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**RESEARCH, DEVELOPMENT, TEST AND
EVALUATION IN THE NAVY**

by

H. B. Thomas

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RESEARCH, DEVELOPMENT, TEST AND EVALUATION IN THE NAVY

ABSTRACT

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Commander H. B. Thomas, Jr.

This paper examines the organization, philosophy, and methodology of the Department of the Navy as an integral part of the defense establishment effort in research, development, test and evaluation.

In examining this organization, analyses of the organizations and philosophies of the Department of Defense, the Department of the Army, and the Department of the Air Force are made. Included in these analyses are studies of the organization structures themselves, concepts concerning the conduct of basic and applied research, responsibilities for development and procurement, and the individual test and evaluation procedures.

The Navy effort in research, development, test and evaluation is examined in detail. The organization structure is studied as well as the traditions and philosophies which combine to support its bilinear peculiarities. Organization structures and functions of the "big three" (the Office of Naval Research, the Bureau of Weapons, and the Bureau of Ships) in the Navy research and development are noted, as well as the organization of the Office of the Deputy Chief of Naval Operations for Development.

The research cycle -- from idea or concept to operational use in the fleet -- is examined as it exists today, and the complex review and coordination procedures are broken down and critically studied.

In the summary, comparisons are drawn among the different Department's organizations for research, development, test and evaluation. Differences and similarities are noted, and the Navy's organization and methodology given critical appraisal.

Finally, in the light of the comparisons drawn, the objectives of the Navy's research, development, test and evaluation program, the importance of research and development per se, and the critical analysis of the Navy's organization and methodology, conclusions are drawn concerning problem areas and methods of solving these problem areas as well as means of improving the overall research, development, test and evaluation program of the Department of the Navy.

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RESEARCH, DEVELOPMENT, TEST AND EVALUATION
IN THE NAVY

COMMANDER H.B. THOMAS JR. USN
//

5 May 1961

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INTRODUCTION

The Eighty-fourth Congress directed that "The Navy shall develop aircraft, weapons, tactics, techniques, organization, and equipment of naval combat and service elements." With these words, the Congress set forth the responsibility of the Navy in research and development. In essence, research and development is the effective implementation of foresight; it requires broad vision, adequate funding, and, detailed and concrete planning.

In addition, once the vision, funding, and planning have been worked out, research and development requires constant supervision to insure efficient administration, management, and organization. Inasmuch as new techniques in these areas are being developed almost daily, it is further necessary that the Navy re-examine and reappraise its own methods and procedures to insure that the Navy's administration, management, and organization meet the test of the times.

Research and development in the Department of Defense -- and the Navy -- is big business; in 1961 the total Department of Defense research, development, test and evaluation budget was over four billion dollars. Of that amount the Navy's share was about 1.4 billion dollars. In addition to the dollar value, the importance of obtaining new equipment and weapons consistent

with the worldwide state of the art is self evident. The ultimate fate of the United States of America could well depend on her research and development prowess; production alone is not enough, for without a research and development program equal or superior to that of a potential enemy, we might well find ourselves in an indefensible position in a struggle for existence.

The purpose of this paper is to examine the research, development, test and evaluation program in the Navy, appraise its effectiveness, and develop constructive recommendations to enhance its future.

In developing this theme, the organization and philosophies of the Department of Defense, the Army, and the Air Force will be examined in addition to that of the Navy. An attempt will be made to explore the inter-relations which exist among the departments and between the departments and the Department of Defense.

Research, development, test and evaluation in the Navy will be examined in detail to determine whether or not the Navy organization fits its expressed desires and the needs of the Naval Service in this period of dynamic change.

Finally, comparisons will be made among the programs examined, conclusions drawn and recommendations

suggested in the light of objectives desired, and traditions prevailing.

RESEARCH, DEVELOPMENT, TEST AND EVALUATION
IN THE NAVY
CHAPTER I
THE ORGANIZATION FOR RESEARCH AND ENGINEERING
IN THE DEPARTMENT OF DEFENSE

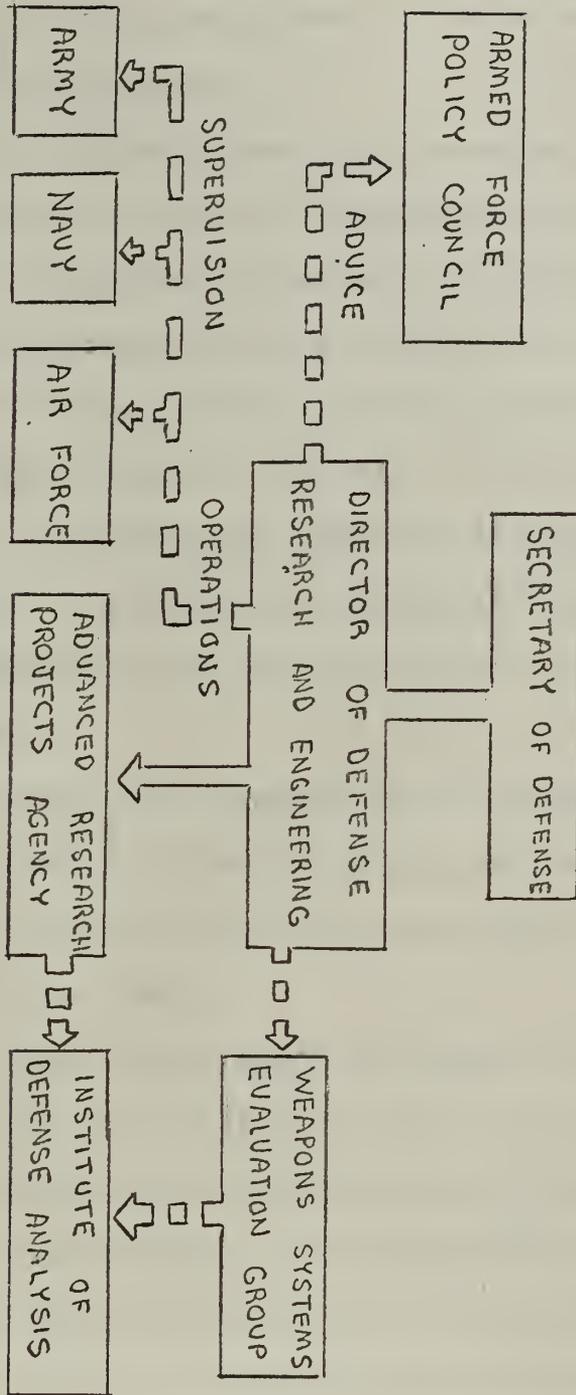
In conformance with recommendations of the Hoover Commission and independent study groups, the former Assistant Secretary (Research and Development) and the Assistant Secretary (Applications Engineering) were combined on 18 March, 1957 into the single position of an Assistant Secretary of Defense (Research and Engineering); this position was further modified under the Reorganization Act of 1958 to a Director of Defense Research and Engineering. The Director ranks just after the three service secretaries.

Since the Reorganization Act of 1958, the Research and Development programs of the Department of Defense have been under the supervision of the Director of Defense Research and Engineering.

The functions of the Director of Defense Research and Engineering include staff as well as line responsibilities.

First, he acts as the principal advisor to the Secretary of Defense on scientific and technological matters.

DEPARTMENT OF DEFENSE ORGANIZATION FOR RESEARCH AND DEVELOPMENT 1



Second, he directs all research and engineering activities in the Department of Defense that need centralized management.

Third, he supervises all research and engineering activities within the Department of Defense.

His responsibility under this mandate includes research and engineering activities of the Army, Navy, Air Force, National Security Agency, Defense Atomic Support Agency, as well as those centrally managed in the Advanced Research Projects Agency. The latter is a separately organized department within the Department of Defense which works in three broad areas:

1. Those too advanced to be included in the specific mission of any of the services.
2. Those of concern to more than one military department.
3. Those which must be handled by an agency not subordinate to one of the services.

To coordinate the research and development programs of the services and the Advanced Research Projects Agency the Director has established (at this writing) six Operational Systems Offices headed by Assistants to the Director. These offices cover:

1. Air Defense.
2. Tactical Weapons

3. Strategic Weapons.
4. Communications.
5. Underseas Warfare.
6. Special Projects.

These offices are in addition to offices in the technical areas of Aeronautics, Electronics, Maintenance Engineering, Human Sciences, and Atomic, Biological, Chemical Warfare, which are also headed by Assistants to the Director.

Supporting the Director in the above is the Weapons Systems Evaluation Group, which provides evaluations of current and proposed weapons systems, conducts field tests of certain systems and weapons, and determines their vulnerability to countermeasures through operations analyses.

Under the Department of Defense Directive which established the Director of Defense Research and Engineering¹, his responsibilities functionally are four-fold, in:

1. Scientific and technical matters.
2. Basic and Applied Research.
3. Research, Development, Test and Evaluation
4. Design and Engineering for suitability, producibility, reliability, maintainability,

¹Department of Defense Directive 5129.1 of 10 February 1959.

and materials conservation.

In carrying out the specific functions related to the fulfilling of these four functional fields, the Director is responsible for:

1. Recommending policies and guidance for planning and program development.
2. Planning and recommending an optimum integrated Research and Development program, and initiate projects to fill known gaps.
3. Reviewing projects, programs, and objectives of the military departments and other Department of Defense Research and Development agencies.
4. Developing systems and standards for administration and management of approved plans and programs.
5. Evaluating administration and management of approved plans and programs.
6. Recommending assignment or reassignment of Research and Development engineering responsibility for the development of new weapons or weapon systems.
7. Directing and controlling Research and Development activities that the Secretary of Defense deems to require centralization.
8. Engaging in or designating appropriate Re-

search and Development facilities to engage in basic or applied research projects pertaining to military requirements, (a) by contract with civilian agencies, (b) through one or more military departments, (c) by utilizing employees or consultants of the Department of Defense.

9. Recommending to the Secretary of Defense appropriate Research and Development funding.
10. Recommending appropriate steps to provide more efficiency, effectiveness, and economical administration of Research and Development projects.
11. Informing the Department of Defense on significant scientific research trends which relate to national security and recommending measures to assure continual progress.
12. Exercising administrative direction of the Weapon System Evaluation Group and assuring its responsiveness to the Joint Chiefs of Staff and Office of the Secretary of Defense.
13. Engaging in programs for assistance to friendly countries in military research and development

This realignment of the Research and Engineering

Office of the Department of Defense was primarily to introduce considerably more centralized control over the entire defense research and development effort than was previously possible. By the exercise of, for all practical purposes, a "veto power" over all Research and Development projects within the Department of Defense, the Director has direct control over the amount of duplication, competition, and project initiation in the area of defense research and development.

While the former Assistant Secretary for Research and Engineering recommended modification, approval (or disapproval) or initiation of research projects in the Department of Defense, these decisions are now made in the Director's office.

Although the law provides that the Director has full authority to direct research and development, the military department research and development funds are not appropriated to him and he has no direct control over the individual management teams. This might appear to be a contradiction of centralized Research and Development control, but close examination will reveal that, to a large extent, this becomes merely academic when the fact is recognized that, while he cannot control the funds of the departments, he can control what they are used for.

