Since World War II, the government's large and important scientific establishment has had continuing difficulty competing with industry and the universities for the services of talented scientists and engineers. Many groups, both inside and outside the government, have studied this problem and made recommendations. A number of the recommendations have now been adopted, and the government's competitive position is consequently stronger today than at any time in the past 18 years. But, as Table 1 shows, the salaries paid to scientists and engineers at the upper levels of government career service are far below those prevailing at comparable levels in private industry. The discrepancy is even greater in the top policy positions. Ironically, the government is often in the position of reimbursing a contractor for salaries the contractor has paid to scientists and engineers that are very much higher than the salaries the government can pay its own employees. Enactment of pending legislation authorizing higher salaries at the upper levels of government service would improve the government's competitive position.

Table 1.—Comparison of top Government career salaries with those in private business for comparable work

Federal Government:		*Corresponding levels in private business*
GS–16	$16,000 to $18,000	$20,000 to $30,000
GS–17	$18,000 to $20,000	$27,500 to $37,500
GS–18	$20,000	$32,500 to $45,000

Source: The Competition for Quality, vol. 1 Federal Council for Science and Technology, 1962. (The Federal Government salaries listed here reflect upward revisions enacted since that report.)

Raising salaries is only one of several measures that must be taken if the government is to attract and retain its fair share of the nation's best scientific and engineering talent. Managers of some federal laboratories should strengthen their recruiting programs, particularly at colleges and universities. The government should also take more positive steps to provide scientists and engineers employed in federal laboratories with a wider variety of opportunities for continuing their education and developing their professional competence. These opportunities should include work in private industry, at other government establishments, and at universities, and they should be available to scientists and engineers at reasonable intervals throughout their professional careers.

Federal laboratories and agencies should also encourage their scientists and engineers to participate in activities of professional societies. The personnel of these establishments have not always had the opportunity to participate on study groups and advisory panels, and in scientific missions representing the United States. They should be called upon more than they are now, and their participation should be encouraged by their employers. They have much to contribute.

As part of its study, the Committee had case studies made for it on the utilization of scientific and engineering manpower in the development of two military systems—Titan II and the Naval Tactical Data System. The first such comprehensive studies so far made, they highlighted the superior opportunities for advanced technical study that are given to military officers, in contrast with relatively meager opportunities available for civilian employees.

11. The U.S. Civil Service Commission should take the lead in working with government departments and agencies to improve the working environment of scientists and engineers employed by the federal government. It should also help to foster improved forecasting of their future requirements for scientific and engineering personnel.

Although improved utilization of scientific and engineering manpower is primarily the responsibility of agency and departmental managers, there is need for action that will cut across departmental lines. The Civil Service Commission should assist the individual agencies in their planning of how many scientists and engineers—of what types—the government is likely to require in the future.

The Civil Service Commission should, in addition, carefully review government personnel policies to determine which ones have or can have a significant effect on the environment in which research and development is carried out in government laboratories. Where changes in such policies seem advisable, authority to make them should be promptly sought. At the same time, the commission should aid and encourage agency heads and laboratory directors fully to use all existing authority to improve working environments.

12. The Department of Defense, the Atomic Energy Commission, the National Aeronautics and Space Administration, the Department of Health, Education and Welfare, the Department of Agriculture, the Department of Commerce, and other government departments and agencies should periodically review the missions and programs of the mission-oriented research laboratories they finance in full, both those they operate directly and those operated under contract, in order to make sure (a) that their resources continue to serve high-priority national needs and objectives, (b) that the arrangements for their management and location provide them maximum opportunity to be strong and creative, and (c) that their programs and administrative arrangements are compatible with the objectives of the institutions with which they may be linked. The Committee suggests that the resources of the President's Science Advisory Committee could be called upon in conducting these reviews and in arriving at decisions.

The great national research centers financed by the government utilize large numbers of scientists and engineers. The missions of some of them, especially of those related to defense, have changed since their establishment. It is important that their present and future missions be clear-cut and of high priority, and that their use of scientists and engineers be unmistakably in the national interest. In maintaining these major concentrations of manpower, the government has a special responsibility to appraise them in terms of both their contributions to urgent government needs and their impact on the over-all utilization of scientists and engineers, taking into consideration the needs of the private sector of the economy.

New ways to manage and house the large research laboratories of the federal government are needed. Some laboratories can be handled directly by the government, others by industry, by universities, and by non-profit corporations. It may be necessary to handle some of them in new ways. In the long future, it will probably be wise not to expect universities to manage such establishments unless there is no alternative for the government.

APPENDIX H

Department of Defense

IN-HOUSE LABORATORIES

Report of the

Defense Science Board Task Force

31 October 1966

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

DEPARTMENT OF DEFENSE IN-HOUSE LABORATORIES

Report of the
Defense Science Board Task Force

Office of the Director of Defense Research and Engineering
Washington, D.C. 20301

31 October 1966

MEMBERSHIP

Defense Science Board Task Force on Department of Defense In-House Laboratories

Dr. Leonard S. Sheingold, Chairman
Vice-President
Sylvania Electronic Systems

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Systems Development Corporation

Dr. Martin Goland
President
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Mr. John Golden
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Dr. O. G. Haywood
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Huyck Corporation

OFFICE OF THE DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D. C. 20301

7 November 1966

TO: THE SECRETARY OF DEFENSE

THROUGH: THE DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

The Defense Science Board herewith submits its report on Department of Defense in-house laboratories and recommends it for your consideration. This report is the outcome of a study made by a task force of the Board, under the chairmanship of Dr. Leonard S. Sheingold, in response to a request by Dr. Foster.

Dr. Sheingold is willing to assist you and Dr. Foster in preparing for any action that you deem appropriate pursuant to the findings and recommendations. I wish to thank him and the other task force members for their able and perceptive conduct of this review.

