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DOD LABORATORIES IN THE FUTURE

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FOREWORD

This paper was presented on 19 October 1967 at a National Security Industrial Association R&D Symposium, of which the theme was "National R&D for the 1970's." The intent of the paper was to summarize the past actions taken with respect to the Department of Defense (DoD) laboratories and to predict the future role and characteristics of those organizations.

INTRODUCTION

Kettering once remarked, "We should all be concerned with the future because we will have to spend the rest of our lives there." Playing the role of a prophet, however, can be both stimulating and frustrating, pleasure and pain, but, as Horace Walpole said, "Prognostics do not always prove prophesies, . . . at least the wisest prophets make sure of the events first." I intend to take this advice seriously.

Before we can really examine the future of our laboratories, we must first make some assumptions concerning the future role of the Department of Defense, the organization which they serve. We must assume that the international scene will undoubtedly continue to require that our national objectives have the strong support of military power; that our major objectives will be both to maintain an "assured destruction" capability and an effective deterrent to limited wars; and that we will require a flexible capability that can react rapidly to the countermoves of our adversaries or take immediate advantage of new advances in science and technology. Finally, in order to meet these defense needs, new technology, techniques, weapons and systems will be required, together with a greater degree of interaction between technology and operations.

DEFENSE-SUPPORTED INSTITUTIONS

In order to maintain our most flexible and imaginative defense posture, the Department of Defense must utilize every conceivable resource, capability and contribution it can possibly motivate, attract or support. This requires the competence and contributions of all types of institutions—industry, university, nonprofit and in-house organizations. Each of these institutional forms has a relatively unique, although not mutually exclusive role to play. Each is an important, interrelated, synergetic subsystem whose products of new knowledge, designs and weaponry are the first-line technological defense against foreseeable threats.

In terms of level of support for these organizations (FY 1966 obligations), industrial organizations receive about 60 percent of the RDT&E (research, development, test and evaluation) appropriation; educational institutions, about 12 percent; nonprofit organizations, approximately 5 percent; and in-house organizations, slightly above 20 percent. Although the dynamics of Defense RDT&E activities will result in many programmatic changes, it is not clear that there will be major shifts in the relative balance of support for these institutions.

ROLE AND DEFINITION OF LABORATORIES

Probably no class of institutions has been studied and analyzed, praised and criticized, organized and reorganized to the degree that has been the lot of the Defense in-house laboratories. This is an area in which everyone fancies himself an expert, but areas of agreement seem to be difficult to reach. This lack of consensus may be due in part to the "blind-men-and-the-elephant" syndrome. Each study group sees only a portion of the total laboratory system, either because of special interests or the lack of an adequate definition of just what a laboratory is.

Their important contributions to military technology and weaponry over the years also attest to the variety of activities of the Defense laboratories. These include such developments as the Sidewinder and Shrike missiles, thermal batteries, proximity fuzes, fluid amplifiers, caseless ammunition, irradiated foods and the heart pump. With respect to the more immediate needs of Southeast Asia, contributions such as antimalarial drugs, defoliants, night vision devices, the 175mm artillery system, frozen blood and antipersonnel weapons such as the "Gravel" mine have added significantly to our defense capability.

A popular notion of a laboratory is a place enclosed by four walls and populated by men and women in white coats. This is obviously a too narrow and restrictive definition. In fields such as oceanography, deep submergence, terrestrial sciences and atmospheric physics, the natural environments provide the setting for R&D environments. The broad-ranging facilities now required to carry out sophisticated research and development in support of defense and space activities have given new dimensions and properties to the term "laboratory."

In the case of the Defense laboratories, they seem to be involved in almost the entire spectrum of RDT&E activities, ranging from the more fundamental end of the spectrum, as represented by the Air Force's Cambridge Research Laboratories, through the technology-oriented organizations such as the Fort Monmouth Electronics Laboratories and, finally, encompassing such development organizations as the Naval Ordnance Test Station (NOTS) at China Lake—now the Naval Weapons Center—and the Naval Ordnance Laboratory at White Oak. However, test and evaluation centers like the Army's Dugway Proving Ground, the Navy's Patuxent River Air Test Station or the National Test Ranges are generally excluded from our definition.

