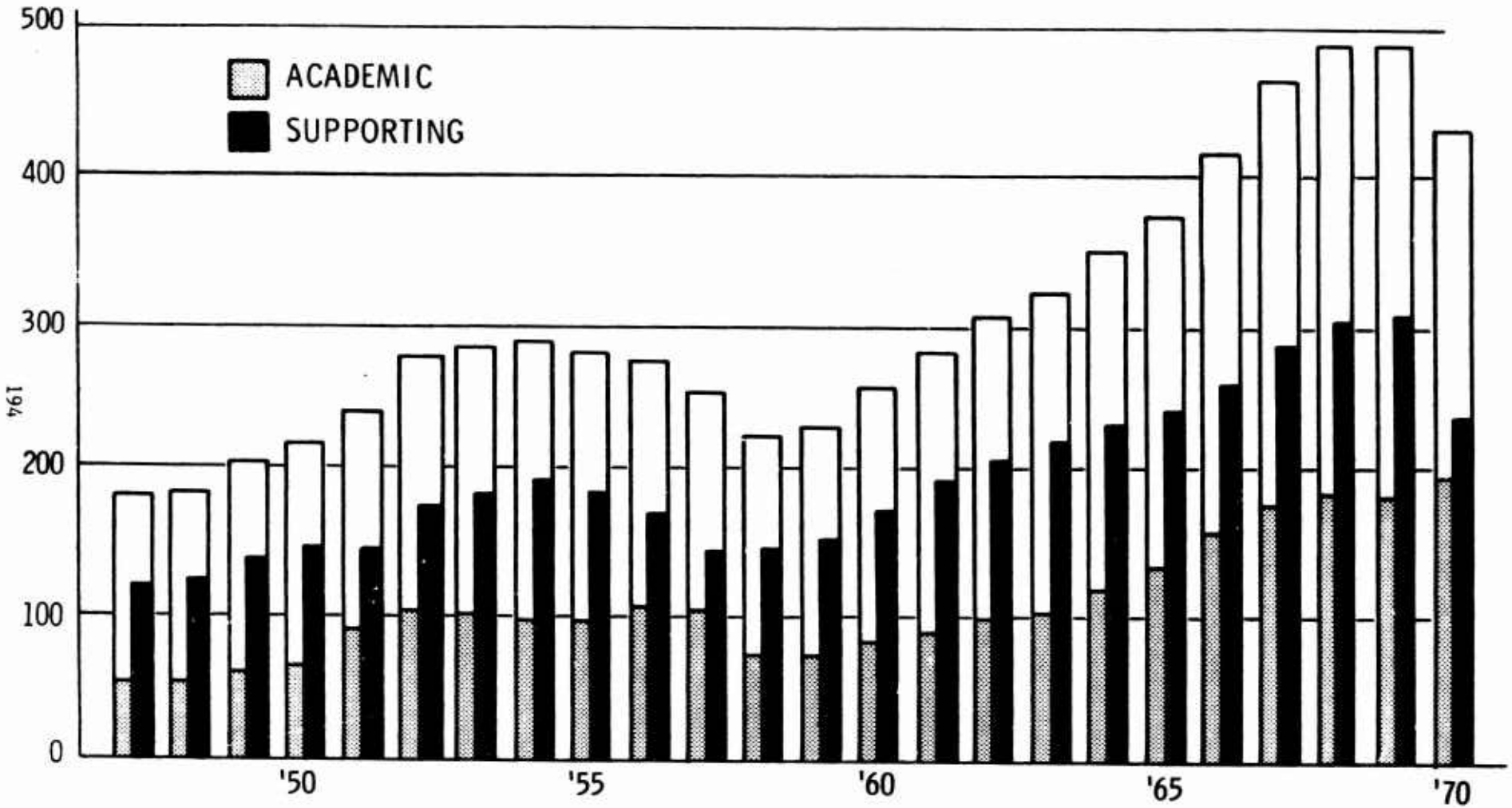
NOTES: 1. MK 48 EFFORT IN FY 67, 68, 69 DOES NOT INCLUDE SUBCONTRACTS WHICH WERE NEGOTIATED BY COMMAND IN VIEW FCRC CEILING.

2. EXPANDED MK 48 EFFORT ANTICIPATES RETURN OF SUBCONTRACTS TO ORL.

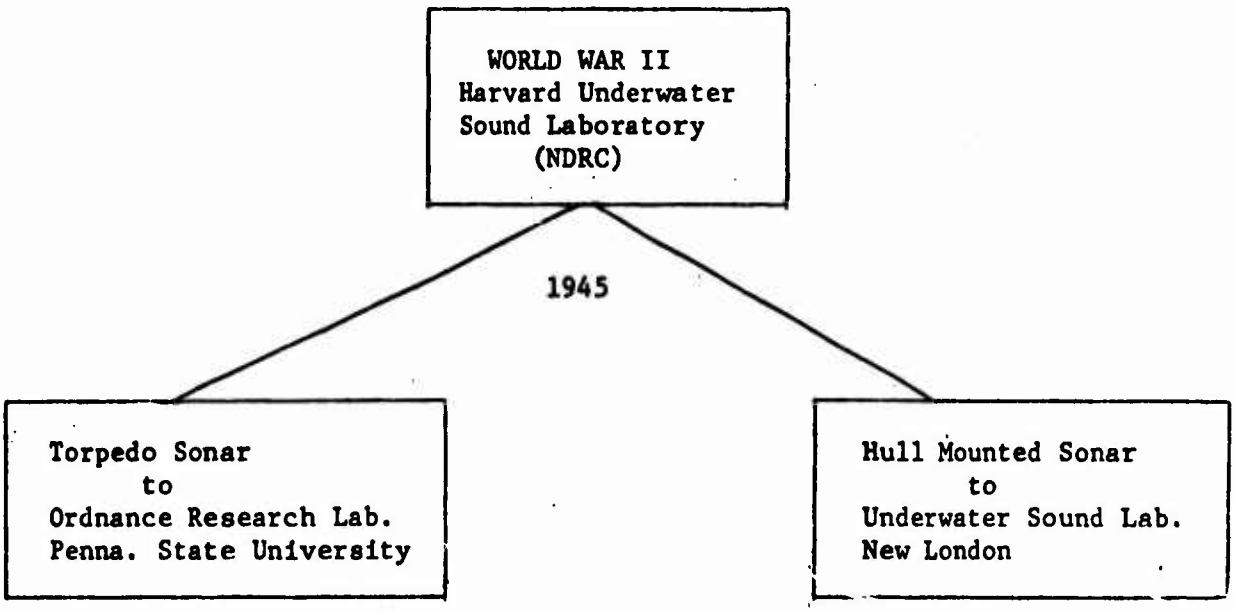
TABLE I
ORL FUNDING PROFILE
(Fiscal Year: October 1 through September 30)
(Dollars in Millions)