Frederick Seitz
Chairman
Defense Science Board

OFFICE OF THE DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D. C. 20301

31 October 1966

MEMORANDUM FOR CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Department of Defense In-House Laboratories, Report of the Defense Science Board Task Force

The Defense Science Board Task Force on In-House Laboratories submits herewith its final report dealing with proposed management actions to make more effective use of the DoD technical laboratories.

The Task Force concentrated on the laboratories' contributions to the development and acquisition of military operational systems and equipments to determine the necessary steps to be taken to improve the effectiveness of the laboratories in high-priority research and development areas.

Since it is the most recent of a number of reports involving in-house laboratories issued during the past several years, this report contains a summary of those previous activities most pertinent to the DSB effort.

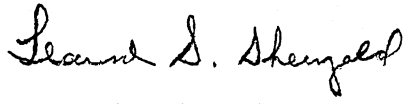
Basically, an attempt was made to determine the laboratories' involvement in the current DoD RDT&E programs; and it is indicated that, although the in-house activities cover a very broad spectrum, there are some areas in which the laboratories are scarcely involved, such as ballistic-missile systems development. On the other hand, the laboratories' participation in conventional-warfare matters appears to be the basis for an important mission area that will exist for many years.

Previous committees have recommended that the Military Departments establish mission-oriented laboratories or weapon centers. This report defines such a weapon center and discusses some of the relative advantages and disadvantages in its establishment.

One of the more significant actions taken by the Departments in the last few years was the establishment of the position of Director of Laboratories. The critical nature of this high-ranking position and the opportunities it offers for the future management of the in-house laboratories are considered in some detail.

The report also deals with some issues of long standing, such as military versus civilian management, personnel policies and allocation of resources.

The report contains three specific recommendations. The first involves a marked increase in the in-house laboratories' participation in the weapon-systems planning process. The second concerns a proposal for the establishment of the first weapon center; and the third relates to the solution of the administrative problems associated with providing the necessary resources for effective planning and management of the laboratories.



Leonard S. Sheingold, Chairman
Task Force on In-House
Laboratories

CONTENTS

1. INTRODUCTION

The Secretary of Defense has often stated as a matter of policy the need for competent and creative in-house technical laboratories. Among the evident reasons underlying this need 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 Services 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.

In recent years, increased attention has been given by the Office of the Secretary of Defense (OSD) and the Military Departments to the management problems associated with in-house technical efforts. Constructive progress—particularly regarding salaries, working conditions, personnel administration, flexibility of funding, ease of obtaining laboratory instrumentation, etc. —has been made, especially during the past four years. Nevertheless, there remain many critical and fundamental problems relating to laboratory mission areas and to the relevancy of the laboratories' programs to providing our military forces with superior weapons, equipment, training and techniques.

There is a growing awareness that the many innovations during the past years in weapon-system planning, organization and management have had a profound impact on the in-house laboratories, and have given rise to a number of questions regarding their future operations.

The Defense Science Board (DSB) Task Force on In-House Laboratories held its first meeting on 9 February 1966 and determined that it would:

(1) Examine how the laboratories contribute to the development and acquisition of military operational systems and equipments.

(2) Determine the feasibility of establishing weapon centers or lead laboratories, as previously recommended by the Director of Defense Research and Engineering (DDR&E).

(3) Consider alternate approaches for improving the effectiveness of the laboratories.

(4) Formulate recommendations for future actions by the DDR&E.

The approach selected was to schedule a series of meetings to examine how the Military Departments consider the laboratories have contributed—or are expected to contribute—to important military programs. Three subsequent meetings were held to obtain an assessment of laboratory contributions to strategic systems (9 March 1966), weaponry for general-purpose forces (14 April 1966), and specific Vietnam warfare requirements (27 May 1966).

During the meetings, the Task Force was apprised of one very familiar problem, largely administrative, relating to personnel, facilities and financial management. Specifically, laboratory managers have considerable difficulty in planning and managing their laboratories because manpower, facilities and funding are handled by three separate OSD offices. In this regard, the Task Force observed that the DDR&E has inadequate authority over all the resources required for efficient laboratory planning and management. As a result, the Task Force concluded that the assigned authorities and responsibilities of the DDR&E need further examination. A separate pertinent recommendation has therefore been included in this report.

2. BACKGROUND

The basic policies on research and development (R&D) activities were established by a memorandum from the Secretary of Defense dated 14 October 1961 and by the Bell Report[1] of April 1962. Both policy statements reaffirmed the need for stronger in-house organizations to spearhead the Defense research, development, test and evaluation (RDT&E) programs, and established both broad and specific objectives to be met. All three Military Departments subsequently issued implementing policies concerned with strengthening their in-house activities.

The DDR&E continued to maintain surveillance over the program structure of the in-house laboratories during the period 1961-1966. In 1964, a study group in the Office of the DDR&E was established to

[1] Bureau of the Budget (David E. Bell, Director), Report to the President on Government Contracting for Research and Development, 30 April 1962, Document No. 94, 87th Congress, 2d Session.

reexamine the total in-house laboratory structure. It concluded that, although much progress had been made since 1961, these improvements were evolutionary rather than revolutionary and did not produce any necessary fundamental changes.

The Plan for the Operation and Management of the Principal DoD In-House Laboratories[2] was issued in November 1964. The salient features of the plan were:

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

(2) A proposed elimination of echelons between the Departments' Assistant Secretaries (R&D) 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 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 development, to weapon-system development and acquisition organizations.

On 20 November 1964, the Secretary of Defense forwarded this plan to the Military Departments, and asked that they work closely with the DDR&E and the Assistant Secretary of Defense (Administration) in planning the detailed implementation of "some such plan in each of the military departments." During 1965 there was considerable exchange of ideas and detailed study of approaches that were compatible with the mode of operation of each Department.