If the department wishes to use its research and development funds it must use them on authorized projects or in authorized areas. Likewise, the actual operations of the individual management groups will be determined largely by the policies laid down by the Director of Defense Research and Engineering through the implementation of his responsibilities of program evaluation, program review, and program funding.

CHAPTER TWO

THE ORGANIZATION FOR RESEARCH AND DEVELOPMENT IN THE DEPARTMENT OF THE ARMY

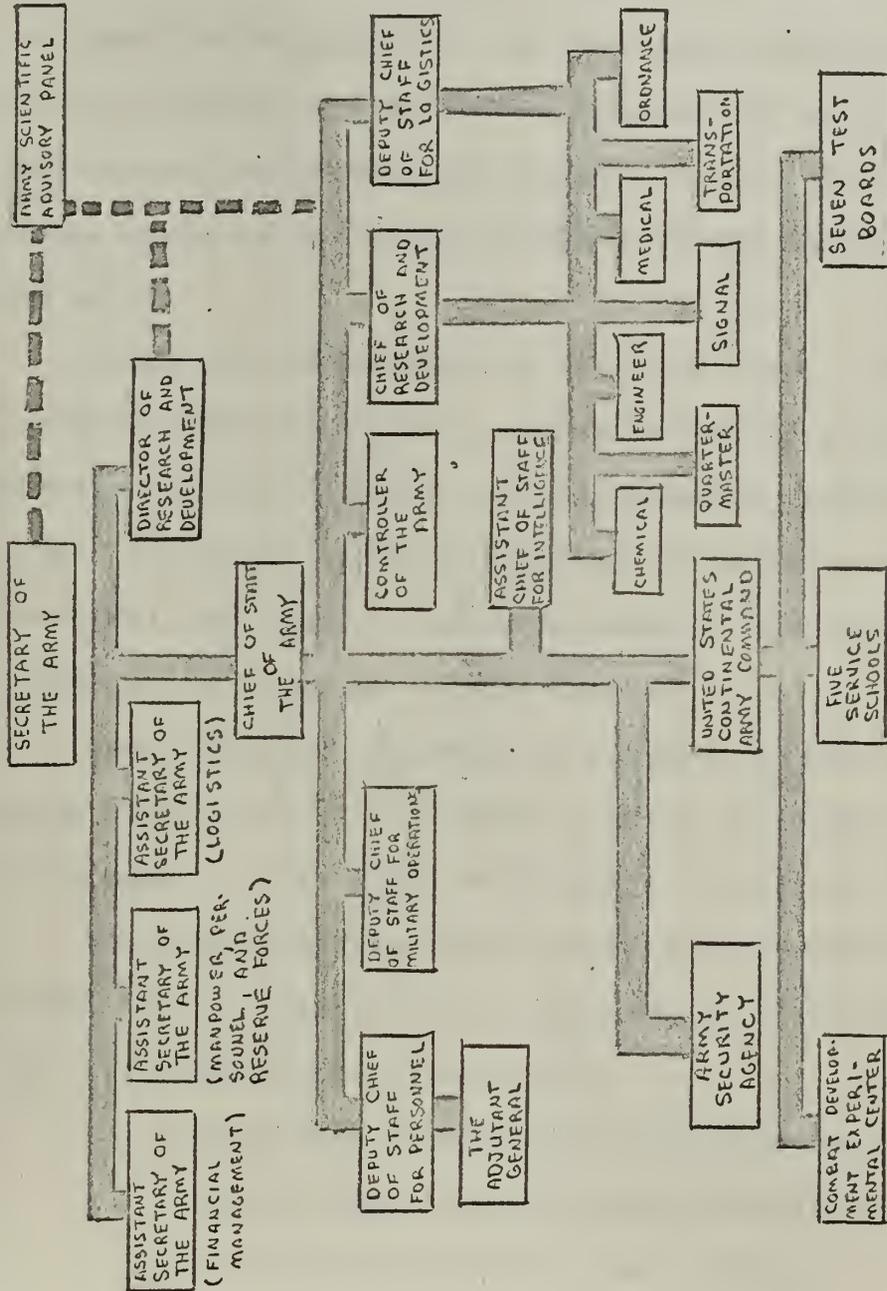
I ORGANIZATION STRUCTURE -- ARMY

Research and Development in the Army is the responsibility of the Secretary of the Army. Secretary of the Army exercises this responsibility through a Director of Research and Development, a civilian post of equal responsibility with the statutorily limited three Assistant Secretaries.

The Director of Research and Development directs overall Army Research and Development through functional policy supervision of the broad policies of the Secretary.

Assisting the Secretary, and working closely with the Director and the Chief of Research and Development, the top military research and development echelon, is the Army Scientific Advisory Panel. This panel, although not in the command or supervisory structure, is composed of eminently qualified scientific and industrial personnel appointed by the Secretary of the Army. The panel is subdivided into sub-panels which concentrate in particular fields and work closely with both the Director of Research and Development and the Chief of Research and Development in developing policies and programs.

ARMY ORGANIZATION FOR RESEARCH, DEVELOPMENT, TEST AND EVALUATION¹



* OPERATIONAL CONTROL ON R&D MATTERS

1. Shirley, Jackson E., "A Better Way To Do The Job" Armed Forces

The Chief of Research and Development is at the Deputy Chief of Staff level and answers directly to the Army Chief of Staff. Chief of Research and Development is responsible for planning, coordinating, and supervising all matters pertaining to Army Research and Development and deals directly with the seven technical services in Research and Development matters.

Below the Department of the Army level, the research and development program is run by action agencies of the Research and Development organization. Two major agencies are the aforementioned technical services -- the developers -- and the Continental Army Command -- the users.

Each technical service is charged with the complete life cycle of a product -- from research, to procurement, to setting maintenance standards.

The United States Continental Army Command (USCONARC) is functionally organized for research and development activities into:

1. Combat Developments which deals with new tactical organizations, new tactics, and use of and requirement for new material.
2. Material Developments which provides military characteristics, monitors new equipment developments, and finally tests the

equipment under field conditions. This function is carried out by six Army Test Boards with definite areas of principal concern. These boards are located adjacent to or in vicinity of their respective combat arms center and service schools.

The boards evaluate the design and tests the mock-up, prototype, and pilot model under field conditions as used by the ordinary soldier. After test and evaluation, the boards make its recommendation to the Chief of Research and Development.

The Office of the Chief of Research and Development is organized on a directorate and division basis. The Director of Plans and Management has overall management in the Office of the Chief of Research and Development. The Research Directorate (Army Research Office) has the vast research area under its supervision, and the Special Weapons and Development Directorates work primarily with material.

II PHILOSOPHY OF RESEARCH AND DEVELOPMENT -- ARMY

The philosophy of Research and Development in the Army is characterized by three primary concepts; one, centralization of the Research and Development program, two, reliance on an "in-house" capability, and three, dependence on a healthy relationship in

many informal organizations.

As a result of the work of the Roderick Board appointed by the Secretary of the Army to "conduct a study to determine the adequacy of the Army's present Research and Development organization and philosophy of operations and to make such recommendations as appear to enhance the effectiveness and capability of the Army's Research and Development Program" the following conclusions were reached:

1. Use of many industrial practices is affected by fundamental differences between private and governmental agencies.
2. Many industrial practices such as treating research and development as a line function, technical service organization on a commodity basis, and programs guided by potential military value of research results, have been used by the Army for some time.
3. Following industrial practices of true delegation of authority and responsibility and providing guidance and control on a broad basis at higher levels of management although desirable is limited by the differences between private and government agencies.
4. Modified use of certain industrial practices

is feasible and desirable; these include:¹

- a. Greater continuity of service for military Research and Development personnel.
- b. Relative stability of Research and Development effort at the funding level.
- c. Recognized research duplication and controlled competition.
- d. Distinct authority and control lines.

To implement the findings of this board, the recent reorganization of the Army Research and Development effort has provided the following additional centralization insurance:

1. Chief of Research and Development now controls research and development activities of the technical services through a line of authority paralleling that of the Deputy Chief of Staff for Logistics (for logistics only).
2. Chief of Research and Development now has directive authority in all matters primarily concerned with research, development, test and engineering.

¹Shirley, Jackson E. (Col.USA), "A Better Way to Do the Job", Armed Forces Management, December 1960, p18.

3. Chief of Research and Development now controls military and civilian Research and Development personnel positions in the technical services.

These recent changes, combined with the control and allotment of all research and development funds, the responsibility for assignment of research and development responsibilities, and forming and supervising those portions of the budget pertaining to research and development provides highly centralized control of Army Research and Development by the Chief of Research and Development.

Conducting the major part of Army basic and applied research in government-controlled laboratories operated by the seven technical services, is the second fundamental concept of the Army research and development philosophy.

In supporting this concept, the Army points out the following advantages to maintaining an "in-house" capability:

1. It helps keep contractors honest in the development and production phases by having technically proficient personnel on hand at all times.
2. Service laboratories possess unique capabilities, facilities, and experiences more closely

allied with capabilities of the military.

3. Service laboratories have better knowledge of military requirements.
4. These laboratories create and maintain continuity of technical and administrative competence in design, evaluation and direction of projects.
5. Advantages result from distinct lines of authority and control.
6. Recognized and controlled duplication and competition are maintained.
7. Service laboratories provide funds and facilities for research into areas of doubtful interest to industry and University research.

Recent indications, however, indicate that the Army, while not abandoning the "in-house" philosophy, is modifying it somewhat. At a recent presentation LTGEN Arthur G. Trudeau, Chief of Army Research and Development, stated¹:

Although "in-house" capability pays high dividends in the form of creating and maintaining technical and administrative competence in

¹Trudeau, Arthur G., "Management -- Prime Key to Research and Development", Conference on Management Problems of Military Research and Development, Test and Evaluation, July 1960, p. 9.

the design, evaluation, and direction of projects, we do seek a balance between ever-increasing installation and operating costs and the competency but pyramiding cost of private industry.

Within the Army, I am convinced that little further expansion should be authorized (although coordination must be further improved) in our "in-house" research and development facilities and activities, and that we must make maximum use of the competence and experience of qualified industrial laboratories.

Although the existence of a healthy relationship among informal organizations is the goal of all cooperative enterprises, its attainment is mandatory in the Army Research and Development Organization. With certain members of the technical services wearing two hats -- one for Research and Development, and the other for the parent technical service -- any conflict would have a serious effect on the overall effort. In addition, at the Pentagon level, with the Chief of Research and Development having material research and development and the operations people having the tactics, without excellent cooperation and informal joint effort a solid working relationship between the strategists and research and development personnel that develop the hardware could easily break down.