Year	Navy R & D	Others
1966	9.5	0.04 (NASA)
1967	8.1	----
1968	9.4	0.10 (NASA)
1969	8.6	0.10 (NASA)
1970	8.5	----
1971 (estimated)	7.9	0.10 (WECO) 0.07 (NASA) 0.02 (AF)

PERSONNEL


500
400
300
200
100
0
194
ACADEMIC
SUPPORTING
'50
'55
'60
'65
'70
FISCAL YEARS

COMPARISON OF ORDNANCE RESEARCH LABORATORY
VS
UNDERWATER SOUND LABORATORY

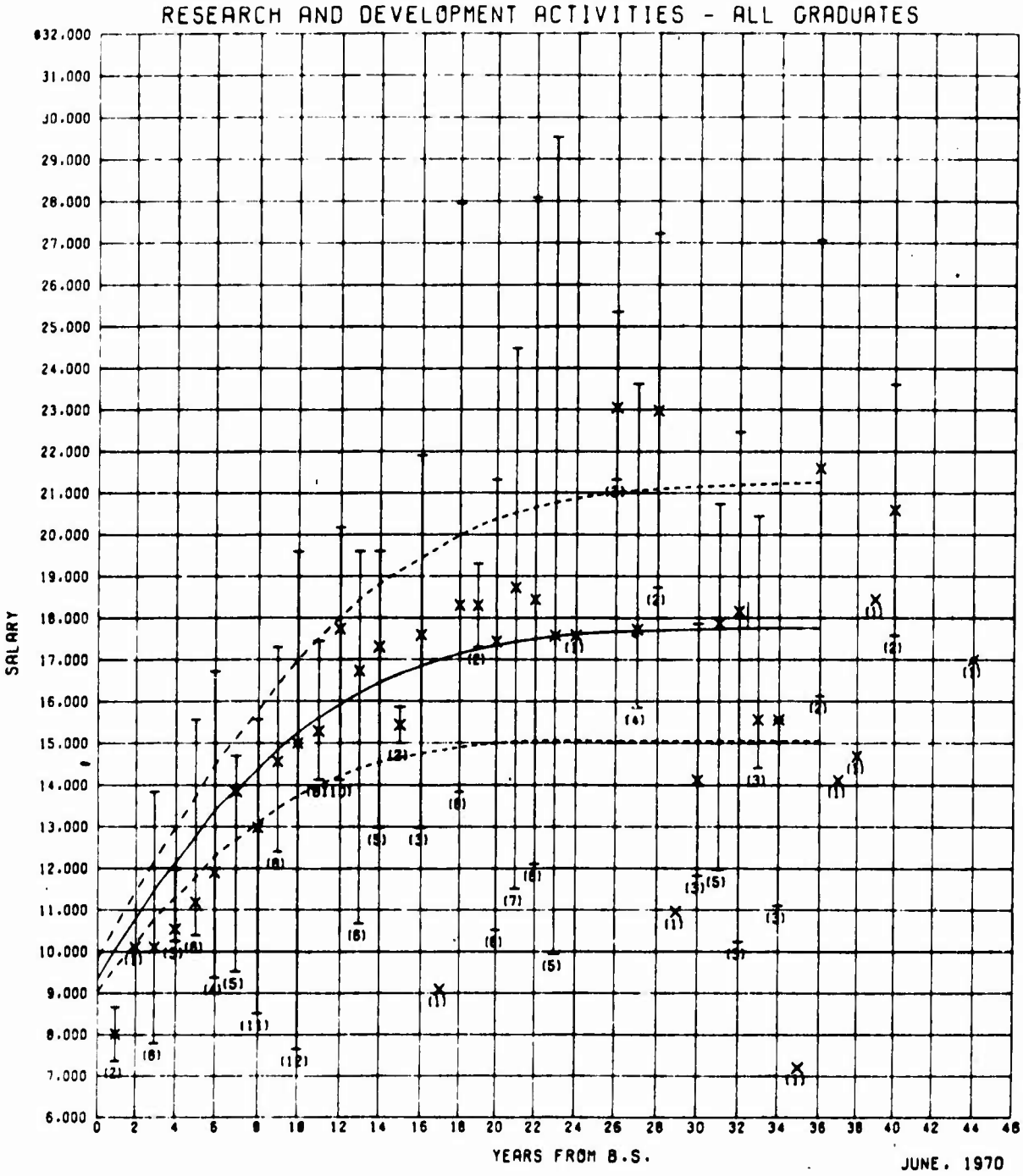


PERSONNEL (PROFESSIONAL)

	ORL	USL
1945	58	73
1950	67	179
1955	91	205
1960	82	216
1965	134	421
1970	167	590

LEGEND

——ENGINEERS JOINT COUNCIL
MEDIAN CURVE 1968 - 1969
– –UPPER QUARTILE
– –LOWER QUARTILE
× MEDIAN SALARY WITHIN
YEAR'S RANGE
I SALARY RANGE
(NUMBERS) - POPULATION INCLUDED
IN RANGE