In June 1964, the President's Science Advisor, Dr. D. Hornig, established the President's Science Advisory Committee (PSAC) Panel on U.S. Government In-House Laboratories to ascertain ways of

[2]Office of the Secretary of Defense, Plan for the Operation and Management of the Principal DoD In-House Laboratories, 16 November 1964.

increasing the total effectiveness of the Federal Government's laboratories. Because of the size of the RDT&E base system in the Department of Defense (DoD), particular attention was given to the Defense laboratories. The PSAC Panel's report is not yet available, but it is expected to consider many of the same basic questions covered in previous reports.

Shortly after Dr. Foster succeeded Dr. Brown in October 1965, he initiated action to determine the status of the DoD laboratory question. After a series of meetings with the Departments' Assistant Secretaries (R&D), he forwarded to them a memorandum, dated 7 November 1965, which emphasized the urgent need to develop a comprehensive plan for the development of the DoD in-house laboratories. He has asked the Military Departments to:

(1) Develop a list of five to ten top-priority military R&D problem areas needing urgent and continuing attention for the next ten years (e.g., amphibious warfare, limited warfare, air-to-ground warfare).

(2) Determine which of the problem areas developed are the most suitable for lead or systems laboratories or technical centers; indicate any necessary construction at the lead sites and subsequent phase-outs of other sites.

(3) Outline the main functions that should be considered for performance in the lead DoD laboratories or technical centers.

(4) State what additional authorities or steps are required to make the new laboratories as effective as possible.

Dr. Foster received preliminary responses from the Departments and has held a number of meetings with them to determine the most appropriate action to take. In addition, he established a Defense Science Board Task Force to assist in the evaluation of these Service inputs and possibly to provide suggestions for appropriate alternatives. On 10 May 1966, Dr. Foster convened a special group, composed of the Chairman of the PSAC Panel on Government In-House Laboratories, the Chairman of the PSAC Panel on Government Personnel, the Chairman of the DSB Task Force on In-House Laboratories, the Military Departments' Directors of Laboratories, and the Air Force Special Assistant for Laboratories. It is Dr. Foster's intention to meet periodically with this group to discuss specific plans of action to improve the DoD laboratories.

3. THE LABORATORIES' CONTRIBUTIONS TO THE DEFENSE RDT&E PROGRAM

In general, the DoD laboratories engage in a very broad spectrum of activities. The Task Force considered it important to gain some understanding of the laboratories' direct involvement with the development and acquisition of operational hardware for our modern military forces. With this understanding, even if only qualitative, it should be possible to identify critical problem areas that require management attention.

The present system by which important military systems are developed and produced consists of at least the following three basic steps:

(1) A firm requirement is established, usually after much discussion between the Departments and OSD; systems studies are made, concepts are evaluated, and funds are allocated.

(2) A program-management organization is then established within an appropriate Service systems command.

(3) After competitive bidding, a substantial contract is awarded to an industrial concern for large-scale system development and production.

The program-management system is a highly efficient arrangement for evaluating the performance of contractors on well-defined major programs. In general, the laboratories' personnel are involved in providing important services to the system/project office (SPO). Prior to an award, specifications are prepared for bid solicitations, special studies are conducted, and consulting support to the SPO is provided. Laboratories' specialists usually participate in the source-selection process. After the award is made, the DoD laboratories' involvement is substantially decreased, particularly if a tight incentive contract has been negotiated. Occasionally, if a contract is in difficulty because of technical-feasibility problems, in-house laboratories are asked to examine the problem areas, make recommendations, and subsequently contribute.

The DoD laboratories provide supporting services to the SPOs; they provide supporting services to the organizations responsible for establishing requirements; they provide supporting services to operational commands. The level and quality of their support are usually difficult to evaluate, since there is little available data that can be interpreted meaningfully.

Although the SPO-industry team arrangement is the management mechanism by which most of the costly and sophisticated weapon systems are acquired, a good percentage of R&D for subsystems and components is handled directly by the laboratories. Most of these systems developments involve contracts with industry, although some of them are actually carried out by in-house laboratory engineers. Also, some of these developments—fuzes, air-to-surface missiles, munitions, etc. —result in working models that are subsequently turned over to industry for production. Of the three Services, the Army and the Navy do a substantial amount of in-house development, whereas the Air Force does considerably less. Virtually all production is accomplished by industry.

The tremendous variation in the percentage of in-house development efforts of the various Service laboratories is quite understandable because of fundamental differences in their management approaches. For example, the Air Force has decided to rely almost exclusively on the SPO-industry team, whereas both the Navy and the Army consider a hybrid arrangement, which includes some laboratory developments, to be effective.

All the Services' technical organizations, however, do have prime responsibility in one area—they establish projects and provide contractual support for a large university and industrial base to advance technology for future weapon-system developments. The funding requested in FY 1967 for these efforts was $407 million for R&D category 6.1, research, and $1.063 billion for 6.2, exploratory development.

The funds expended in these areas are divided among a multitude of small contracts or projects covering a number of technical disciplines. The Task Force concluded that the relevancy of the 6.1 and 6.2 laboratory programs could be increased substantially if the laboratories were given an opportunity to define and work on significant military systems problems. This could be done by increasing the participation of the in-house technical specialists in systems analyses, systems syntheses, establishment of requirements, SPO management, and other important functions relating to weapon-system research and development—particularly if high-level planners would depend more on the laboratories' specialists for technical judgments in significant RDT&E matters.

4. ROLE OF THE IN-HOUSE LABORATORIES IN DEVELOPING BALLISTIC-MISSILE SYSTEMS

In analyzing the proper role of the DoD's in-house laboratories, the Task Force reviewed their involvement in developing strategic weapon systems, weaponry for general warfare, and developments for special types of warfare such as that in Southeast Asia. Strategic weapon systems and, in particular, ballistic-missile systems received the Task Force's close attention.