CHAPTER THREE
THE ORGANIZATION FOR RESEARCH AND DEVELOPMENT
IN THE DEPARTMENT OF THE AIR FORCE

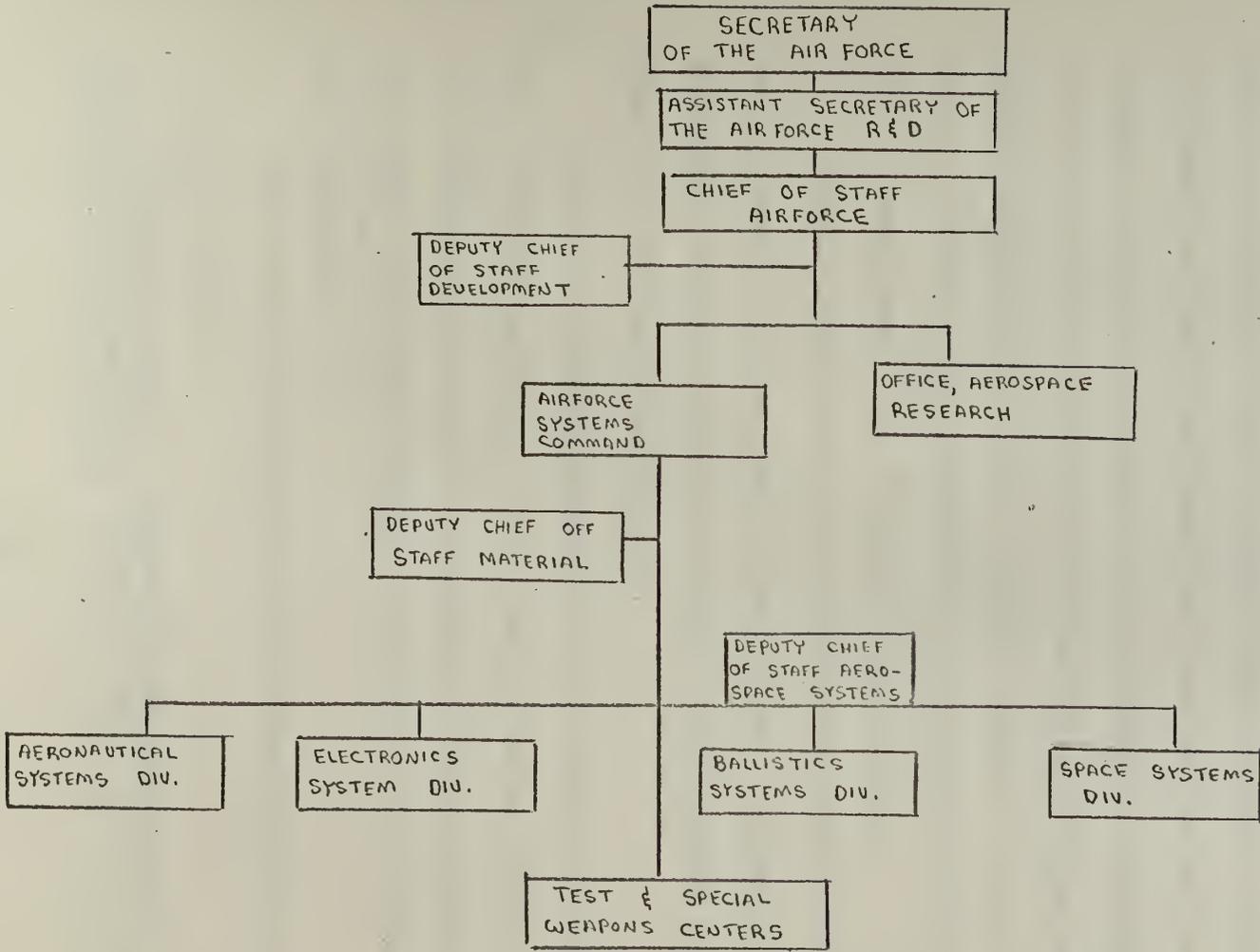
I ORGANIZATIONAL STRUCTURE -- AIR FORCE

The one word which can be used to describe research and development organization in the Air Force is dynamic. Ever since its creation, the Air Force has been organizing, reorganizing, and modifying its Research and Development organization.

The most recent organization was triggered by the placing of the lion's share of space programs responsibility under the cognizance of the Air Force and is still not completely firmed up. There is no guarantee that the organization described herein is still accurate; it is a certainty that it will be modified with time.

As presently organized, the Assistant Secretary of the Air Force (Research and Development) is responsible for acting and advising the Secretary of the Air Force in matters of research and development, requirements, integration of technology with military requirements, and procurement planning.

The primary working relationship of the Assistant Secretary of the Air Force Research and Development in dealing with the Air Staff is with the Deputy Chief of Staff (Development), and in the operating organization with the Commander, Air Force Systems



Command. (Formerly Air Research and Development Command.)

The Deputy Chief of Staff (Development) is responsible to the Chief of Staff for supervision and management, at the Air Staff level, for all research and development within the Air Force. Organizationally, the Deputy Chief of Staff Development office includes two Assistant Deputies, one acting as the "alter ego" of the Deputy Chief of Staff Development and the other in charge of the Air Force-Navy-Atomic Energy Commission Nuclear Systems program. In addition, there is an Assistant to the Deputy Chief of Staff Development for Foreign Developments.

Finally, the office of the Deputy Chief of Staff Development includes four directorates: Development Planning, Research and Technology, Development Programming, and Systems Development

Under this organization¹, the Director of Development Programming works with other members of the staff to coordinate the entire research and development program with the major segments insuring proper balance and emphasis.

The Director of Research and Technology assumes

¹"The Air Force -- Research and Development"
Armed Forces Management, November 1959, pp. 122-123.

responsibility when a given system is approved, funded, and ready to go. He maintains close liaison with the Deputy Chief of Staff Material and watches over the program while it is being produced, tested, and readied for the operating forces. This Directorate also supervises Air Force work in basic and applied research.

The Director for Development Planning is responsible for developing broad term guidance for future systems; by working with RAND Corporation, it studies future wars and the weapon systems that will be necessary to fight them.

The Director of Systems Development is in charge of all weapon systems programs. A Director of Advanced Technology reports to the Director of Systems Development as a Deputy for his area of responsibility. He is the focal point for space matters liaison with NASA.

All basic and applied research, formerly under various offices of the Air Research and Development Command, is now consolidated under a new Office of Aerospace Research, reporting directly to the Headquarters, Air Force.

The operating command under the Deputy Chief of Staff (Development) is the Air Force Systems Command, recently created out of the Air Research and Development Command and segments of the Air Material

Command. The new command has sole responsibility for acquisition and development of missiles and space systems, including contracting and funding, until the missile or system is turned over to the user.

The organization of the Air Force Systems Command is made up of four functional divisions which exercise management, development, procurement, and testing responsibility within their own area of interest. These divisions are: Space Systems, Ballistics Systems, Aeronautical Systems, and Electronic Systems.¹

¹Missiles and Rockets, March 27, 1961, p. 15.

II PHILOSOPHY OF RESEARCH AND DEVELOPMENT -- AIR FORCE

According to the Air Force their philosophy concerning research and development is consistent with their basic organizational philosophy throughout the Department: to organize for functionality, flexibility, decentralization, and simplicity.

The Air Force organization is a complex combination of centralization and decentralization. It is decentralized execution in a centralized structure.

The Deputy Chief of Staff (Development) exercises centralized control through supervision, management, and funding control over the entire Air Force research and development effort. On the other hand, there is almost complete delegation of authority to the Commander, Air Force Systems Command, and, through him, throughout the entire research and development organization, making it highly decentralized in execution.

Another characteristic segment of Air Force research and development philosophy is their attitude concerning "in house" research and development capacity. The Air Force maintains that while a limited capability in research is desirable within their own establishment, the majority of such work should be done through contracts with industry and educational institutions. This philosophy is succinctly stated by Lt. General B. A. Shriever, Commander, Air Force

Systems Command, as follows¹:

At the end of World War II, the military services had an "in house" capability sufficient to maintain a force in being, and to improve incrementally the performance of our systems. But the growth of technology has forced us to apply more and more technical management to our programs.

Within the past few years, the weapon system concept has come to the front. This is not just an arbitrary or theoretical approach. It is a concept forced upon us by the rapidity with which new developments have been brought into being. Weight, size, and performance are more critical than ever before. The interrelationship of each subsystem to the over-all weapon system assumes major importance. Today there is an overriding need for integration among several weapon systems. This is particularly true in the command and control areas.

The increasing complexity of our systems, the increasing advent of new technologies, have made it more apparent that no single contractor could be best qualified in each of the myriad of specialized sciences.

He further states:

To bring the special capability of each industry to bear, while at the same time recognizing the interrelationship of all, has made it necessary for the Air Force to call into being new agencies, concerned primarily with engineering the total system and with the integration of the various subsystems.

I do not want to minimize the outstanding contributions made by our Air Force engineers

¹Shriever, B. A., Lt. General, United States Air Force, "Management's Key to Survival", Air Force and Space Digest, December 1960, p. 104

and scientists in our own laboratories. However, the very nature of this meeting (Editor note; Industry Seminar of the 1960 Air Force Association Convention at San Francisco, September 23, 1960) and the large expansion in the budget for research and development are two indications of a sharply accelerated growth in our requirements.

A basic follow-on in this philosophy is the Air Force-Industry team concept that is continually referred to in any articles concerning Air Force research and development.