Because of the heterogeneity of these organizations and their varying interrelationships, it is not easy to come up with a simple and meaningful definition. The same difficulty applies to defining the role of the Defense laboratories. Many attempts have been made to delineate the roles of these organizations and the reasons underlying the need for them.

Because technology has become the life blood of the Military Departments, laboratories in the Department of Defense are necessary for many purposes, examples of which are:

(1) The maintenance of national competence during peacetime, as well as times of conflict, in those areas of technology peculiar to military needs;

(2) The necessity for maintaining a continuity of effort, free from commercial pressures and directed toward the conception and evolution of advanced weapon systems;

(3) The need for competent in-house skills that can monitor and assess the accomplishments of DoD contractors; and

(4) The requirement of having available to the Military Service a fast-reaction capability to solve critical immediate problems that arise in connection with existing operational weapon systems, or when unexpected combat situations are encountered such as that currently existing in Southeast Asia.

BACKGROUND

During the 1960s, there has been consistent high-level emphasis within the Government on improving the effectiveness of the in-house laboratories in carrying out the roles discussed abovee. Many of you are quite familiar with the Bell Report, the DoD Task 97 report and the "Competition for Quality" reports of 1961 and 1962. During the years immediately following the issuance of these reports, increased attention was given to the solution of management and administrative problems that had seriously hindered the effectiveness of these organizations. Constructive progress was made, particularly with respect to working conditions, salaries, facilities, personnel administration, flexibility of funding, ease of obtaining laboratory equipment, etc.

Beginning about 1964, a consensus was developing to the effect that the in-house laboratories lacked meaningful problems, management stability and prominence, and recognition, and they also failed to impact at the highest policy levels. While administrative improvements were valuable and should be pursued diligently, they were not considered, in themselves, sufficient to make laboratories effective tools of the organizations they served. During the latter part of 1964, there evolved a new concept designed to produce fundamental changes in the DoD in-house laboratories which included the following salient features:

(1) A proposed reorientation of the larger Defense laboratories toward military problem areas of military missions (e.g., antisubmarine warfare (ASW), battlefield communications, air-to-ground warfare, etc.).

(2) A proposed elimination of echelons between the Military Departments' Assistant Secretaries (Research and Development) and the

principal mission-oriented laboratories through the establishment of a new technical line management structure headed by a Director of Laboratories with requisite authority to provide the proper R&D environment for the Defense establishment.

(3) A proposal that laboratories encompass the full spectrum of activities (basic research through operational systems development) with respect to a military problem area. They would be given (a) greater local authority over decisions in the areas of research and exploratory and advanced development; and (b) greater responsibility for providing technical assistance and advice—in the areas of engineering and operational systems development—to weapon-system development and acquisition organizations.

During 1965 and early 1966, each of the Military Departments embarked upon many studies in response to this new concept. They examined many approaches and alternatives, seeking means that were responsive to the DoD objectives, yet were compatible with their own history, traditions and methods of operation.

It was during this time period that the Army and the Navy established positions of "Director of Laboratories." The Air Force also created the position of Special Assistant for Laboratories at the Assistant Secretary level to give high-level support to its Research and Technology Division, its Aerospace Medical Division and its Office of Aerospace Research. Within the Army and the Navy, this was accompanied by some regrouping of technical resources. This elevation of status and reporting level of these ranking technical managers provided the laboratories with new opportunities for important interactions between high-level decision makers and the technical specialists within the laboratories.

Shortly after Dr. John S. Foster, Jr., assumed the position of Director of Defense Research and Engineering, he asked the Defense Science Board to examine the progress that had been made in strengthening the Defense laboratories and to develop specific action plans for those aspects requiring additional strengthening. As a result of these studies, a unified effort was developed to increase the laboratories' involvement in urgent military problems and to continue the long-standing effort to eliminate the major administrative difficulties that still impaired the efficiency of laboratories. These actions, currently under way, will determine the characteristics and roles of the Defense laboratories for many years to come. However, these changes will not be carried out in one massive reorganization or restructuring, but rather in well-thought-out steps over the next five years or so.