The growth of a very substantial industrial competence in the development of strategic weapons, which has continued at a high level during peacetime, places this area in a special situation. In this matter, there is general agreement that engineering and production should continue to be concentrated primarily in private industry, but there are different views on whether the in-house laboratories should participate fully in the advanced development of strategic weapons. There are those, particularly in the Air Force, who feel that industry should perform this function along with a special not-for-profit organization that has been established to provide the Government with technical and management assistance. In any event, up to the present time the development of large strategic missile systems for the three Military Services has been carried on largely outside the structure of the in-house laboratories.

The Task Force recognizes that the development pattern used in the area of strategic weapons has been quite successful. The combination of a strong industrial (or nonprofit) contractor and a qualified program office appears to be the accepted approach for developing major strategic missile systems such as Minuteman, Poseidon and Nike X.

If it is assumed that, during the next few years, there will be no fundamental changes in the way strategic missile systems are developed or procured, there still remain some issues involving the laboratories that must be resolved. They include the participation of the laboratories in long-range planning for strategic systems to ensure that the laboratories' R&D efforts relating to future strategic systems are significant and pertinent. The laboratories may also have the important function of troubleshooting and updating operational strategic systems. Clearly, there is need for a better understanding—and better mission statements—concerning the laboratories' participation in activities involving strategic weapon systems.

5. THE CONCEPT OF WEAPON CENTERS

It has been recommended by the Office of the DDR&E that the Military Departments seriously consider the establishment of large weapon centers, each embracing a broadly conceived technical program concentrated on a particular military problem area associated with general-purpose warfare. Whereas in most cases the Services' in-house RDT&E competence in a given mission—ASW, for example—is now spread among many laboratories at numerous geographic locations, the weapon-center concept would draw these varied strengths together and unite them in a single comprehensive technical team. In effect the weapon center would be a project-oriented applied laboratory in which there would be continuous mission-discipline interaction. The establishment of a weapon center could result in (1) the elimination of laboratories that are marginal with respect to either competence or size and (2) a consolidation of interests.

It should be emphasized that, while the weapon-center concept is one possible aid toward achieving R&D effectiveness, it is by no means a necessary requirement for a successful program. Other factors—technical management, personnel policies, financial management, etc. —are of at least equal importance in determining the effectiveness of in-house efforts.

There appears to be considerable variation in the willingness of the Services to plan for the establishment of weapon centers. The Navy and the Army now have some mission-oriented laboratories in which a number of actual developments are carried on by Government engineers. The Air Force laboratories, on the other hand, are organized on the basis of technology areas. If there is a lack of enthusiasm for new centers, it is partially owing to the many organizational changes in the past few years and to the feeling that concentration on making the present system work better by examining new management approaches would result in more progress.

The Task Force believes, however, that the establishment of weapon (-systems) centers is a good concept for long-range planning, since it provides an opportunity to combine in-house resources in order to work more directly and effectively on critical military problems.

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Although it is not possible to present a detailed description of a typical weapon center, some of its important characteristics can be defined as follows:

(1) It would be oriented toward a military mission or a military problem.

(2) The number of professional scientists and engineers would be of the order of 1,000 or more, so as to achieve a "critical mass."

(3) The weapon center, which may have more than one geographical location, would be a self-contained organization in that it would perform research and development with feasibility models as the end product. These models should be capable of demonstrating proof of function in a military situation.

(4) 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 echelon "layering" would be minimum.

(5) About 70 percent of the professional personnel would be devoted to creative in-house engineering. Although contracts would be awarded, the fundamental development engineering would be accomplished within the center.

(6) The weapons center's specialists would participate in the determination of military requirements associated with its mission.

(7) The center would be involved in the initial procurement of equipments and would provide support to the procurement agency when large-scale production is achieved.

(8) The overall performance of the center would be critically evaluated on a periodic basis to guarantee that the center is a competitive organization with high performance standards and achievements.

The advantages of creating a weapon center by combining the capabilities of certain laboratories already engaged in component or subsystem developments are the following:

(1) It would enable concentration on the identification and solution of critical military problems.

(2) It would provide opportunities for Government engineers to work more effectively on important military problems, and would help to better orient specialists responsible for areas of technical disciplines.

(3) Clear responsibility would be delegated to the weapon center.

(4) The combined mission— discipline approach would enable the center to serve as a quick-reaction facility and to be particularly responsive to war needs.

(5) There would be opportunity to arrive at optimum solutions to problems independently of technical-specialty biases. (The systems approach could be more readily applied.)

(6) It would be much easier to evaluate the center's performance, because end products that are clearly the responsibility of the center could be tested and evaluated.

There are also some disadvantages:

(1) Penalties in the form of cost, political effects, time delays, personnel attrition, etc., may be excessive because of a fundamental change in organizational concept.

(2) There could be difficulties in arriving at acceptable mission statements.

(3) There could be a tendency toward monopoly and overprotection.

(4) In the event that one or more weapon centers were created, there would still be a requirement for a management system to handle technical specialties.

A logical approach to the practical planning of a weapon center would be for each Military Department to examine its laboratories with

a view to determining which ones concentrate on developing subsystems in-house rather than depend upon industry. Both the Navy and the Army have some in-house development programs, particularly in the areas of fuzes, projectiles and tactical missiles, while in the Air Force, because of its different management philosophy, in-house development activities are kept at a minimum.

The next step would be to match existing development capabilities to a warfare area of real military interest. An example of a suitable weapon center for the Navy would be an ASW-Surface Systems Development Center which would cover the spectrum of systems analysis and concepts, research, engineering development, prototype development, initial procurement and development testing. An action of this type should encourage original contributions to ASW systems by personnel of the in-house laboratories.

In planning future weapon centers, the tremendous competence that has been established in our industrial base must be recognized. Work by Government engineers in the centers should be directed toward areas in which a competence already exists and could logically be extended.

The Task Force concluded that a plan for establishing the first weapon center should be prepared as a priority item. Furthermore, the center should be devoted to some major aspect of the ASW problem because of that area's importance and outstanding in-house engineering capabilities that now exist in the Navy.