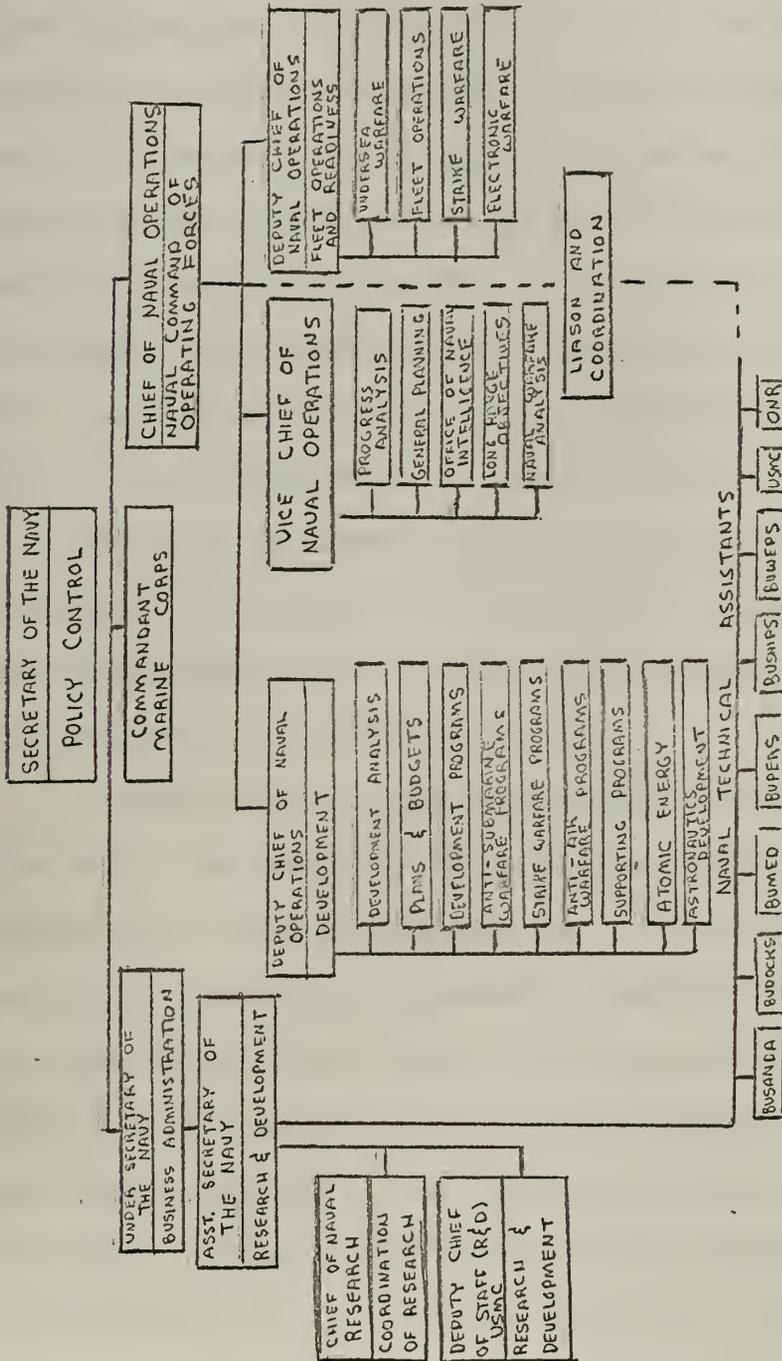
CHAPTER FOUR
THE ORGANIZATION FOR RESEARCH AND DEVELOPMENT
IN THE DEPARTMENT OF THE NAVY

I ORGANIZATIONAL STRUCTURE -- NAVY

As a result of the Committee on Organization of the Department of the Navy, the so-called Franke committee, four significant findings evolved which had a direct effect on the current Navy Research and Development Organization. First, the Franke committee reaffirmed the traditional Navy concepts of decentralized authority and responsibility, and the bilinear structure of Navy Organization. Second, the Bureau of Ordnance and Bureau of Aeronautics were joined to form the Bureau of Weapons; and finally, two key positions were created and filled: an Assistant Secretary of the Navy for Research and Development, and a Deputy Chief of Naval Operations for Development. These positions grew out of the increasing emphasis on research and development in the defense establishment.

Research, Development, Test and Evaluation (RDT&E) in the Navy follows both the bilinear and decentralization of authority and responsibility concepts traditional within Naval Organization. The bilinear structure of the Navy commences immediately

THE NAVY ORGANIZATION FOR RESEARCH, DEVELOPMENT, TEST AND EVALUATION



under the Secretary of the Navy; it consists of two separate chains of command: one for the business administration, the other for military command. The business administration side, under the Under Secretary of the Navy, is primarily concerned with providing equipment, material, personnel and services to meet military requirements. The military command side under the Chief of Naval Operations works mainly with operations, training, and developing the capabilities and readiness of Naval forces.

There is no direct line of authority between operating forces and the bureaus and offices (the business administration side) of the Navy except through the Secretary of the Navy.

In the Research and Development Organization of the Navy, the business administration side of the bilinear structure is headed by the Assistant Secretary of the Navy for Research and Development who is immediately below the Under Secretary of the Navy. Under the Assistant Secretary for Research and Development are the Chief of Naval Research and the six Technical Bureaus. The Chief of Naval Research is responsible for the research program of the Navy and for advising the Assistant Secretary for Research and Development on research matters. The six technical bureaus and the Office of Naval Research are respon-

sible to the Assistant Secretary of the Navy (Research and Development) for planning, initiation, conduct and business administration of their own research and development programs and report to him for prosecution of projects to support specific requirements of the Chief of Naval Operations, Commandant of the Marine Corps, and Chief of Naval Research.

These bureaus and offices perform a dual function:

1. They manage and conduct research and development efforts.
2. They procure equipment and weapons required by the operating forces.¹

Technical and fiscal management for each program is maintained by the parent bureau or office concerned.

On the military side of the organization, the Deputy Chief of Naval Operations (Development) is charged with the planning, coordinating and integrating Research, Development, Test and Evaluation for the Chief of Naval Operations. He is responsible for coordinating the formulation of operational requirements for research and development which come from the Deputy Chief of Naval Operations for Fleet

¹Holmquist, Carl O., Capt., United States Navy, "New Look in Navy Research -- the Organization", Armed Forces Management, December 1960, p. 19.

Operations and Readiness through the warfare desks. These requirements are issued to the appropriate bureaus for action.

In addition, the Deputy Chief of Naval Operations (Development) coordinates the research, development, test and evaluation program of the Navy and Marine Corps to insure that the effort is responsive to long range objectives, immediate requirements, fiscal limitations and advancing technology. The Deputy Chief of Naval Operations (Development) also advises the Assistant Secretary of the Navy (Research and Development) on the Navy development, test and evaluation program.¹ Long range objectives are provided by the Vice Chief of Naval Operations and play an important part in the formulation of the Navy's research and development program.

Coordination of the research and development programs take place within both sides of the bilinear structure as well as between the two sides.

On the military side, the Navy Research and Development Review Board, made up of representatives of the warfare desks, the Chief of Naval Research, and chaired by the Deputy Chief of Naval Operations

¹Navy Management Review, December 1960, pp. 6-7.

(Development) reviews the Research, Development, Test and Evaluation program and attempts to insure that the requirements of the operating forces are listed in true priority within the funding targets.

On the other side of the structure, representatives of the bureaus and offices as well as the Chief of Naval Research and the Deputy Chief of Naval Operations (Development) are formed into the Navy Research and Development Committee chaired by the Assistant Secretary of the Navy (Research and Development). This committee advised the Assistant Secretary of the Navy (Development) on research and development matters and reviews the overall Navy Research, Development, Test and Evaluation program and advises him as to the fiscal and technical aspects.

In summary, there is technical research and evaluation coordination on the bureau side, and there is coordination of the military requirements of the research and development program on the military side of the house. Finally, there is top level coordination when the Assistant Secretary of the Navy (Research and Development) and the Deputy Chief of Naval Operations (Development) confer.

On the following pages, the individual organizations within the Naval Establishment most concerned

with the Research and Development will be examined. This examination will be limited to the Office of the Deputy Chief of Naval Operations (Development) and the "big three", the Office of Naval Research, the Bureau of Weapons, and the Bureau of Ships. These three organizations account for over ninety per cent of the Navy's Research, Development Test and Evaluation budget.

II ORGANIZATION OF THE OFFICE OF NAVAL RESEARCH FOR RESEARCH, DEVELOPMENT, TEST AND EVALUATION

The mission of the Office of Naval Research as set forth by Public Law 588 is:

to plan, foster, and encourage scientific research in recognition of its paramount importance as related to the maintenance of future naval power . . . and . . . to provide within the Department of the Navy a single office which, by contract and otherwise, shall be able to obtain, coordinate and make available to all bureaus and activities of the Department of the Navy, world-wide scientific information and the necessary services for conducting specialized and imaginative research . . .

The Office of Naval Research is, in a manner of speaking, the operating unit of the Assistant Secretary of the Navy (Research and Development). It is charged with acting as the scientific staff for the Secretary of the Navy. In fulfilling this mission, the Office of Naval Research (ONR) maintains and utilizes its own "in-house" facilities as well as contracting out with private industry, educational institutions, and other non-profit foundations and organizations.

The Chief of Naval Research exercises management and technical control of the following research facilities or offices:

1. U. S. Naval Research Laboratory, Washington, D. C.
2. U. S. Naval Training Device Center, Port

Washington, Long Island, N. Y.

3. U. S. Navy Underwater Sound Reference Laboratory, Orlando, Fla.
4. Office of Naval Research Branch Offices (Boston, New York, Chicago, Pasadena, San Francisco, and London).

The Chief of Naval Research also provides budgeting, accounting, and related reporting services for the Assistant Secretary for Research and Development that he needs for management and control of the Navy research, development, test and evaluation appropriation.

The Office of Naval Research, under the Chief of Research, includes a Research Advisory Committee, and four administrative branch heads:

Comptroller

Contract Division

Civilian Personnel and Services Division

Military Services Division

Under the Assistant Chief of Research, are the three operating directorates. These directorates include the Naval Research Directorate which is further divided along program lines into the following administrative divisions:

1. Earth Sciences Division
2. Material Sciences Division

3. Physical Sciences Division
4. Psychological Sciences Division
5. Mathematical Sciences Division
6. Biological Sciences Division
7. Naval Sciences Division

In addition, are the Naval Applications Directorate and the Naval Analysis Directorate concerned with systems analysis and warfare analysis.

The majority of basic research in the Navy is conducted through the Office of Naval Research either by its own "in-house" capability or by contracts with outside sources. In addition a limited amount of applied research is done within the same framework. In any case, all basic research within the Naval Establishment is under the coordination of the Office of Naval Research.

III ORGANIZATION OF THE BUREAU OF NAVAL WEAPONS RESEARCH, DEVELOPMENT, TEST AND EVALUATION

The Bureau of Naval Weapons came into existence as a result of the report of the Franke Committee. It is the result of merging the Bureau of Aeronautics with the Bureau of Ordnance on 1 December 1959.

The Research, Development, Test and Evaluation organization of the Bureau of Naval Weapons represents about one third of the total military and civilian strength of the entire bureau. This is due to the fact that the Bureau of Naval Weapons accounts for the largest portion of the Navy Research, Development, Test and Evaluation budget. It is responsible for all development, nearly all of the applied research, some of the basic research, technical evaluations and program management of most of the aircraft, and weapon systems, support systems and equipment planned for the fleet.

One of the difficulties in organizing the Bureau of Naval Weapons, Research, Development, Test and Evaluation is in the difficulty in matching the organization functionally with the needs of the fleet. The operating forces require hardware; research and development however, more logically follow subject matter areas such as guidance, propulsion, explosives

etc. Organization based on specific needs of the user is not practical.

The organization of research, development, test and evaluation in the Bureau of Naval Weapons, therefore, is established primarily as a horizontal organization of functional elements. Superimposed over this, in a vertical structure are the system project officers.

The Bureau of Naval Weapons provides the Navy with a considerable "in-house" capability in research and development. Under the Bureau there are twenty-seven research and development field activities in selected technical fields. These laboratories and facilities provide the bulk of the applied research and development efforts necessary within the area of responsibility of the Bureau of Naval Weapons although a limited amount of basic research is also undertaken by these activities.

In addition, some of these facilities with specialized instrumentation and equipment are used as technical evaluation centers for testing equipment for proper technical performance.