THE FUTURE

It is clear that the future success of the Defense effort will depend more and more on scientific, technological and engineering excellence. Flexible arrangements will have to be devised to permit all of the Defense-supported institutions to respond rapidly to changing needs, the changing state of technology and the changing nature of new tasks. As a result of this dynamic environment, we will see many fundamental changes in the in-house laboratory structure of the 1970s. Although many of the laboratories we now have will continue in their existing forms, there should emerge a number of new "weapon centers" created through the elimination or consolidation of existing technical organizations.

These centers will be fashioned to embrace a broadly conceived technical program which concentrates on a particular military problem or warfare area, such as underseas warfare, air-to-ground warfare, battlefield communications, etc. Thus, they will be project-oriented centers with continuous mission—discipline interactions. The strength of these organizations will be the mix of scientists, technologists and engineers, working in a closely related way on an important set of common problems. Although each center will be tailored specifically to meet the needs of its assigned military warfare area and accordingly will have many unique features, there will be a commonality of important characteristics that will apply to all.

Each center will be oriented toward a military mission or a military problem. It will employ on the order of 1000 or more professional scientists and engineers. Although it may have more than one geographical location, the weapon center would be a self-contained organization in that it would perform research and development, with feasibility models as an important product.

About 70 percent of the center's professionals would be devoted to creative in-house engineering. Although contracts would be awarded, the fundamental development engineering would be accomplished within the center. The center's specialists would participate in the determination of military requirements associated with its mission; would be involved in the initial procurement of equipments; and would provide support to the procurement agency when large-scale production is achieved. The director of the center would have direct control over all the resources required, such as funding, manpower and facilities, and he would report at a sufficiently high level that he could ensure the required "R&D environment" and could participate readily in important policy decisions.

The overall performance of the center would be critically evaluated periodically to guarantee that the center is a competitive organization with high performance standards and achievements.

To this end, the Navy has recently taken a series of steps to consolidate and realign a number of existing organizations, creating centers of critical size that will deal with the problems of major Navy

systems and subsystems. Examples of actions already taken are as follows:

The David Taylor Model Basin and the Marine Engineering Laboratory have been combined to form the Naval Ship R&D Center, with the responsibility for advanced ship concepts.

. NOTS (Pasadena), segments of the Navy Electronics Laboratory, and several other smaller Navy elements have been administratively combined into the Naval Undersea Warfare Center.

. NOTS (China Lake) and the Naval Ordnance Laboratory (Corona) have been unified into the Naval Weapons Center, with broad responsibilities for air-to-air and air-to-ground warfare.

The Army has developed a long-range plan to consolidate many of its medical, materials and technology-oriented organizations. In addition, two weapon-center-like organizations are under study—an Air Mobility Center and a weapon center with broad responsibilities in the area of gun systems, fire-control systems and related subsystems.

. The Air Force has under consideration the desirability of combining a number of activities to create an Armament Weapon Center concerned with conventional air munitions.

I don't want to leave the impression that there is complete unanimity on the weapon-center concept, for that is not the case. Advocates are sure that the creation of this type of organization would bring enormous benefits to the DoD. They see new opportunities for optimum concentration on the identification and solution of critical military problems. The combined mission—discipline approach would enable the center to serve as a quick-reaction facility and to be particularly responsive during crises or war. Such an arrangement is believed to enhance the systems approach and would provide a better basis to arrive at optimum solutions to problems independently of technical-specialty bias, and in addition would orient researchers and technologists toward more meaningful and productive areas of work. Finally, a center's performance would be much easier to assess, because its end products could be tested and evaluated.

Those who oppose this concept see penalties in the form of cost, time delays, personnel attrition, etc., because of this fundamental change in organizational philosophy. Considerable duplication of effort is foreseen because of the commonality of technical disciplines to many military problem areas, unless a management system is created to minimize this. Further, there would be a tendency toward monopoly or overprotection under such an arrangement.