RESEARCH AND DEVELOPMENT ACTIVITIES - ALL GRADUATES
SALARY
32.000
31.000
30.000
29.000
28.000
27.000
26.000
25.000
24.000
23.000
22.000
21.000
20.000
19.000
18.000
17.000
16.000
15.000
14.000
13.000
12.000
11.000
10.000
9.000
8.000
7.000
6.000
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEARS FROM B.S.
JUNE, 1970

REPORT OF VISIT TO
APPLIED PHYSICS LABORATORY (APL)
UNIVERSITY OF WASHINGTON (UW)

11 May 1971

A. HISTORY

1. During World War II, a small group of highly capable people was assembled under Section T of the National Defense Research Council (NDRC) located on the campus of the University of Washington in Seattle. This group was involved primarily with the VT fuze problem. At the end of the War, the Navy had a serious problem with torpedo influence exploders. It was decided that the capabilities of this highly skilled group should be applied to this related problem; so the APL/UW was formed, utilizing personnel from the NDRC group. This resulted in development of the Influence Exploder MK 9, which is still in use in the Torpedo MK 16. Another more recent example of the APL/UW exploder capability is the close-in stand-off exploders for the Torpedoes MK 46 and MK 48 which were developed from an APL/UW design. These torpedoes are the latest torpedoes available to the U.S. Fleet. The APL/UW has been in continuous operation since that time (1945) with major emphasis on undersea warfare and related systems. The major capabilities include underwater tracking ranges, underwater weapon system alignment, acoustic imaging, technical direction of developments, target development and acoustics of the target.

2. The Navy needs for the Applied Physics Laboratory, University of Washington (APL/UW), are directly or indirectly related to developing hardware, techniques, or information for undersea warfare against fast, deep-diving submarine targets; and for use in development of offensive undersea weaponry of submarines and surface ships. This effort includes research, development, engineering, test and evaluation.

Over a period of more than 20 years, the APL/UW has developed a competence in specialized fields of undersea warfare that is not readily available elsewhere. The unique or special characteristics of this laboratory relate to: (a) its professional staff, (b) its proximity to the ocean and naval activities in the Seattle area, and (c) its relationship to the University of Washington.

B. MAJOR PRODUCTS/ACCOMPLISHMENTS

1. Underwater Tracking Ranges: APL/UW has pioneered the development, installation and checkout of underwater ranges; first at Dabob Bay, Keyport, Washington; then at Nanoose in the Straits of Georgia; and then at St. Croix off Roosevelt Roads. The first two ranges are used largely by torpedo development and torpedo proofing activities. The latter range is for test and evaluation of underwater weapon systems by Fleet activities. An in-house laboratory with industrial support has now developed an underwater range capability and has participated in the development and installation of underwater tracking ranges in the Tongue of the Ocean in the Bahamas, and at Barking Sands

in the Hawaiian Islands, but APL/UW provided the basic oceanographic concepts and is still called upon to supply technical assistance. They service and recalibrate the ranges which they have developed when circumstances dictate. These services have proven to be essential in the last few years.

2. Underwater Weapon System Alignment: More than ten years ago, APL/UW, on its own initiative, began reporting sonar and fire control misalignments that had not been suspected. The measurements of misalignment could be made comparatively simply on the Dabob Bay underwater tracking range and were reported in depth until it was finally recognized that major misalignment of the underwater batteries was not just isolated instances but a factor requiring continuing preventive and corrective action. APL/UW devised the measurement techniques and data analysis methods which are now employed in the Weapon Systems Accuracy Trials (WSAT). There have been many outgrowths of this interest in systems alignment. APL/UW proposed and installed the first Fleet Operational Readiness Accuracy Check Sites (FORACS), which was followed by several others on both coasts and in Hawaii.

3. Acoustic Imaging: APL/UW has developed a unique position in the area of acoustic lenses. They have developed both single component liquid lenses and compound solid and liquid lenses which focus the acoustic pressure field in front of the lens on a retina of independent transducers, providing an electrical representation of the acoustic pressure field in the entire forward hemisphere on the lens.

4. Torpedo MK 45: The APL/UW was named Technical Director of the only nuclear warhead torpedo development for the U.S. Navy. They have been active in this program from its inception and have continued to maintain design cognizance because of their unique experience and capability to perform this function with full efficiency.

5. Targets: Acoustic homing torpedoes are ranged and proofed on simulated targets, out of necessity. Providing the development and calibration of these targets has been an important technical contribution of the APL/UW. As the guidance and control systems of torpedoes have become more demanding that the target indeed "look" like a real submarine target, the development of simulated acoustic targets has taken on a new dimension of importance. APL/UW is now working on a target system for the next generation of torpedo guidance and control systems. This will be much more demanding of the simulated target to respond in a true target-like fashion. Both in-house and commercial activities have developed underwater targets which have been successful but the capabilities of APL/UW are a major asset of the targets program. The only Fleet Torpedo/Sonar Acoustic target in use today is the MK 29, developed by APL/UW.

6. Torpedo MK 48: One of the highest priority programs currently assigned to the Naval Ordnance Systems Command is the Torpedo MK 48. Although the APL/UW has not had direct responsibility in this development program, they do play an important role in the technical support of the program. Their unique expertise in the use of acoustic tracking ranges for evaluation makes the laboratory highly qualified to act as consultants on evaluation of the Torpedo MK 48.

7. Acoustics of Target: A submarine target no longer looks like a "point source" when the attacking torpedo approaches the target. It is important to understand the type of echoes received from a true target during the close-in attack phase. The APL/UW has developed a technique for using the high spatial resolution of their acoustic lens to identify acoustic highlights on submarine targets. The goal of this program is to understand the type of echo received from true targets so that improved acoustic homing systems can be developed to take advantage of the actual target characteristics.

C. ALTERNATIVE SOURCES

1. The APL/UW has been treated more like an in-house Navy laboratory than like a contractor. Specific work assignments are by letter and may be changed without modification of the contract document as long as financial limitations are not exceeded. The APL/UW is given technical direction assignments over engineering development contracts performed in industry in the same manner that similar assignments are made to Navy laboratories. APL/UW is represented on the Undersea Warfare Research and Development Planning Council and other study and advisory committees as if they were a Navy laboratory. However, the contract provisions in regard to funding limitations, facilities, travel regulations, etc., are just as binding as contracts with any commercial activity. The Navy does not dictate manpower limitations as these are normally determined by the laboratory based on financial resources available and workload requirements.