The Research, Development, Test and Evaluation Organization of the Bureau of Weapons is under the cognizance of the Assistant Chief of the Bureau of Naval Weapons for Research, Development, Test and

Evaluation. The Assistant Chief is responsible to the Chief of the Bureau for the development of planning and supervising authorized research, development, test and evaluation programs to meet the requirements of the Chief of Naval Operations for new and improved weapon systems, support systems, and associated equipment. He is also responsible for the accomplishment of basic, applied, and supporting research programs in the areas of technology which may yield new fundamental concepts, physical laws, and devices applicable to naval weapons. He is given authority to direct and control the work and the staff of the Bureau and field-support activities performing research, development, test and evaluations.¹ To assist him in policy control and as aids in decision making he has four special civilian assistants:

1. Chief Scientist
2. Chief Engineer
3. Chief Mathematician
4. Chief Materials Engineer

Directly under the Assistant Chief of the

¹Stroop, Paul D., "Bureau of Naval Weapons" Ordnance, January-February 1960, p. 565.

Bureau for Research, Development, Test and Evaluation, are four military administrative echelons, Plans Officer, Programs and Budget Officer, Services Officer, and Weapons Systems Analysis Officer. The operational assistants, also directly under the Assistant Chief are:

1. Research and Engineering Officer
2. Aircraft Officer
3. Missile Officer
4. Antisubmarine Officer
5. Ship Installations Division
6. Astronautics Officer

The aforementioned project officers come under these operational assistants.

IV SPECIAL PROJECTS OFFICE -- BUREAU OF WEAPONS

No mention of the Research and Development effort of the Navy would be complete without a mention of the Special Projects Office of the Bureau of Weapons -- its past -- its present -- and its future.

By virtue of the large degree of success of the Polaris Missile System, Special Projects has achieved world wide recognition. It is basically a unique management system, highly centralized, and with almost autonomous control over men, material, and money assigned to the project.

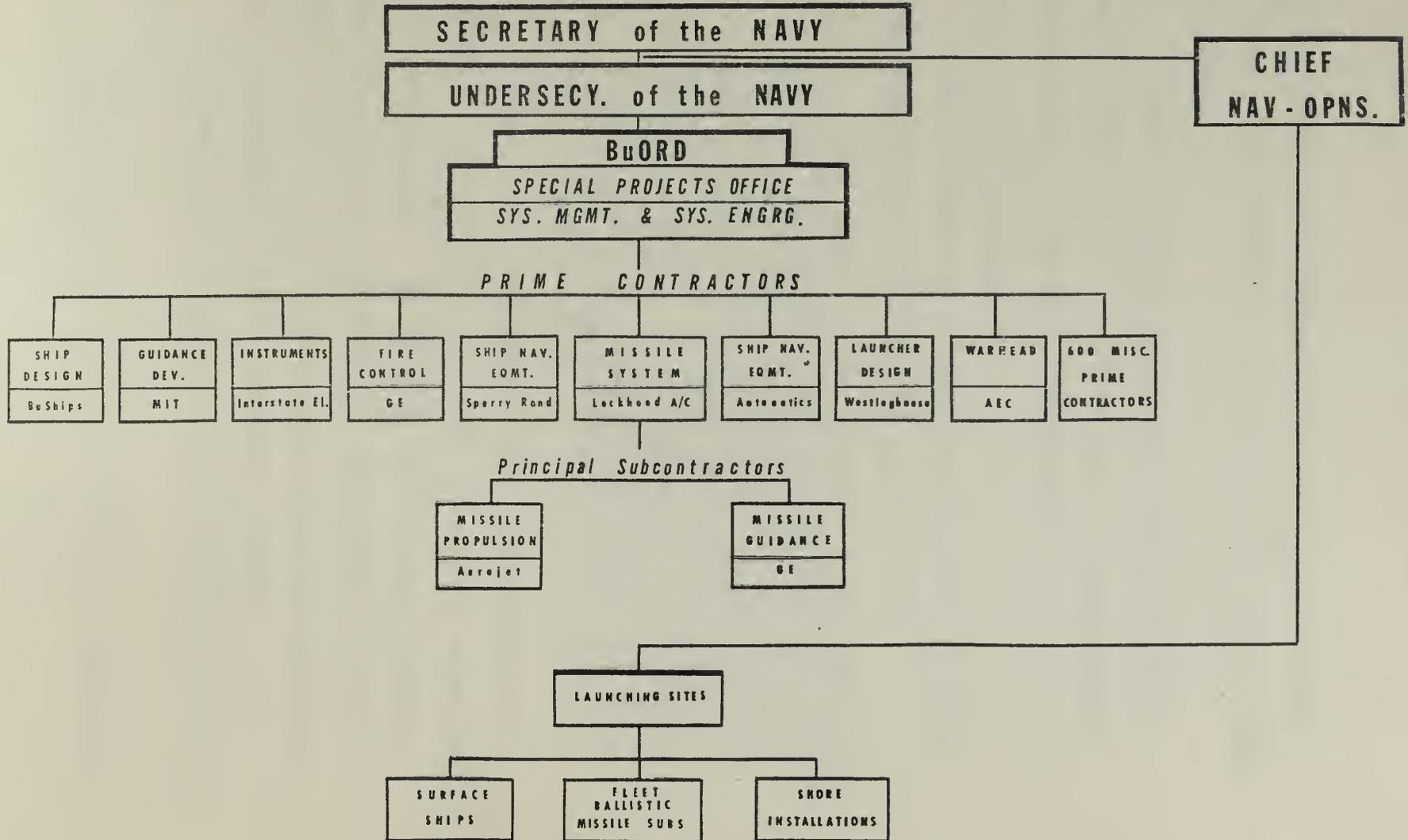
Aside from the factor of a motivation of high purpose which enables Special Projects to recruit and retain dedicated personnel, the Special Project Office has several management facets heretofore unique to the military.

First, funds for the Polaris program are placed in a separate management fund. This fund can be used in any part of the program and no part of them are specifically designated by statute or edict except as directed by the Director of the Special Projects Office. These special budgetary arrangements offer a streamlined and strengthened fiscal procedure for estimating, controlling, and accounting for funds.

Second, the Polaris program was given the highest priority; men, money, and material were

POLARIS MISSILE ——— MANAGEMENT COMPLEX

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immediately available -- both within and outside of normal Navy channels -- for the prosecution of this program.

Third, a unique program-management team was established responsible directly to the Secretary of the Navy. This program-management team was the Special Projects Office.

To quote Mr. G. O. Pehrson, director of plans and programs of the Special Projects Office:

The scope of the director's responsibility is as broad as the scope of the approved program itself. It grows as the program has grown. The scope of his authority is in balance with his responsibility, and he has responsibility for defining, scheduling, and assigning the work that has to be done to carry out the approved program. He has authority to require coordinate response to his assignments regardless of where the work is to be done and he has control of the resources required to support his assignments.¹

Special Projects Office deals directly with industry both in technical matters and in connection with procurement. It acts as an "in-house" management contractor, and provides the operational input of knowledge to the contractor necessary to the design, production of an operational system.

To perform the vast and highly important function

¹Pehrson, G. O., "Missile Management", Ordnance, July-August, 1959. p. 20.

of programming and planning, the Special Projects Office has established a program-planning control system unique in concept and operation. Called PERT (for Program Evaluation and Review Technique), the system is both simple in form and concept and comprehensive in program coverage. PERT is the closest thing to a systemized approach to scheduling and programming research in existence today. Through its reporting system which ties every separate unit of the system to the master system in terms of inter-relationship and time schedule, PERT through computer calculations permits up to date display of development and production events in management terms; it highlights current areas that need attention, and predicts the potential problem areas of the future.

V ORGANIZATION OF THE BUREAU OF SHIPS FOR
RESEARCH, DEVELOPMENT, TEST AND EVALUATION

In keeping with the Navy's emphasis in the field of research, development, test and evaluation, the Bureau of Ships has recently created an Assistant Chief for Research and Development. The new Assistant Chief is responsible directly to the Chief of the Bureau of Ships in matters concerning the Bureau's effort in all research, development, test and evaluation matters with the exception of nuclear propulsion.

The Assistant Chief for Research and Development is responsible for planning, scheduling, directing, budgeting, reviewing and accounting of the Bureau's research, development, test and evaluation programs.¹ He is further authorized to utilize technical personnel assigned to other areas within the Bureau of Ships.

The research and development programs of the Bureau of Ships covers all aspects of building and powering of ships as well as the development of specialized, new, or improved equipments to enable these ships to carry out their assigned missions.

¹Navy Management Review, December, 1960, p. 20.

As in the Bureau of Naval Weapons, the Bureau of Ships supports a sizable "in-house" capability in her eight laboratories. About one third of its money is spent within the "in-house" capability, and the other two thirds with private industry and non-profit institutions.

The organization of the Office of the Assistant Chief of the Bureau of Ships for Research and Development contains an administrative assistant, a consulting statistician, and a technical analysis and operations research staff.

Directly under the Assistant Chief are the six operating divisions:

1. Laboratory Management Division
2. Research and Development Planning Division
3. Applied Research Division
4. Advanced Concepts Division
5. Warfare Systems Division
6. Antisubmarine Warfare and Ocean Surveillance Division.

VI ORGANIZATION OF THE OFFICE OF THE

DEPUTY CHIEF OF NAVAL OPERATIONS (DEVELOPMENT)

Within the Office of the Chief of Naval Operations, the Deputy Chief of Naval Operations (Development) has centralized control over research, development, test and evaluation programs. He is responsible that the research, development, test and evaluation effort is responsive to current and future military requirements.

In fulfilling these responsibilities, the Office of the Deputy Chief of Naval Operations (Development) is organized under the Deputy Chief of Naval Operations as follows: Directly under him is the Assistant Chief of Naval Operations (Development), a Director of Development Planning, and a Director of Development Programs. All of these positions are filled by Rear Admirals.

The Office is further divided into nine divisions and groups of specialized interest as follows:

1. Atomic Energy
2. Astronautics Development Division
3. Advanced Technology Group
4. Anti-Air Warfare Programs
5. Development Analysis Group
6. Plans and Budget
7. Antisubmarine Warfare Programs

8. Supporting Programs

9. Strike Warfare Programs¹

These directorates and divisions are responsible to the Deputy Chief of Naval Operations (Development) in their respective areas for the coordination of operational requirements, for research and development, and the coordination and integration of the Navy Research, Development, Test and Evaluation program to insure responsiveness and adequacy.

¹Navy Management Review, December 1960, p. 8

CHAPTER FIVE
THE RESEARCH, DEVELOPMENT, TEST AND EVALUATION
CYCLE IN THE NAVY

BASIC RESEARCH

The majority of the basic research in the Navy is conducted by or through the Office of Naval Research although a small part of the total effort is conducted by the bureaus and offices through an "in-house" capability or through contracts with industry or educational institutions. All basic research, however, regardless of source, is coordinated by the Chief of Research.