6. DIRECTOR OF LABORATORIES

In addition to the weapon-center approach, there will always be a need for laboratories organized on a technical-discipline basis. It is important that these laboratories are represented at a high policy-making level to ensure that individual laboratory programs are based upon an understanding of important military needs.

Only four years ago, the Air Force examined its many laboratories and decided to group its resources in eight technical organizations. In addition, a systems engineering group was created to do systems engineering and to provide technical direction for aeronautical systems. The laboratories were given division status (Research and Technology Division—RTD) under Major General Marvin C. Demler, reporting to the Commander, Air Force Systems Command (AFSC).

Similarly, the Army and the Navy have regrouped their technical resources during the past two years. General Besson, Commander, Army Materiel Command (AMC), recently appointed a Director of Laboratories, Dr. Jay Tol Thomas, who has line authority over the central AMC laboratories. The Navy established a new position, Director of Navy Laboratories, reporting to the Assistant Secretary of the Navy (R&D), to which Dr. Gerald Johnson was appointed. In the last few months, the Assistant Secretary of the Air Force (R&D) created a new position in his office, Special Assistant for Laboratories, and appointed Dr. William Lehman to serve in that capacity.

The Task Force observed that the status and reporting position of the ranking technical managers in each Military Department have been increased substantially during the past few months. This step alone should have a beneficial effect on the morale and contribution of the in-house laboratories' personnel, since it is clear evidence that the laboratories are sufficiently important to warrant high-ranking positions. Each of these directors now has an opportunity to provide the important interaction between high-level decision-makers and the technical specialists in the laboratories.

Every effort must now be made to give the three Departmental Directors of Laboratories the support necessary for better utilization of the laboratories' resources. With the direct assistance of the DDR&E, the Directors of Laboratories should concentrate on using in-house technical specialists to—

(1) understand and define overall systems problems, particularly in tactical-warfare areas;

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

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

(4) conduct sufficient technical work in-house to ensure that specifications for weapon systems can be developed with confidence; and

(5) provide a limited amount of consulting support to special project offices when a commitment is made to undertake a major program development.

If each Department's Director of Laboratories is fully accepted as a member of the top-level management team, the mission-discipline interaction should be substantially improved, and the laboratories' personnel should couple more effectively with—

(1) the military users (requirements);

(2) special program offices and major contractors that handle the management of critical weapon-system developments;

(3) nonprofit organizations, of which some provide special studies for the higher echelons and others are responsible for roles in systems engineering and technical direction;

(4) the technical community at large which provides advanced technology for future weapon systems; and

(5) organizations responsible for testing and evaluating existing military systems to determine how they perform and what improvements can be made.

The Task Force concluded that the frequent meetings now being conducted by the DDR&E with the Directors of Laboratories should be continued indefinitely. The resultant dialogue creates the mutual understanding that is required to improve the laboratories' responsiveness to important present and future military requirements.

7. MILITARY VERSUS CIVILIAN MANAGEMENT

Below the level of Director of Laboratories are the laboratory managers who have line responsibility for their organizations' activities. In previous examinations of the in-house laboratories, the problem of military versus civilian leadership has been considered critical.

It is generally conceded that competent management of a military in-house laboratory requires a sound knowledge of the military problems encountered in actual field and combat situations. This has been the leading argument for maintaining military management control of the Defense laboratories.

Nevertheless, in a carefully planned program, it is not out of the question to have civilian personnel who are thoroughly versed in military affairs from a quite practical viewpoint. It is as possible for civilians to understand the military environment as it is for military personnel to be trained in technical areas.

It would appear that, for the future, there will be available a certain number of military personnel who are entirely competent to direct in-house laboratories. In addition to their military training, they must have technical education and training, as well as direct experience in research and development.[3] Also, as has already been noted, civilian personnel can most certainly be trained to direct programs in military operations. It might be said that both classes of individuals have similar training and backgrounds, but the military personnel are more heavily indoctrinated in combat matters, while the balance of training in the case of civilians is heavier on the technical and theoretical side.

It appears that every director of an in-house laboratory should be chosen on the basis of capability, especially his ability to challenge and stimulate his staff, and regardless of military or civilian status. Only in this way can both civilians and military personnel be afforded the same opportunity for professional advancement. The idea has often been suggested that, if a laboratory director is military, his deputy should be civilian, and vice-versa. This is a satisfactory management approach in view of the increasingly technological complexion of modern weapon systems. It has also been suggested that, if the emphasis is on in-house development, the director should be a civilian engineering manager. On the other hand, if the emphasis is on contractual activities, the director should be a technical military officer.

These remarks are directed toward research and development. As military systems move into test and evaluation, there is little difference of opinion on the conclusion that military management should prevail.

One final point regarding the selection of individual laboratory directors: A deliberate attempt should be made to avoid appointing to key laboratory management positions military officers who are preparing to retire. Similarly, under no circumstances should a civil servant be allowed to assume the leadership of a laboratory primarily because of longevity of service. Above all, the tenure of office should be of sufficient duration to indicate clearly that the director himself has had a real impact on laboratory operations.

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[3]Office of the Director of Defense Research and Engineering, Technical Military Personnel, Report of the Defense Science Board Subcommittee, 9 September 1965.

8. PERSONNEL POLICIES

Perhaps the most serious problem standing in the way of effective in-house laboratory work is that of achieving flexibility in handling laboratory personnel. It is generally agreed that, if the management of DoD 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.

The problems standing in the way of flexibility in personnel matters are too well known to require elaboration here. Foremost among them are the rigidity of job assignment, the difficulty of reassignment to new duties, and the conflict between available funds and spaces. These circumstances are a result of civil-service regulations, in addition to what appears to be an unduly rigid interpretation of civil-service policies by the top management of DoD and the Military Departments. The latter point is not certain, since civil-service regulations may indeed be as inflexible as the Departments believe them to be, but there are some indications that the Departments are not taking advantage of all the flexibility that current civil-service regulations permit.