2. Specific tasks are assigned to the APL/UW rather than another FCRC, a Navy laboratory, or a commercial contractor on the basis of their qualifications in manpower, facilities, and technical background to meet the requirements, although in some cases consideration is given to the desirability of maintaining a somewhat level workload.

3. Current programs assigned to APL/UW are of extreme importance, and if APL/UW were abolished, would be delayed for significant periods. In this event each program would be reviewed in detail and assigned to other activities involved in undersea warfare. In assigned Naval activities it would be necessary to provide personnel ceiling compensation and at FCRC's "ceiling" relief. In the process of reassigning work, some of the competence would be lost since some individuals would be unwilling to leave the Seattle area or sever their relationships with the University. The completion date of most programs would probably the delayed for several years, the program would require additional funding in view of these delays, and it would be necessary to recruit and train additional personnel. In addition to the above, a principal asset for APL/UW, namely, its association with the University which provides us access to a reservoir of scientific and academic professional talent, would be lost.

D. FUNDING/PERSONNEL/SALARY

1. The NAVORDSYSCOM controls the APL/UW's size and capability by means of the annual contract amendments which provide funding and by the annual (more frequent if necessary) letter of instruction which establishes programs and

priorities. This is done after discussion between representatives of NavOrd and APL/UW to review progress, proposed schedules and funding requirements, latest Navy requirements, and other factors affecting the program.

2. The manpower and installation or modification of facilities is dependent upon funding.

E. ATTACHMENTS

1. Funding History

2. Personnel History

FUNDING PROFILE, LAST FIVE YEARS

(Funding in Thousands of Dollars)

	Funding in NavOrdSysCom Contract, By Source				Other Funding	Total*
	ORD	SHIPS	AIR	OTHER NAVY		
FY 66	$4,715	$924	$367	$ 74	---	$6,080
FY 67	2,105	610	---	132	---	2,847
FY 68	3,175	325	325	75	---	3,900
FY 69	2,282	459	340	125	---	3,206
FY 70	2,121	545	194	50	198	3,108
FY 71(est.)	1,365	462	92	25	677	2,621

*When subcontract amounts are subtracted from these totals, then the amounts available for in-house Laboratory effort were as follows:

FY 66	$4,186K
FY 67	2,801
FY 68	3,191
FY 69	3,063
FY 70	2,400
FY 71	2,393

APPLIED PHYSICS LABORATORY
UNIVERSITY OF WASHINGTON

Personnel History

Year	Total Employees
1970	129
1969	155
1968	169
1967	166
1966	158
1965	139
1964	140
1963	132
1962	119
1961	124
1960	124
1959	124

REPORT OF VISIT TO
APPLIED PHYSICS LABORATORY (APL/JHU)

12 August 1971

A. HISTORY

The Applied Physics Laboratory of The Johns Hopkins University was established in April 1942 by the Office of Scientific Research and Development (OSRD) to carry through the development and assist in the deployment of Radio Proximity Fuzes for Naval anti-aircraft gunfire. In 1944, the Bureau of Ordnance of the Navy took over sponsorship of the laboratory from OSRD. At the close of hostilities in 1945, the University, upon strong representations from the Chief of the Bureau of Ordnance, supported by the Secretary of Defense, agreed to continue in peace time the operation of the laboratory for the Navy in order to pursue the development of new techniques aimed at providing the Fleet with high performance guided missiles, a program designated by the code name "Bumblebee." This program led to the development of many new technologies and to a family of three anti-aircraft guided missiles, TALOS, TERRIER, and TARTAR which have been deployed extensively in the United States Fleet, and adopted by at least seven foreign navies. The experience gained in this work led directly to participation in the test and evaluation phases of the Polaris Program, and later to the concept,

design and deployment of a worldwide Satellite Navigation System.

The laboratory's main objective is to provide technical support to the Navy and other government agencies through research, development, engineering, test and evaluation pertaining to surface missile systems, space systems, astronautics, electronic warfare systems, ballistic missile systems, and advanced propulsion systems. The laboratory conducts basic and supporting research, exploratory and advanced development; constructs special instruments and components as needed; plans, conducts, analyzes and evaluates tests of equipment and systems in the areas specified; identifies deficiencies of systems in fulfilling requirements and in achieving objectives; and proposes corrective actions.

B. MAJOR PRODUCTS/ACCOMPLISHMENTS

During the past 25 years, the Applied Physics Laboratory has developed a deep understanding of all aspects of naval warfare, including the nature of the current and potential threat to the fleet, the peculiar problems and limitations of the shipboard environment and operating personnel, the requirements of safety, and the workings of the various sections of the Navy organization. It has also acquired a first-hand knowledge and understanding of production, as well as maintenance and logistics problems and

applied this knowledge in development work. Applied Physics Laboratory also devised sophisticated simulation equipment to permit accurate prediction of flight performance from laboratory breadboard testing; and this capability contributes directly to space and strategic systems programs.

The technical staff of APL includes specialists spanning the great variety of scientific and engineering fields embodied in combat systems technology, and has developed men with broad system understanding capable of leading teams engaged in technical development of systems. The Navy regards APL as its lead laboratory in fleet air defense. APL also has a vital role in strategic systems evaluation and its follow-on effort, SSBN Defense. Its capability in combat avionics, has led to increased responsibility for systems for the protection of aircraft in hostile environments.

The following describes the areas in which the laboratory is currently working, and past accomplishments:

1. Fleet Air Defense with special emphasis on ship launched missiles and systems. Work in this area includes theoretical and experimental studies to evaluate and understand the performance in realistic tactical environments of deployed and potential missiles and missile systems against realistic threats, and to devise and implement methods for improvement of performance to meet present

systems or by the deve ent of new concepts. In this area the laboratory works very closely with cognizant offices in the Navy, and with industrial contractors. Also included are research and exploratory development in related fields such as high-speed propulsion and new guidance and control principles, components and techniques, new techniques for radar design and data processing to improve performance in tactical conditions, warhead technology and high speed aerodynamics and structures.