Currently, the Office of Naval Research, conducts only about twenty per cent of its basic research in its own laboratories and facilities. Virtually all of the research supported by the Office of Naval Research in these outside institutions results from unsolicited research proposals from scientific personnel seeking to solve problems within their own areas of interest. Contract awards are based on the individual competence of the proposer, the pertinancy of the project to the Navy, the potential advantage of the proposal in filling gaps in our overall research picture, and, of course, the funds available

to support this research.¹

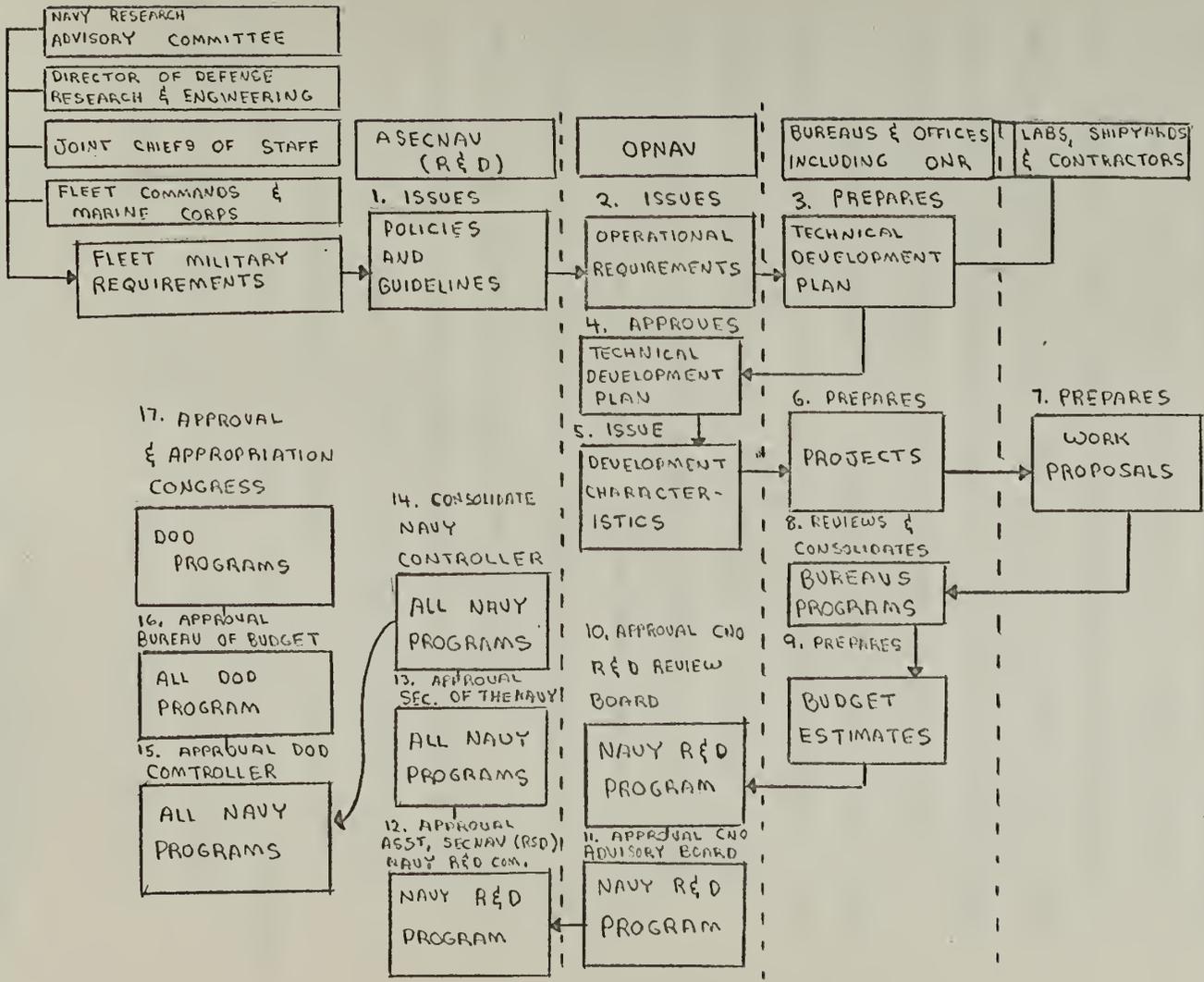
APPLIED RESEARCH

Applied research is done mainly by the technical bureaus with only a small part of the total being done by the Office of Naval Research. Most Applied Research is done in response to Chief of Naval Operations requirements. Applied Research and Development is coordinated and integrated by the Deputy Chief of Naval Operations (Development).

In conducting their applied research, the Bureaus rely on a combination of "in-house" and contracted sources. The decision on whether to select one of the Navy's facilities or whether to contract out the particular applied research project depends on the talents, facilities and funds available or necessary at the time.

A specific research and development project can originate in many ways. It can originate in response to the Navy's Long Range Objectives, a plan prepared in the Office of the Chief of Naval Operations covering a period extending about fifteen years into the future. This plan is based on a predicted military threat, trends in national policy, and the pre-

¹Navy Management Review, December 1960, p. 11.



1. "New Look in Navy Research: Management techniques" ANALYSIS FORG-3
 MANAGEMENT SEPTEMBER 1960, p.1

dicted state of the technical arts.

In addition, research and development can originate in response to the individual Bureau Long Range Plans which are developed consistent with the Navy Long Range Objectives, Chief of Naval Operation's Medium Range Plans and the Annual Program Objectives and which provides guidance on systems and equipment desired and expected within three to five years.

Another source of research and development projects is the System Concepts. A System Concept expresses in general physical terms a system to support research and development planning objectives and Navy Strategic Plans. These are prepared by the Chief of Naval Operations and the Marine Corps Commandant to present general performance for systems expected to be developed during time periods coinciding with those of the Long Range Objectives.¹

A large number of research and development projects, however, originate from the fleet. Someone in the operating forces sees a need, or envisions a possibility for either a new equipment, or an

¹ Holmquist, Carl O., "New Look in Navy Research: Management Techniques." Armed Forces Management, September 1960, p. 26.

improvement in something currently in use and submits it to the Office of the Chief of Naval Operations.

In the Office of the Chief of Naval Operations the idea is reviewed by the Weapons or Support Systems Division (Op-03) or Aircraft Division (Op-05). If the review is favorable the cognizant division prepares an "Operational Requirement" for promulgation by the Deputy Chief of Naval Operations (Development). An Operational Requirement is a statement addressed to a bureau or office, outlining in broad terms specific performance to be attained in a specific equipment or weapon. Formulation of these Operational Requirements is based on need and technical feasibility within the projected state of the art. Although development of new equipment will probably call for some basic or applied research, it is likely that some or all research necessary will have been completed prior to the issue of an Operational Requirement. If such Research is still needed, it is conducted by the Office of Naval Research or the cognizant Bureau as necessary.

The Deputy Chief of Naval Operations (Development) promulgates the Operational Requirement to a lead or action technical bureau. If the project developed by the Operational Requirement involves

the joint effort of two or more technical bureaus, the bureau with the greatest responsibility is designated the lead bureau.

In the case of Operational Requirements of complex equipments and systems, additional information is provided to the development bureaus in the form of Development Characteristics. Prepared by the cognizant Division in the Office of the Chief of Naval Operations, and coordinated and promulgated by the Deputy Chief of Naval Operations (Development), these Development Characteristics give performance requirements, physical parameters and time phasing for completion of development in greater detail than the Operational Requirement. Development Characteristics are sent to a specific bureau for action, and upon receipt the bureau prepares a Technical Development Plan (TDP).

The Technical Development Plan is based on the Operation Requirement and the Development Characteristics, and is basically a recommended approach to the project by the lead bureau. The Technical Development Plan will include proposed funding level, as well as detailed resumes of characteristics of equipment components and sub-systems and all other amplifying information necessary to the program.

Copies of the Technical Development Plan are

sent to the Chief of Naval Research for technical review and coordination with existing research programs, and simultaneously reviewed by the cognizant Division of the Chief of Naval Operations and approved or modified by the Deputy Chief of Naval Operations (Development). Upon approval of the Technical Development Plan, the lead or action bureau commences design and development.

Design and Development are performed entirely by the cognizant bureau or bureaus. This work can be done either by the bureau's own "in-house" facilities or contracted out to industry. The design and development phase includes the actual production of the hardware and the technical evaluation of prototypes and/or production models. Technical evaluation, as differentiated from operational evaluation, is the appraisal by the developing agency of a system equipment or component to ascertain whether or not it meets original requirements and design specifications and is technically suitable for service use.

As work progresses during the design and development phase, the Deputy Chief of Naval Operations (Development) monitors it, appraises it success, and feeds into it any new requirements or modifications.

After technical evaluation (or in many cases

concurrent with it) operational evaluation takes place under the direction of the Operational Test and Evaluation Force, a fleet operating command. When the lead bureau certifies that the equipment or system is ready for operational evaluation it so notifies the Chief of Naval Operations. The Chief of Naval Operations through the Deputy Chief of Naval Operations (Development) directs the Operational Test and Evaluation force to prepare and execute a test plan. The purpose of this operational evaluation is to ascertain how the equipment operates in the fleet environment when operated by fleet personnel. Also evaluated or developed by Operational Test and Evaluation Forces are the adequacy of training procedures associated with the new equipment, the ease of maintenance and tactics or techniques applicable to the equipment or system.

Acceptance of the equipment or system is based on the recommendations resulting from these evaluations, and upon assured logistical suitability.

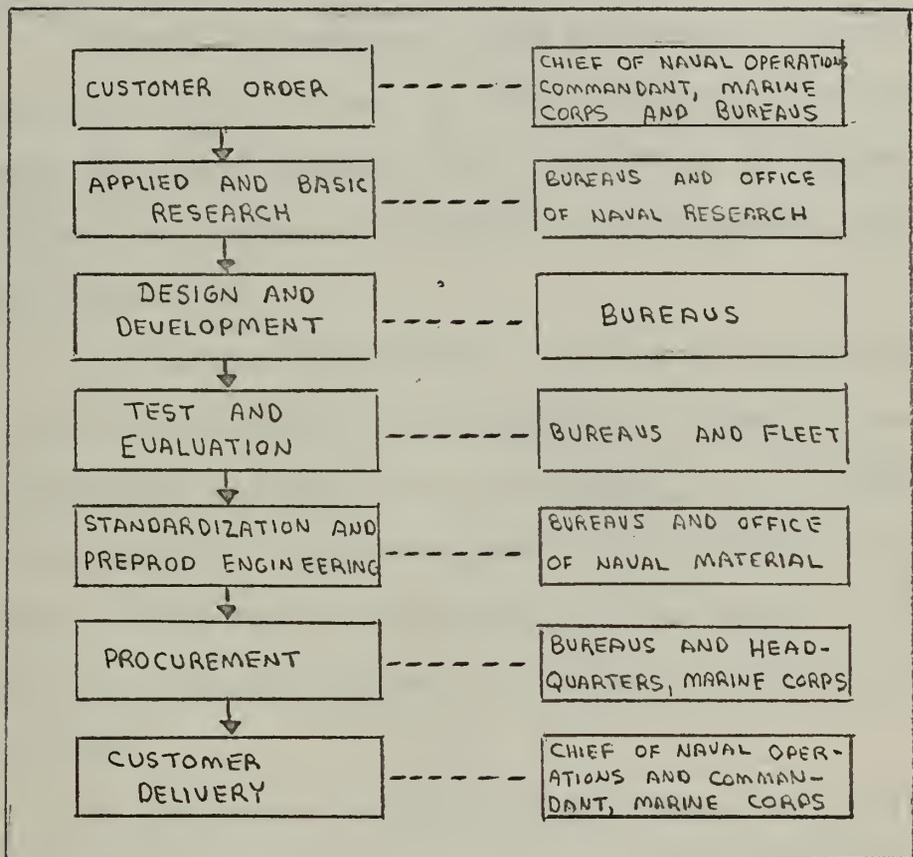
When an equipment or system successfully passes evaluation and is recommended for service use, the Chief of Naval Operations makes the ultimate decision as to whether or not procurement will be initiated. If the decision is to procure, the Chief of Naval Operations designates the quantity authorized, and

the lead bureau is then responsible for standardization and pre-production engineering. In this area the Office of Naval Material has progress review authority to insure standardization, reliability, maintainability, and productability.