In any event, no matter how the result is achieved, it is absolutely essential that substantially more flexibility be allowed laboratory management in handling their personnel than is now permitted. If the laboratories are to operate at the expected high level of efficiency and competence, they must have the same degree of control over their staffs that agencies outside the Government have.

It should be recognized that many of the civil-service regulations are the consequence of a system designed in past years when the Government was not faced with major scientific and technical problems. Today, Government salaries are much improved; moreover, the Government is the largest national employer of professional personnel. It is fair to say, therefore, that a drastic revision of personnel policies relating to scientific and technical professionals is not only in order but necessary for the future.

If the Government cannot employ and reward highly skilled professional people with the same flexibility that industry currently practices, the Government cannot expect an equal measure of performance by its technical teams. There appears to be no question that this is one of the major impediments to improved efficiency on the part of the in-house laboratories, and DoD management should give this problem its concentrated attention.

The point has already been made that there is some difference of opinion regarding the handicaps that current regulations impose on the management of in-house personnel. In order to help resolve this and allied questions, it would be useful to initiate studies that include the examination of a number of case histories in which personnel difficulties have been encountered. While each case history can be reported under the cloak of anonymity, each should be a detailed study of an actual situation, with a careful analysis of the input at all management levels. Following such detailed studies, recommendations can be drawn up regarding the proper direction of future action.

It should be remarked that some studies of this kind have been conducted in the past, but they have usually been incidental to studies with a broader purpose and have not concentrated adequately on a detailed examination of personnel management procedures. Moreover, none have brought forth a specific and constructive plan of action to resolve the known problems.

9. RESOURCES MANAGEMENT

In addition to their mission orientation, the laboratories must have sufficient flexibility to react when there is an urgent national need. There have been too many times in the past (ballistic missiles, ASW system studies, etc.) when problems have arisen on which the immediate support of in-house laboratories could have been used. One of the main reasons given for not using the Government's technical specialists is the lack of flexibility in their response.

Virtually every study that has been made of the in-house laboratory system has been critical, in varying degrees, of the combined management of manpower, facilities, funding and personnel resources. At present, each of these is managed differently at practically all levels within the Military Departments. The Task Force believes that the management of resources and the responsibilities for policy, procedures and regulations pertaining to their use are fragmented among many staff agencies, whose concerns and interests are broader than merely RDT&E. In too many cases, RDT&E activities are bound by practices designed for logistical and operational activities—in contrast to the more generally recognized practices of industrial organizations, which are tailored specifically for the creative, laboratory-type organization. As a result, the operation and future planning of the laboratories depend upon a diffuse, high-level management structure with divided control and authority over resources and their use.

The Task Force concluded that the systems approach could well be applied to the administration of the DoD laboratories.

10. RECOMMENDATIONS

10.1 Participation of Laboratories in Weapon-System Planning

The Task Force urges that an intensive program be established to sharply increase the direct involvement of the in-house laboratories in high-priority RDT&E activities. Their involvement must include:

- technical evaluation of operational equipment,
- participation in the generating of requirements,
- systems analyses and syntheses,
- interaction with the SPO—industry team, and
- planning for future weapon systems.

The success of a program of this type, which will depend heavily on the Departmental Directors of Laboratories, should drastically increase the participation of key laboratory personnel in the weapon-system decision process. As a result, the technological program (R&D categories 6.1, 6.2 and 6.3) should be more directly focused on critical military needs.

(1) Recommendation: The Task Force recommends that, by 1 January 1967, each Military Department prepare plans for action that will markedly increase the participation of its laboratories in planning for weapon systems.

Some suggested approaches are:

(a) Establish ad hoc systems groups to help define important technical problems in specific areas of military concern.

(b) Create systems teams of laboratory personnel to define threats and determine the vulnerability of proposed major weapon systems.

(c) Have the laboratories examine current 6.1 and 6.2 programs and recommend which specific ones should be heavily supported in FY 1968 or 1969, based on the relevancy of technical accomplishments to military needs.

The Task Force suggests that, in recognition of the Departments' individual differences in mission and management approach, the DDR&E permit them broad latitude in responding to this first recommendation.

10.2 Weapon Centers

The combining of laboratory resources into a new weapon center is a promising management approach toward improving the mission—discipline interface. A single weapon center should be established on a priority basis and should serve as an example for the establishment of others if experience warrants such action.

(2) Recommendation: The Task Force recommends that, by 1 January 1967, the Navy conduct the required planning for establishing the first weapon center. The planning should depend heavily upon the unique in-house engineering competence that exists in one or more of the Navy laboratories, and the center's mission should be related to a significant part of the ASW problem.

10.3 Authority of Laboratory Directors

The Task Force's final recommendation involves the problem of providing each laboratory director with adequate resources for the effective planning and management of his organization. This particular problem must be faced squarely at the OSD level.

(3) Recommendation: The Task Force recommends that an OSD committee be established to determine the steps that are necessary to provide laboratory directors with appropriate controls over facilities, manpower and funding resources. The committee should include the Director of Defense Research and Engineering as chairman, the Assistant Secretary of Defense (Installations and Logistics), the Assistant Secretary of Defense (Manpower) and the Assistant Secretary of Defense (Administration).