APL contributions:

a. Radio Proximity Fuze design and development.

b. Recognized as leading development organization in surface-to-air guided missiles. Pioneered in supersonic aerodynamics, control, missile guidance systems, and solid rocket propulsion.

c. Designed, developed and directed the engineering of the TALOS Missile which has the longest range and is the most accurate surface-to-air missile in the world.

d. Developed Aerodynamic Configuration of Shipboard Missiles which eliminated wing surfaces and made shipboard high density storage and automatic launching and handling possible, while still achieving high missile maneuverability.

e. Developed Building Block Missile Concept which resulted in major savings in TARTAR Missile development and later enabled TERRIER and TARTAR replacement by the Standard Missile.

f. Solved critical Standard Missile Engineering problems and technically directed adaptation of shipboard weapon systems to the Standard Missile.

g. Technically directed improvement of the TALOS, TERRIER, and TARTAR shipboard weapon control systems which resulted in major increase in reliability, availability, and performance under unfavorable conditions.

h. Designed and developed the Adaptive Video Processor which greatly improves the performance of conventional shipboard surveillance radars and is an essential part of the SAMID modifications to improve the defense of existing ships against the anti-ship missile.

i. AEGIS Baseline System. Designed and developed the baseline design of an advanced multi-function radar which will form the heart of the AEGIS system.

2. Special Air Defense Programs. At the request of DDR&E, following the loss of aircraft to Soviet surface-to-air missiles over North Vietnam (7/25/65), APL responded with recommendations for protective formations, maneuvers, and countermeasures. The APL tactical recommendations were promptly issued to the Fleet and were used successfully by pilots in combat. Three major programs, which grew directly out of this action, were:

a. Conceived and served as the primary technical agency for CNO Project F/O 210, which was a comprehensive flight test and analysis program carried out with combat-type aircraft flying against instrumented hardware representations of enemy anti-aircraft systems.

b. Conceived, planned and directed the development and installation of Echo Range, a comprehensive flight test range incorporating up-to-date hardware simulations of enemy missile and gun systems, and employing advanced testing techniques.

c. Designed and developed a modification to aircraft fire control systems to permit lock-on to emissions from enemy radars and accurate bombing attacks.

3. Fleet Ballistic Missile Systems with special emphasis on techniques for testing and evaluating the performance of prototype and operational systems under realistic conditions. This work includes interpretation of the results, isolation of places where improvement is indicated and a certain amount of exploratory development to implement ideas leading to devices and techniques to bring about the indicated improvements. In 1969 APL was given a major additional responsibility for the new SSBN Defense program. The following paragraphs briefly cover the principal elements of the FBM effort:

a. Developed test methods, planned and specified instrumentation for demonstration, shakedown, and operational tests on all POLARIS/POSEIDON submarines.

b. Invented the Transit Navigational Satellite System which FBM submarines depend upon for precise navigation, as a result of analysis of POLARIS navigational problems.

c. Fleet Ballistic Missile Defense Program. APL/JHU was selected as the principal activity for the high priority SSBN Defense project because of its competence and experience with the FBM program.

4. Space Systems. Since the first generation of the Satellite Navigation System became operational, work in this area has concentrated on extending the lifetime of operational satellites, in exploring new and simplified operational procedures, and in simplifying and extending the applications of surface based navigation equipment to surface ships and to land operations. Development is carried on toward the design of a second generation of satellites compatible with existing ground and shipboard systems. The laboratory pioneered the use of gravity gradient stabilization which is now operational in many satellites. Extension of this principle of stabilization to higher altitude satellites was also demonstrated.

APL's contribution in the field of space technology includes the following:

a. Conceived and fully developed the Navy Navigation Satellite System which is also known as the TRANSIT System.

b. Developed the concept, instrumentation and programming and established the TRANET Doppler Tracking System for satellites, now recognized as the most economical and accurate system in existence for the tracking of near-earth satellites.

c. Developed Doppler Beacons for use in satellites to make possible the tracking of the TRANET system.

d. Developed and technically directed the design, production and test of operational models of the Geoceiver intended for use with the Navy Navigation Satellite System for geodetic purposes.

e. Conceived, developed and successfully demonstrated gravity gradient stabilization as a technique for causing one face of a satellite to face the earth continuously by purely passive means.

f. Developed and successfully demonstrated a number of useful stabilization techniques, other than by gravity gradient. These included magnetic stabilization in 1960; magnetic controlled spin stabilization with magnetic spin axis precession in 1965; and a dual spin system applied to the SAS-A satellite.

g. Developed extremely accurate series expansion for the gravity field of the earth based on TRANET tracking data of a large number of geodetic and other satellites.

h. Designed and built most of the satellites specifically devoted to geodetic use such as ANNA IB for the Armed Services and GEOS I and II for NASA.

i. Designed and developed the BRN-3 Navigation Receiver which provides precision position information to POLARIS submarines in conjunction with the TRANSIT Satellite System.

j. Designed and developed SRN-9 Navigation Receiver which enables surface elements of the fleet, particularly carriers, to obtain precision position information from the TRANSIT satellites.

C. ALTERNATIVE SOURCES

The APL/JHU has been treated more like a Navy in-house Navy laboratory than like a contractor. APL/JHU has been considered as an extension of the Navy Project and Program Management Offices since it supplies the objective scientific and technical analysis, consultation, recommendations and necessary hardware that cannot be obtained from within a limited size Navy management headquarters organization. Specific Navy work assignments are in response to APL/JHU technical proposals, and are by letter. Changes may be

made through technical instructions as long as the scope of the contract is not exceeded and financial limitations are observed.

The APL/JHU exercises two principal roles, one as Technical Support Agent, and the other as Weapon System Integration Agent. While the first role relates to all necessary individual scientific and technical support required, the second relates to the crucial overall weapon system integration which is vital to the success of any new system as well as effective operation of existing weapon systems.