Procurement is done by the bureaus, and deliveries to the fleet are effected through the Chief of Naval Operations.

NAVY RESEARCH AND DEVELOPMENT

HOW THINGS GET DONE¹



Holmquist, Carl O., "New Look in Navy Research: The Organization"

Armed Forces Management August 1960 Page 18

CHAPTER SIX

AN ANALYSIS OF THE REVIEW AND COORDINATION PROCESS OF THE NAVY RESEARCH, DEVELOPMENT, TEST AND EVALUATION EFFORT

I THE REVIEW AND COORDINATION PROCESS

Through the medium of the Operational Requirement, the Deputy Chief of Naval Operations (Development) has some control over the efforts of the various offices and bureaus in research, development, test and evaluation.

The bureaus and offices perform a dual function -- that of management and conduct of research and development programs and procurement of equipment. Technical and fiscal management is centered at the bureau level for each program and the bureaus and offices perform detailed accounting of funds allotted to them.

In conforming with their individual and collective responsibilities the bureaus and offices prepare the Annual Navy Research, Development, Test and Evaluation Program. This is a line item list of projects that comprise the Navy's Research, Development, Test and Evaluation Program; it is prepared by the bureaus and offices and compiled by the Office of Naval Research. Programs are listed by budget activity and

budget project.

The individual work proposals of each bureau are consolidated into these individual bureau programs. After internal review and consolidation by the Office of Naval Research the program becomes the bureau's yearly budget.

The Research and Development Review Board, under the Deputy Chief of Naval Operations (Development) reviews and modifies these programs for the Chief of Naval Operations. This board is composed of the Deputy Chief of Naval Operations (Development) as chairman, Chief of Naval Research, and representatives of the warfare (Office of the Chief of Naval Operations) desks. The purpose of this review is to insure that the Research, Development, Test and Evaluation Program reflects as true a program priority list as possible to meet the operating requirements of the Navy.

Upon approval of the Research, Development, Test and Evaluation program by the Research and Development Review Board, it is sent to the Chief of Naval Operations Advisory Board, composed of all the Deputy Chiefs of Naval Operations and chaired by the Vice Chief of Naval Operations. The Chief of Naval Operations Advisory Board reviews the Research, Development, Test and Evaluation program in the light of

the entire Navy effort and budget and recommends to the Chief of Naval Operations what portion of the entire Navy effort and budget should be allotted to research, development, test and evaluation. When the final decision has been reached by the Chief of Naval Operations the entire Navy Budget is forwarded to the Secretary of the Navy.

At this stage, the Assistant Secretary of the Navy (Research and Development) convenes the Navy Research and Development Committee. This committee, composed of the Deputy Chief of Naval Operations (Development), Chief of Naval Research, and Assistant Chiefs of the Bureaus (Research and Development), aids the Assistant Secretary of the Navy (Research and Development) in his review. At the same time, under the bilinear system of the Navy's organizational structure, the producer side of the organization can appeal any action taken by the Office of the Chief of Naval Operations in the area of research, development, test and evaluation.

Finally, when approved by the Secretary of the Navy, the Research, Development, Test and Evaluation program, together with the entire Navy program and budget, is forwarded to the Secretary of Defense for Review.

II CRITIQUE

This complex, time consuming, and exhaustive review process is a direct result of the bilinear organizational structure of the Navy. This fact has been long recognized both in and out of the Department of the Navy. Recently, an unnamed executive in the Director of Defense Research and Engineering office observed, "Between the Bureau system, the Deputy Chief of Naval Operations for Development, Office of Naval Research, and the Office of the Assistant Secretary of the Navy for Research and Development, Navy is bucking a four-way coordination problem that would give anybody trouble."¹ In a recent issue of Armed Forces Management, a senior Naval officer in the Office of the Assistant Secretary of the Navy (Research and Development) after a description of the current Navy research and development review process wryly observed:²

Several years ago, Henry L. Stimson wrote with more humor than insight that the Navy was

¹ "From Research to Hardware", Armed Forces Management, November 1960, p. 89.

² Carl O. Holmquist, Captain, "New Look in Navy Research : Management Techniques", Armed Forces Management, September 1960, p. 31.

organized with a peculiar psychology which ". . . frequently seemed to retire from the realm of logic into a dim world in which Neptune was God, Mahan, his prophet, and the United States Navy the only true church." For any reader who has had the tenacity to struggle this far through the story of the Navy's organization for research and development, Stimson's words may have some appeal.

But the Navy, particularly its research and development structure has evolved over the years to satisfy its own peculiar needs . . .

The recent reorganization of the Navy which provided the positions of a Deputy Chief of Staff for Development and an Assistant Secretary of the Navy (Research and Development) was a long stride towards centralization of control in the research, development, test and evaluation effort. The degree of centralized control, however, is limited by the two-channel organization structure.

In their report to the Secretary of the Navy, the Committee on Organization of the Department of the Navy considered the origin, underlying philosophy, and current application of the traditional bilinear organizational structure of the Navy. They concluded that the present organization:

. . . with its definite division of military and nonmilitary duties and responsibilities among uniformed and civilian officials, offers a greater prospect for the successful prosecution of future naval warfare because of its more effective integration of both of the elements, industrial and military upon which the national seapower depends; and, in particular, it seems to be that form of organization best suited to embrace and exploit the opportunities afforded by continuing breakthroughs

in the realm of the physical sciences.¹

In arriving at this conclusion, the committee examined comparative forms of organization including the general staff system. The general staff system, as practiced by the Army and Air Force, is characterized by a single military chief acting under civilian political superiors with complete responsibility and control over both the total military operational effort and the supporting logistic and administrative effort as well. The committee found that this system "is advantageous in many respects. Lines of authority are clearly defined, decisions are quickly made, and the organization is ideally adapted to the prompt and effective implementation of decisions."²

The committee, however, rejected this form of organization for the Navy on the grounds that:

1. It failed the Prussians in the 19th century.
2. They believed that the complexity of problems at the headquarters command level is such that even the most skilled administrator supported by a brilliant staff would not be able to handle them.

¹Report of the Committee on Organization of the Department of the Navy, 1959, pp. 17-18.

²Ibid. p. 16.

3. The administration of such a large organization as the Navy required a careful balance of considerations, civilian as well as military, even though this might involve a " . . . somewhat more deliberate process¹ of decision."
4. The current Navy organization is uniform in structure and philosophy to that of the Department of Defense.

Research and development today are a matter of national survival. Production prowess is no longer sufficient to keep our country at the top of the economic and military ladders, the items we produce must be as timely and as advanced as the international state of the art. Research and development organizations must be flexible, oriented toward prompt and effective implementations of decisions, and geared to the requirements of research and development personnel. We can ill-afford in the Navy or in the nation any organization for research, development, test and evaluation which is not responsive to these criteria.

In the Navy, the link between the user and the producer of new weapon systems, equipments, or components must be a positive one. Time is paramount;

¹Report of the Committee on Organization of the Department of the Navy, 1959, p. 17.

resources are scarce; and the consequences of failure unacceptable. When excessive coordination between different sides of an organization is necessary to agree on or proceed with an important program it is possible that the need will expire before the requirement is met.

The fewer the coordinating units, the quicker the decision; the quicker the decision, the faster the new equipments will get to the operators. There is no real need for multiple coordination among equal commanders; consultants and advisors can advance ideas and viewpoints of varying schools of thought. In any problem, a decision must be made eventually. It is better to have the person ultimately charged with the making of the decision make it at a much earlier stage of deliberation. There is no guarantee or even sound basis for the belief that prolonged debate or multiple reviews will eliminate unsound decisions. Neither is there a similar guarantee that having a civilian "balance" in decisions affecting military operational matters is necessary to the national defense. Even though the civilian voice is supposed to be limited to non-military matters of technology, business, industry and manpower, how are those factors separated within the concept of research, development, test and evaluation

in a complex weapon system?

Civilian control of the military is traditional and necessary in a democracy. The control, however, should be on a level above the operating and support elements of the military department.

The ideal organization, in the opinion of the author, would be a centralized organization structure featuring decentralized execution of programs.

A strong centralized structure is necessary for control; control over funds, control over parallel effort, and control over competitive areas. This does not mean elimination of parallel effort or competition; on the contrary, either or both might increase if the payoff was considered crucial or the uncertainty of the project was significant. Centralization of control is not necessarily synonymous with directed or "programmed" research. With proper decentralization of execution through the delegation of authority within the organization structure, the initiative, freedom of action, and nonrestrictive atmosphere so necessary to research programs can be preserved.

Decentralized execution, through the delegation of authority is necessary in order that decisions can be made at the level most concerned with the factors involved. Excessive referral of decisions up the

chain of command has the same stifling affect as excessive reviews and "coordination." Decentralization is particularly important, as was previously mentioned, in research organizations in order to provide the proper atmosphere for scientific personnel in their scientific pursuits.

In these times when the national survival could depend on the adequacy of our research and development effort, it is essential to have all research and development programs within the Department of Defense conducted within organizations where lines of authority are clearly defined, decisions quickly made, and where the organization is adapted to the prompt and effective implementation of decisions - - the very characteristics credited to the vertical or general staff type organization by the Franke Committee.

The rejection of such an organization on the basis of the Prussian failure in the 19th century does not recognize the improvements built into the modern concept through decentralization; neither does it take into consideration the dynamic changes which have occurred in the past thirty years in the field of research and development.

Furthermore, the justification of the present Navy bilinear organization on the grounds that it

is closely similar to the organization in the Department of Defense does not consider that the Department of Defense itself is not responsible for the actual production of weapon system hardware nor for their research and development phases. It is not necessary that a machine shop have the same organization structure as the board of directors.

It is significant that when the Navy was faced with a critical problem such as the research, development and production of the Polaris weapon system, it determined that the program could not be satisfactorily pursued within the current organization; Special Projects Office, organized on vertical lines featuring centralized control with decentralized execution was adopted.