APPENDIX I

DoD Laboratories In The Future

(By E. M. Glass, Assistant Director, Laboratory Management)

Management Analysis Memorandum 67-3 of the Office for Laboratory Management, Office of the Director of Defense Research and Engineering, Washington, D.C. 20301

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 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 above. 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 later 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 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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APPENDIX J

NOTES ON THE ECONOMY ACT OF 1932

(Warren H. Donnelly, Science Policy Research Division, Legislative Reference Service, the Library of Congress)

The Economy Act of 1932 [1] permits any executive department or independent establishment of the Government to place orders with other parts of the executive branch for materials, supplies, equipment, work, or services of any kind that the requisitioned agency may be able to supply if (1) funds are available, and (2) it is determined by the head of the requisitioning department to be "in the interest of the Government to do so." [2] Although the notion of cost is not defined, it is further provided "that if such work or services can be as conveniently or more cheaply performed by private agencies such work shall be let by competitive bid to such private agencies." Several interpretations of this act have resulted from decisions by the Comptroller General: (1) The indefinite loan of equipment among agencies which might result in transfer without reimbursement was prohibited; [3] (2) authority to procure services and supplies from other agencies rather than from commercial sources because of lower cost was regarded as permissive rather than mandatory; [4] (3) payment of actual cost is required [5] including charges for depreciation.[6]

A relevant decision of the Comptroller General holds that a performing agency should be in a position to supply what is needed without adding new plant and equipment.[7] Directly related to this concept was an unpublished decision, made in July 1954, that the Economy Act did not contemplate that one agency would acquire, even with its own funds, substantial equipment for the sole purpose of being able to supply services to other agencies, nor that it would request other agencies to support the construction of facilities.[8]

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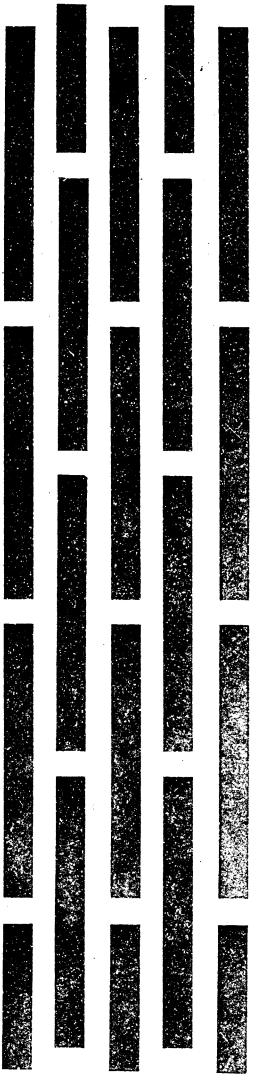
[1] 31 U.S.C. 686 (47 Stat. 417) Public Law 72–212.
[2] 31 U.S.C. 686(a).
[3] 38 C.G. 334.
[4] 37 C.G. 16.
[5] 22 C.G. 74.
[6] 38 C.G. 734.
[7] 33 C.G. 565.
[8] Unpublished Comptroller General decision B–119486, dated July 23, 1954.

APPENDIX K



SCIENTISTS AND ENGINEERS IN THE FEDERAL PERSONNEL SYSTEM

U.S. CIVIL SERVICE COMMISSION
1968

"The power of the sun is in our hands. From this day forward there will be no excuses."

—President Lyndon B. Johnson
February 10, 1966

To the Federal Scientist and Engineer:

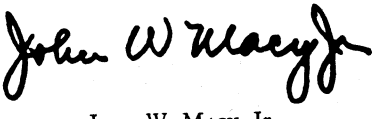
President Johnson's statement to the recipients of the National Medal of Science for 1965 was a call that went far beyond the scientific and technical programs of this Nation.

Today many of the best of the generation for whom there will be no excuses are working in Government laboratories. Here they must be both scientists and public servants. Neither role diminishes or compromises the other; indeed, it is because these two roles are so complementary that I am confident our Government laboratories can continue to attract men and women of the quality that disdains excuses.

The Civil Service Commission and the heads of the employing agencies are exerting every effort to insure that Government research and development programs are staffed by such people. The Federal personnel system can make its full contribution to this effort, however, only if the special features and flexibilities of the system are widely understood and fully exploited.

This pamphlet is an attempt to make sure that such understanding is widespread in the Federal scientific and technical community. I think many managers who read it will realize they have a freer hand in personnel management than they supposed.

I urge you to seek the advice and assistance of your personnel officer, and that of his staff specialists, on how best to use these flexibilities in meeting your own particular needs.



JOHN W. MACY, Jr.
Chairman,
U.S. Civil Service Commission

THE

SPECIAL FEATURES

of the

FEDERAL PERSONNEL SYSTEM

OF INTEREST TO THE SCIENTIST AND ENGINEER

STAFFING FOR EFFECTIVE PERFORMANCE

A primary objective of Federal personnel administration is to enable managers to carry out their missions and programs effectively. Therefore, the personnel function must operate as a part of the total management function rather than as an end in itself. To insure that this relationship exists, agency heads are responsible for determining the appropriate pattern of organization for personnel management most suited to the needs of the agency. The Commission does urge agency heads to delegate their personnel management authorities to subordinate management officials as near the work levels as possible.

Most Federal departments and agencies operate under the civil service merit system, which emphasizes the following principles:

- Wide publicity for employment opportunities.
- Equal consideration of all qualified applicants.
- Qualification standards related to the work to be done.
- Selection from among the best qualified.

Many features of the Federal personnel system apply equally to all agencies and to the many, diverse occupational groups, from clerical to professional, found in the Federal service. Generally, however, there is enough discretion within the broad framework of statute and regulation to allow agencies to develop personnel programs to meet the needs of special groups such as scientists and engineers.

To insure sound planning before recruitment is started, managers should determine the staffing pattern that promises full achievement of the mission or project to be undertaken. This staffing pattern should include forecasts of the numbers of employees needed, the qualifications they must have, and the expected duration of their assignments. Once this advance planning is completed, active recruitment can begin.

A VARIETY OF RECRUITMENT PROCEDURES

The Federal manager has many methods to choose from in deciding how to fill a specific vacancy. Ordinarily, when well-qualified candidates are available within his department or agency, he may decide to fill the job by promotion or by reassignment. If well-qualified candidates are available elsewhere, however, he may decide to hire an employee from some other Federal department or agency, rehire a former Federal employee, or recruit someone who has not previously worked for the Government.

If the decision is to recruit someone from outside the agency, the following methods and tools are available for use by Federal managers:

- *The Interagency Board System.* Applicants file with interagency boards of examiners that are designated to maintain lists of eligibles for engineering and scientific positions. These IAB's then serve as a central source of qualified applicants for Federal agencies. By informing other IAB's of shortages that may develop the interagency board network can refer applications anywhere in the system where a need develops.