If the APL/JHU was disestablished or its utilization otherwise denied to the Navy, it would be immediately necessary to reestablish a similar activity since no other facilities, in-house or contractor operated, are available. It has been conservatively estimated that it would require a minimum of ten years to recruit and train scientists and engineers into a responsive team competence that is now available. Further, it would require an estimated $90 to $100 million to duplicate the current laboratory instrumentation and facilities based on a current audit expenditure of approximately $65-70 million.

The assumption of the effort of the FCRC's by industry is not a practical alternative. In the absence of a special exclusive long-term commitment from the Government, industrial contractors

must concentrate their technical talents in areas where good markets exist. By the same token industrial companies depending on competitive business are not able to invest in an organization specializing in the detailed needs of a particular weapon system area.

D. FUNDING/PERSONNEL/SALARY DATA

The size of the APL/JHU is principally controlled by a university-imposed staff ceiling that has been maintained under 2600 total since 1965. It is the policy of the laboratory not to exceed this level in the future.

The laboratory also assures a conservative salary structure relative to national levels for R&D personnel. They cooperate with a select group of 24 major industrial and educational organizations whose annual salaries, as paid designated equivalent staff groups, are analyzed and compared for subscriber information. APL/JHU has a policy to approach the survey mean as a limit. Prior to the publication of the present "Survey of Research and Development Salaries," APL/JHU had adjusted their salaries to the data base established by the Los Alamos and the MIT R&D Surveys.

The first attached chart shows the Cumulative Salary Distribution of Scientists and Engineers comparing APL/JHU and DOD by percentage at various salary levels.

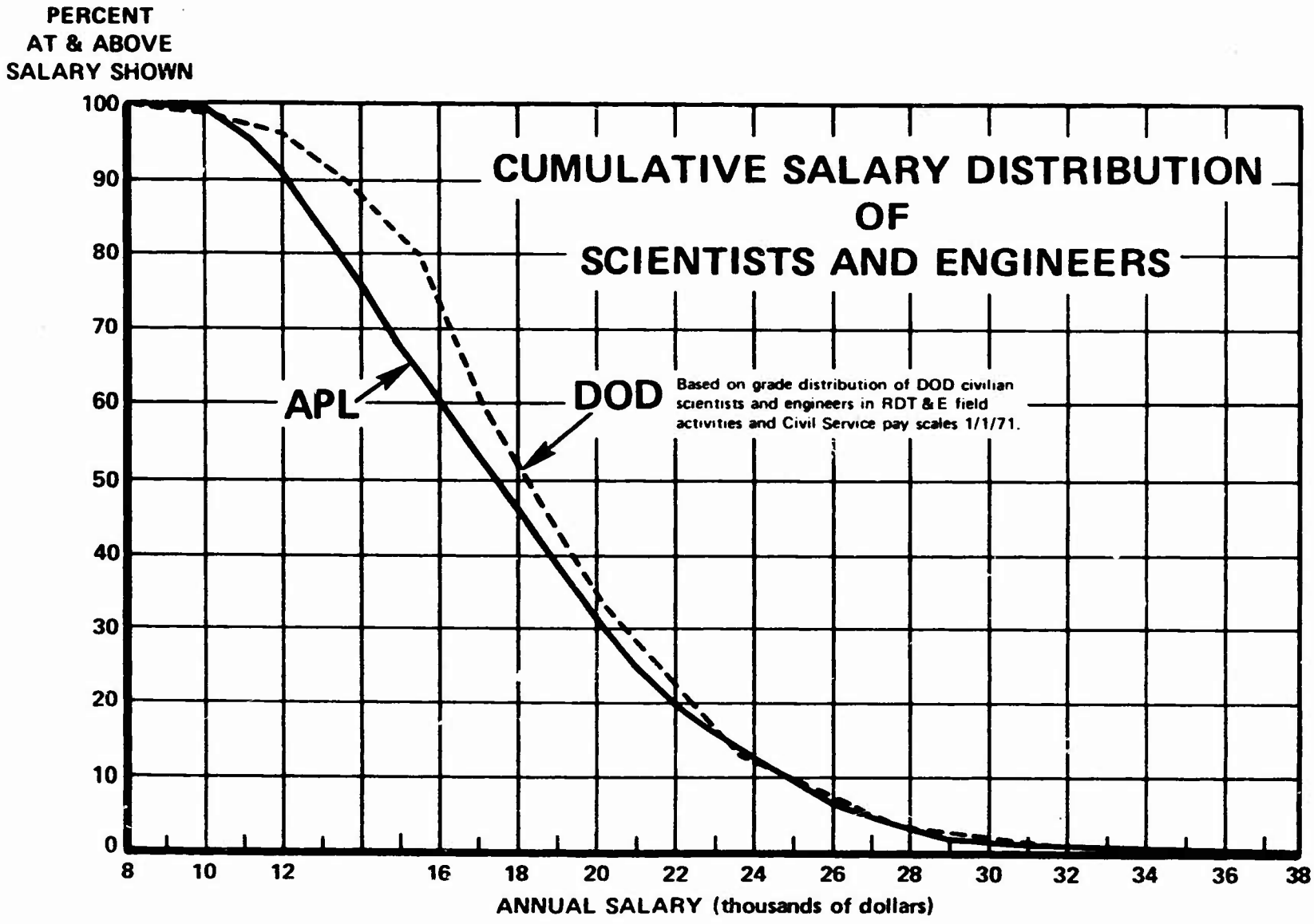
The second chart is an extraction of the 1970 R&D Survey of three APL/JHU groups versus the survey mean. Also shown are the number of persons for each age group.

A table of salary comparisons within Johns Hopkins University indicates an average salary lower than the university as a whole.