Such an organization could be readily adapted to the Navy's present organization structure by moving the Assistant Secretary of the Navy (Research and Development) and the other Assistant Secretaries to an echelon directly under the Secretary of the Navy and by having the Chief of Naval Operations, as the highest military echelon, directly under the Assistant Secretaries (civilian control) as in the general staff concept.

This would provide the centralized control so necessary to dynamic organizations to prevent the

misuse of scarce material resources and the misuse of the one irretrievable resource -- time. In addition, the delegation of authority to subordinate units, long traditional in the Navy, would not be disturbed.

Just as over-management can waste resources and curtail productive effort, so can a lack of centralized control. The time has come in the Navy to recognize this and act accordingly.

CHAPTER SEVEN
SUMMARY AND CONCLUSIONS

I SUMMARY

In summary, from a study of the organization structure, the operation of that structure and the basic philosophy which tempers it, certain similarities and differences among the three departments' treatment of research, development, test and evaluation emerge. First, the three services have different methods of channeling support of basic research. The Navy and Air Force are similar to the extent that most of their basic research is handled through a central agency; the Office of Naval Research, in the case of the Navy, and the Air Force Office of Scientific Research under the newly created Office of Aerospace Research. The Army's support is less centralized. Army basic research is handled principally through the facilities of the six technical services, either using their "in-house" capability or through contracting to outside sources.

There are other differences, however, among the three services in the organization for basic research. The Air Force, having recently completed a major re-organization, controls all basic research through the newly created Office of Aerospace Research

(which includes the Office of Scientific Research) which reports directly to Air Staff, of the Air Force Chief of Staff at Air Force Headquarters in the Pentagon.

The Navy's Office of Naval Research is under the control and direction of the Assistant Secretary of the Navy (Research and Development) and has no direct command link with the Chief of Naval Operations.

The Army's entire basic research program is directly under the control and direction of the Chief of Research who, in the Army organization, is in the direct command chain of the Chief of Staff, Army.

In addition, there is a basic difference in philosophy among the three services about how basic research should be performed. The Air Force contracts out the major portion of its basic research, the Army believes in utilizing her "in-house" capability in most cases, and the Navy believes in the middle-of-the-road position of using a judicious mix between "in-house" and contract. As noted previously, there is recent indication, that the Army is re-aligning her position to more closely coincide with that of the Navy.

In the area of applied research and development there are also significant differences.

The Air Force conducts nearly all applied research and development under the newly created Office of Aerospace Research and Air Force Systems Command respectively. The Air Force Systems Command is responsible for acquisition, development, test and evaluation of all systems until turned over to the user. Thus one agency, the Office of Aerospace Research is responsible for all research -- basic and applied -- and one agency, the Air Force Systems Command is responsible, through its functional divisions, for all development, test and evaluation. Both of these agencies are in the direct command and control chain with the Chief of Staff, Air Force.

Army applied research and development procedures are somewhat similar to the new Air Force organization. The technical services are responsible for the entire life cycle of a particular system or equipment in their area of cognizance. All basic and applied research and development are conducted in the same technical service. Test and evaluation in the Army is conducted by Army Test Boards under the command of the United States Continental Army Command. Both of these activities also are in the direct command and control chain of the Chief of Staff, Army.

The Navy organization for applied research and development, while somewhat similar to the Army, has

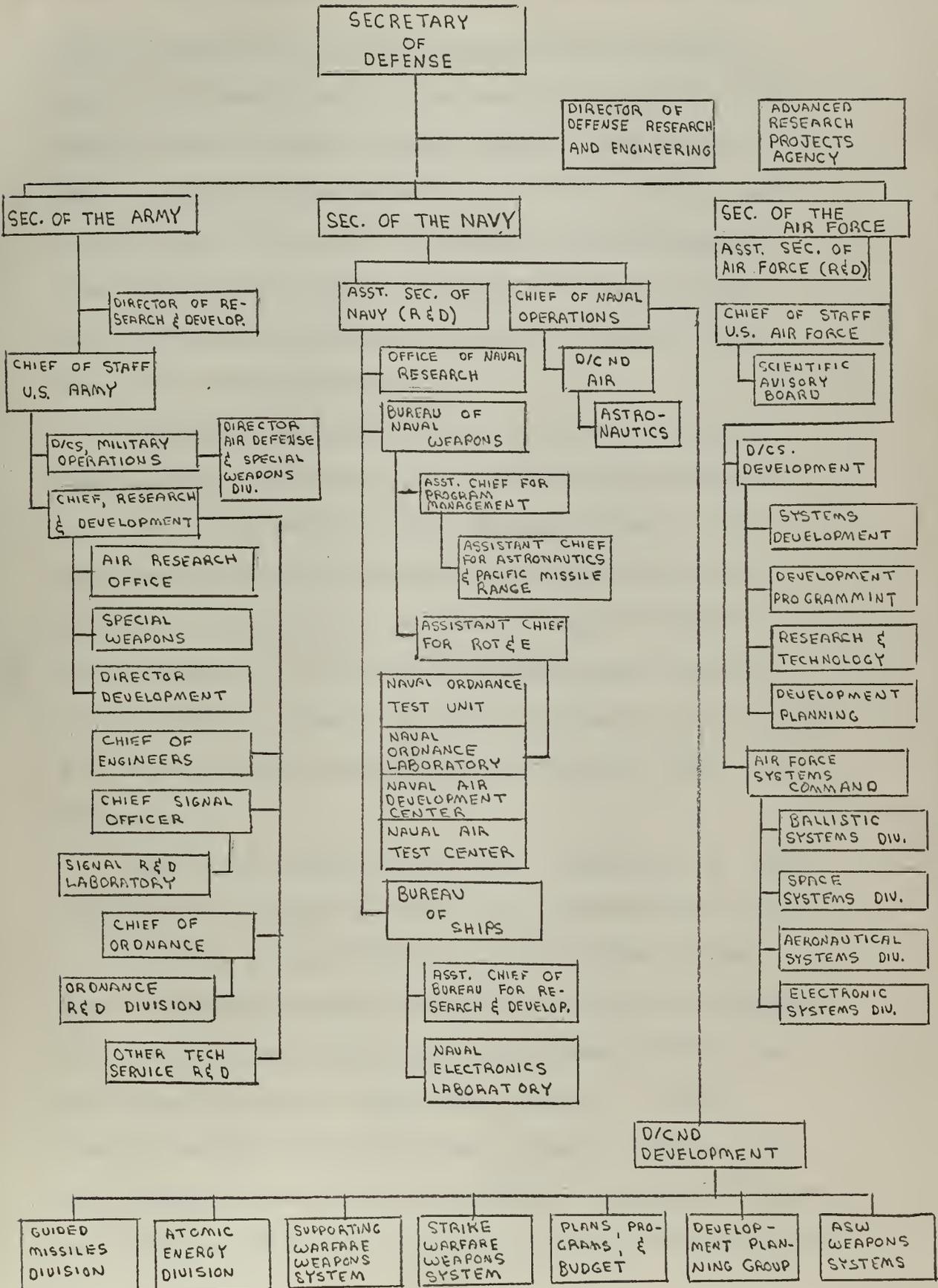
important command relationship differences. Applied research and development in the Navy is the responsibility of the technical bureaus. Although some applied research may be done by the Office of Naval Research, the bulk of it is performed by the technical bureaus. Test and Evaluation is performed both by the bureaus and by the Operational Test and Evaluation Force. Technical evaluation is a responsibility of the technical bureau; operational evaluation is the responsibility of the Operational Test and Evaluation Force. Neither of these organizations are in a common command chain until the Secretary of the Navy level is reached.

Although the differences of the services in the conduct of their basic research, applied research, development, test and evaluation provides insight into their basic philosophies in those areas, it is in the examination of the basic organization structures, however, that the most significant differences are noted.

Referring to the combined diagram on page the organizations are identical down to the senior civilian position directly under the service secretaries.

The Air Force organization is highly centralized in structure. There is a direct command link throughout the entire research, development, test and evaluation organization. Civilian control ter-

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minates with the Assistant Secretary of Air (Research and Development). He deals directly with the Deputy Chief of Staff (Development). The Deputy Chief of Staff, (Development) has direct control and command over the basic and applied research agency, the Office of Aerospace Research, and the development, test and evaluation operating command, the Air Force Systems Command.

Although the organization structure is highly centralized, the execution of the research and development programs is highly decentralized. This decentralization is accomplished through the delegation of authority by the Deputy Chief of Staff (Development), to the Office of Aerospace Research in the fields of basic and applied research and to the Air Force Systems Command for Development, Test and Evaluation.

The Army organization, while cumbersome to some extent, is probably the next most centralized. Although, like the Air Force, the Army Chief of Research and Development has direct control and command over the entire research and development effort, he must exercise that command and control, in part, over commands which have other command affiliations. The technical services are under the command of their own Technical Service Commander and only the research

and development personnel, funds, and functions are under the control of the Chief of Army Research and Development. In effect, some persons in the technical services are "wearing two hats" and reporting to two commanders in contrast with the Air Force single control concept.

The Navy organization is the most decentralized of the three organizations. In keeping with the traditional Navy bilinear organization the research and development programs are fitted into this structure.

The Navy's research and development programs are split into two lines of control and interest. On the "Producer" side of the structure under the direction of the Assistant Secretary of the Navy (Research and Development) are the Office of Naval Research, (the Navy's basic research coordinator) and the technical bureaus, (the applied research and development action agencies).

On the "Consumer" side of the organization, under the Chief of Naval Operation, is the Deputy Chief of Naval Operations (Development) who is charged with the planning, coordinating, and integrating of research, development, test and evaluation for the Chief of Naval Operations.

There is no direct line of authority between operating forces (the consumer -- or the Chief of

Naval Operations) and the bureaus and offices (the producers) except through the Secretary of the Navy.

To integrate, plan, and execute the Navy research, development, test and evaluation programs, close four way coordination is needed; coordination among the Bureaus, the Deputy Chief of Naval Operations (Development), The Office of Naval Research, and the Assistant Secretary of the Navy (Research and Development).

II CONCLUSIONS

1. That the Navy organization for research, development, test and evaluation does not meet the test of centralized control and decentralized execution of programs.
2. There are excessive reviews and coordination required prior to firming up Navy research and development programs.
3. The large number of these reviews and "coordinations" are a result of the Navy's bilinear organizational structure.
4. In the very words of the Franke Committee, the general staff organization is ". . . advantageous in many respects. Lines of authority are clearly defined, decisions quickly made, and the organization is

ideally adapted to the prompt and effective implementation of decisions."¹

5. That the advantages listed above are the very factors necessary in updating our research and development effort and keeping up with the technical state of the art.
6. That the Navy should modify the existing organization for research, development, test and evaluation.

¹
Report of the Committee on Organization of the Department of the Navy, 1959, p. 16.

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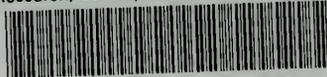
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