In planning future centers of this type, recognition must also be given to the tremendous competence that has been created within our industrial base, and means to continue to exploit this competence must

be an inherent part of the weapon-center concept. Work by the in-house scientists and engineers should be directed toward areas in which in-house competence already exists or could logically be extended.

In any event, the Defense laboratories of the future, regardless of their mode of operation, will become fully accepted members of the top-level management team and, in addition to their more traditional functions, will take on expanding roles to:

(1) understand and define overall system problems;

(2) work jointly with military planners to define crucial military requirements, based upon critical assessment of existing and predicted technology;

(3) provide, within assigned mission areas, military and technical concepts that could serve as the basis for the Department's long-range programs in research and exploratory development;

(4) conduct sufficient technical work in-house to ensure that specifications for systems can be developed with confidence, and serve in the evaluation, assistance and day-to-day direction of the work of other organizations engaged in systems or technology development; and

(5) furnish consulting support to project managers when a commitment is made to undertake a major program development.

Another basic change that will come during the not-too-distant future will involve the flexibility in the personnel policies for laboratory scientists and engineers. Many of us believe that, if the management of in-house laboratories could handle personnel with the same degree of flexibility as is possible in comparable industrial organizations, an immediate and substantial improvement in laboratory effectiveness would be realized.

Part of the problem may be due to the unduly restrictive interpretations of civil service policies and regulations by the Military Departments. In this connection, Dr. Foster and Mr. John Macy, Chairman of the Civil Service Commission, have joined forces to determine how to apply the full flexibilities under the civil service system to the personnel administration of the Defense laboratories. This is preliminary to a more complete examination of the legislation governing the policies that are permissible. Basic legislative changes designed to create the proper personnel environment for creative R&D organizations are expected to be the rule rather than the exception in the 1970s.

SUMMARY

The Defense laboratories of the future will play key roles with respect to shaping and administering the complex research, development, test and evaluation (RDT&E) program upon which our defense posture depends so heavily. These organizations will be completely involved in the mainstream of urgent defense needs, providing the solutions to vital problems, and offering technical judgments highly relevant to the needs of top-level planners and decision makers.

The creation of the new positions of Directors of Laboratories was a first and important step in this direction because of their close interface with the policy level. This was followed by the creation of selected new weapon centers, whose missions will provide a direct correlation with important military problems and functions, should enhance the traditional role of in-house laboratories, and should further strengthen the bond with, and the interplay between, the in-house technical community and other institutional forms.

The total number of Defense laboratories will tend to become smaller because of consolidations and the creation of new weapon centers; however, the relative balance of funding among the various institutional forms will probably remain essentially as it is today.

The emphasis for Defense laboratories will be on quality rather than quantity, and the current manning of the total structure will probably not change significantly, during the next decade, except for unforeseen deficiencies or crises. Thus it becomes even more important that our laboratories be purposefully staffed and directed and appraised critically in a timely fashion. Laboratories that have become obsolete through loss or dilution of mission, or unproductive owing to stagnation or marginal leadership, must and will be revitalized, phased down or eliminated.

An important ingredient of this will result from the optimum availability of personnel and management flexibility at the laboratory director's level. If current trends persist, broad recognition will be given to the premise that the creative work performed by scientists and engineers is quite different from that of other professions, disciplines and employees. Therefore, the management techniques and environment must be responsive to these important differences. As a result, public laws, policies and regulations within the next decade will result in new personnel and management flexibility that will minimize differences between Government laboratories and non-Government organizations.

Finally, one of the most important roles that the laboratories of the future will be increasingly called upon to play is their contribution to the technical definition of crucial military requirements and the consequent translation of these military requirements into technological goals and experimental prototypes, including much heavier

involvement in planning for new weapon systems. It is this role in which laboratories can interact almost universally with the military planners, the operational forces, and all the other non-Governmental institutions that make the realization of our Defense goals possible.

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