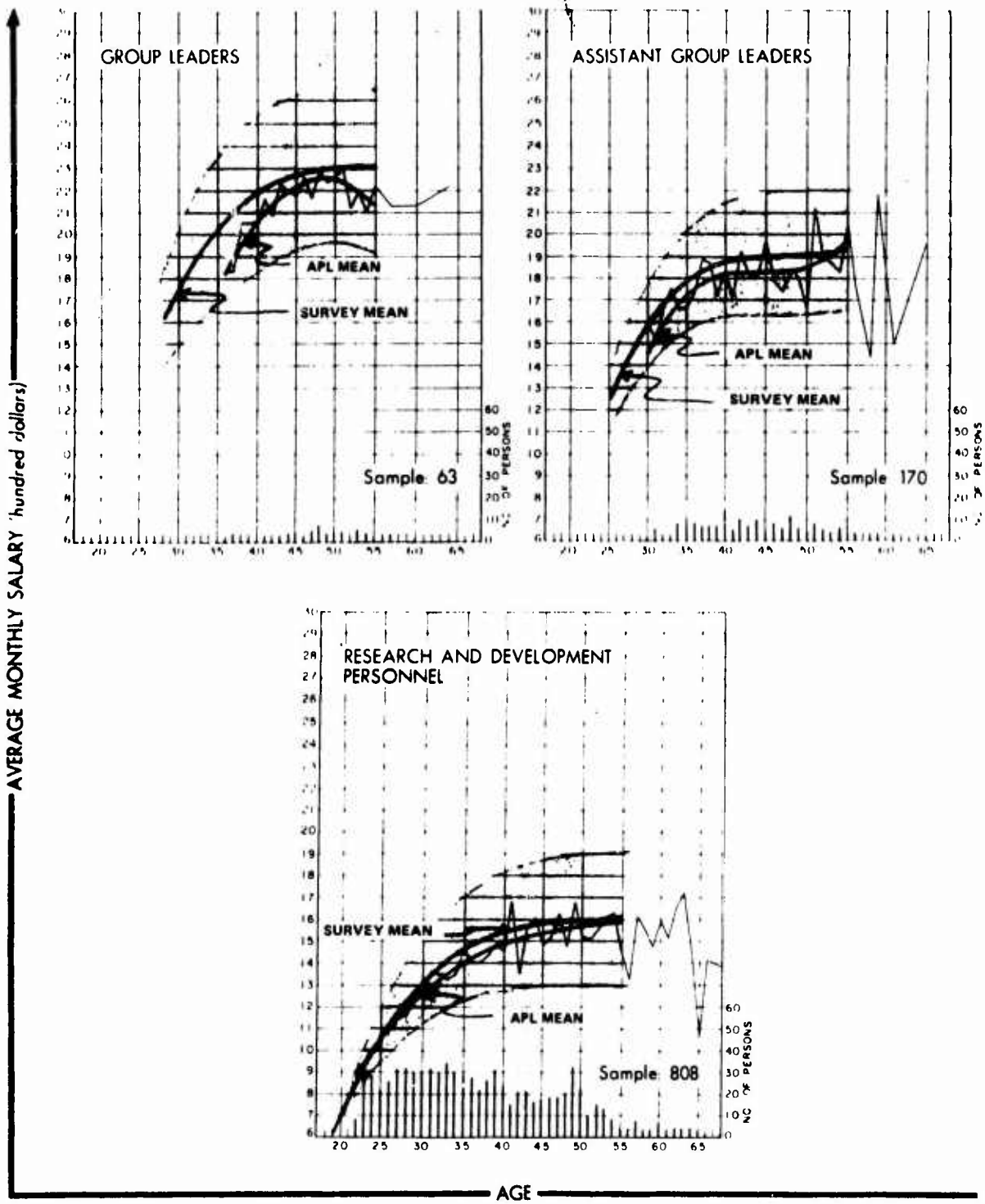
Finally, on the last chart is shown the actual in-house task commitments in total dollars over the last six years. This chart is corrected in the center to reflect deflated commitments based on a 1972 FY OSD definition. The comparison of Navy, DOD and non-DOD total dollar commitments is shown.

On the same chart is shown the corresponding assignment of APL staff to commitment task sponsor groups.

These histograms show that when the effects of inflation are removed, APL has been essentially level in total commitments over the past five years. No significant growth is apparent, although APL is complying with DOD policy to apply military technology in the civil sector where applicable. As noted earlier, total staffing has been held level.


PERCENT
AT & ABOVE
SALARY SHOWN
100
90
80
70
60
50
40
30
20
10
0
CUMULATIVE SALARY DISTRIBUTION
OF
SCIENTISTS AND ENGINEERS
APL
DOD
Based on grade distribution of DOD civilian scientists and engineers in RDT&E field activities and Civil Service pay scales 1/1/71.
8
10
12
16
18
20
22
24
26
28
30
32
34
36
38
ANNUAL SALARY (thousands of dollars)

1970 R&D SURVEY APL POSITION BY SUPERVISORY LEVEL



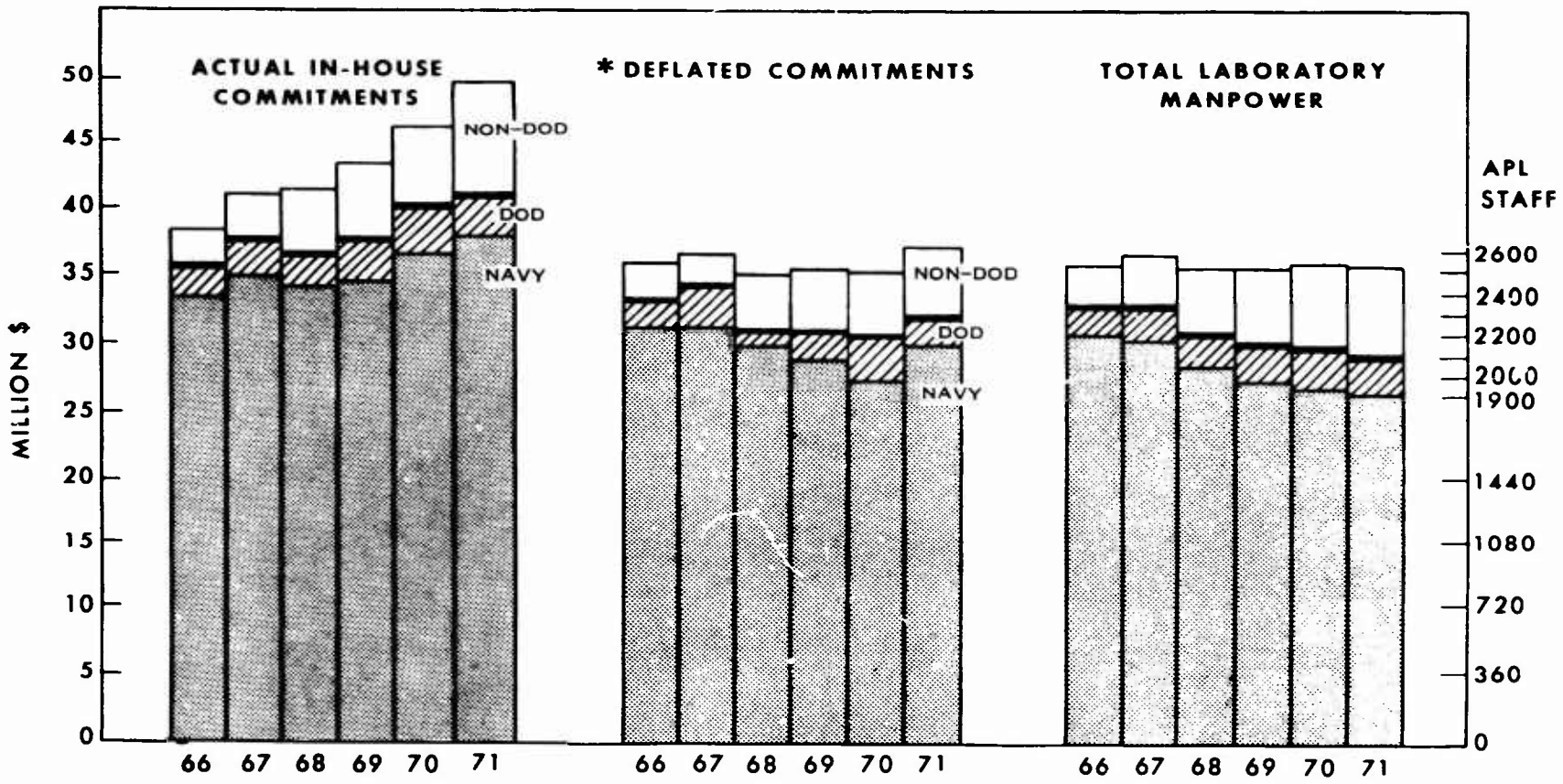
SALARY COMPARISON WITHIN JOHNS HOPKINS

	Medical School*	Arts & Sciences*	APL
Professor	$30,860	$28,365)	$21,364
Associate Professor	20,437	18,660)	
Assistant Professor	16,244	14,081)	13,878
Instructor	11,375	11,330)	

Average, Johns Hopkins University minus APL	$21,067
Average, APL	18,276

*From AAUP chapter report, converted to 11 months

APL/JHU IN-HOUSE COMMITMENTS OF DEFENSE AND NON-DEFENSE FUNDS AND TOTAL MANPOWER UTILIZATION, FISCAL YEARS 1966—1970



* ACTUAL COMMITMENTS DEFLATED CONSISTENT WITH DEFLATOR INDICES EMPLOYED IN FY 1972 DOD BUDGET PRESENTATIONS (1964 = 100)

SELECTED ABBREVIATIONS

ACDA -- Arms Control and Disarmament Agency
AEC -- Atomic Energy Commission
AFSC -- Air Force Systems Command
AFTAC -- Air Force Technical Applications Center
ANSER -- Analytical Services, Inc.
APL/JHU -- Applied Physics Laboratory, Johns Hopkins University
APL/UW -- Applied Physics Laboratory, University of Washington
ARPA -- Advanced Research Projects Agency
ASD -- Assistant Secretary of Defense

CIA -- Central Intelligence Agency
CNA -- Center for Naval Analysis
CNES -- (French nuclear energy organization)

DASA -- Defense Atomic Support Agency
DCA -- Defense Communications Agency
DDC -- Defense Documentation Center
DDR&E -- Director of Defense Research and Engineering
DIA -- Defense Intelligence Agency
DoD -- Department of Defense
DOT -- Department of Transportation
DSPG -- Defense Special Planning Group

ESD -- Electronic Systems Division (Mitre Corporation)

FAA -- Federal Aviation Agency
FCRC -- Federal Contract Research Center

GSE/TD -- general systems engineering/technical direction

HEW -- Department of Health, Education and Welfare
HumRRO -- Human Resources Research Organization

IDA -- Institute for Defense Analyses
ISA -- International Security Affairs (as in ASD(ISA))

JCS -- Joint Chiefs of Staff

MIT -- Massachusetts Institute of Technology
M&RA -- Manpower and Reserve Affairs (as in ASD(M&RA))

NASA -- National Aeronautics and Space Administration
NDRC -- National Defense Research Committee
NSF -- National Science Foundation
NSRDC -- Naval Ship R&D Center

SELECTED ABBREVIATIONS (continued)

OASAF -- Office of the Assistant Secretary of the Air Force
OASD(C) -- Office of the ASD (Comptroller)
OASD(I&L) -- Office of the ASD (Installations and Logistics)
OCRD -- Office, Chief of Research and Development (Army)
ODDR&E -- Office of the DDR&E
ORL -- Ordnance Research Laboratory, Pennsylvania State University
OSD -- Office of the Secretary of Defense
OSRD -- Office of Scientific Research and Development

PSU -- Pennsylvania State University

RAC -- Research Analysis Corporation

SAGE -- Semiautomatic Ground Environment
SALT -- Strategic Arms Limitation Talks
SAMSO -- Space and Missile Systems Office (Air Force)

WSEG -- Weapons Systems Evaluation Group