  In order to provide an open-competitive vehicle for processing applications, examination announcements are no longer issued for specific occupations, such as chemist, or mathematician. Most examination announcements now cover a broad range of occupations and are open for receipt of applications on a continuous basis. Agency recruiters would be wise to check with the appropriate interagency board of examiners to determine if qualified applicants are available before initiating new recruiting efforts when a vacancy develops, or staff increases are anticipated.

- *Selective Certification.* A technique called "selective certification" may be used whereby only those candidates who meet the particular requirements of a specific position are referred to the agency. For example, this technique may be used to fill positions where experience in two or more fields is desired or where experience in a specific subspecialty of a field is desired.

To insure an input of high-quality applicants into the examination process, a well-planned and vigorous recruiting drive is necessary. The following "tools of the trade" will help:

- *Advertising Vacancies.* Paid advertisements may be used to publicize vacancies in shortage category positions. Such advertisements may be placed in any publication including professional and trade journals, college newspapers, and general circulation newspapers, which the agency considers appropriate.

- *Using Various Employment Services.* In addition to the State employment services, agencies may use nonprofit professionally sponsored employment services to recruit for professional scientific or engineering positions without the prior approval of the Civil Service Commission. In using these services, each agency must pay the employment service any fees charged for placement. Agencies may not use an employment service that discriminates because of race, creed, color, sex, or national origin.

- *Hiring On-the-Spot.* Federal officials sometimes complain that industry makes immediate offers to good candidates while the Government may take weeks. Actually, agency recruiters, in cooperation with the Civil Service Commission, can arrange to make on-the-spot offers to candidates for scientific and engineering positions using one of the three plans described below.

PLAN A	Agency agrees to appoint all qualified candidates including those certified by the Commission. Competitors may be rated eligible or ineligible. Numerical ratings are not required. If it becomes impossible to appoint all eligibles under consideration, selection must be made in accordance with veterans preference.
PLAN B	Agency is unable to appoint all qualified candidates. All qualified candidates are given numerical ratings. Appointing officer may appoint any candidate with an eligible rating without immediate regard to order on the register. The register must be reconstituted at least once a month to insure compliance with the "rule of three" and veterans preference.
PLAN C	Civil Service Commission has determined that candidates are in critically short supply. Each position concerned is common to two or more Federal agencies. Agencies may appoint any qualified candidate without either a prior commitment to hire all eligibles as in Plan A, or a periodic reconstitution of registers as in Plan B.

Other approaches are available for hiring on-the-spot. For example, in recent years the Commission has made increasing use of what has become known as the "quality approach" to direct recruiting. The quality approach recognizes that in practically all occupations there is a shortage of the best qualified eligibles. By determining in advance what the shortage level is for a particular occupation, it is possible for an examining office to authorize agencies to hire on-the-spot for career-conditional appointment any eligible whose rating is above the predetermined level. In some cases when there is an examination open, an agency representative may be authorized to recruit, test, and hire candidates whose ratings are sufficiently high to place them in the best qualified group.

- *Making Offers Early.* Offers of appointment may be made to prospective college graduates well in advance of graduation. Security clearances and necessary paper work can then be completed while the individual selected is still in school.

- *Paying Travel Expenses to First Post of Duty.* In filling shortage category positions, as listed by the Civil Service Commission, agencies may pay the travel and moving costs of new appointees and of student trainees promoted to a higher grade upon completion of college work.

- *Appointing Without Examination.* Appointments to positions established under P.L. 313, may be made without competitive examination. However, the qualifications of individuals selected for such positions must be approved by the Civil Service Commission. In addition, the Civil Service Commission may authorize, in exceptional cases, appointment to other positions in the competitive service without examination. Such authority may be granted when qualified persons are so few, or the salary or duties are such, that it would not be in the interest of good administration to fill the vacancy by the normal open-competitive process.

  Former Federal employees who have acquired career status may be reappointed without competitive examination to any position for which they may qualify.

SUPERIOR ACADEMIC ACHIEVEMENT

For scientific and engineering positions which do not require prior experience, candidates who have earned a college degree within the most recent two years and who meet criteria of *superior academic achievement* can qualify for higher grades than those for which they would otherwise be eligible. The table below provides the criteria for each grade and indicates for the higher grades the kinds of positions which may be filled by candidates with such qualifications.

Grade	Degree	Criteria
GS–7	BACHELOR'S	Upper 25% of his class; or "B" average or better; or "B+" (3.5) average or better in applicable major field; or Elected to Phi Beta Kappa, Sigma Xi, or a national honorary subject-matter scholastic society; or Scored 600 or better on an appropriate Area Test or Advanced Test in the Graduate Record Examination. *Note:* The grade averages may be based on completed courses at the time of application or the last two years of the undergraduate curriculum.

GS–9	**MASTER'S DEGREE**	Ranks in the upper quarter of all Master's degree graduates in his field.
GS–11	**MASTER'S DEGREE**	Minimum of two years study required by university for the degree; and Ranks in the upper quarter of all graduates in his field with this same type of Master's degree. Positions involve research, creativity, or advanced scientific work.
GS–12	**Ph. D. DEGREE**	Ranks in the upper half of all Ph. D. degree graduates in his field. Positions involve research or exploratory development.

Moreover, candidates for research and development positions at any level who have made a *significant creative contribution* can qualify for one additional grade above the one for which their experience and training would normally qualify them. However, a candidate who achieves a higher grade on the basis of the criteria in the table above cannot qualify for an additional higher grade based on a significant creative contribution.

SOME APPOINTMENT OPTIONS FOR MEETING PROJECT NEEDS

For scientific projects of limited duration (four years or less), career types of staffing may not be appropriate. In such cases the Commission's regulations provide for two types of appointments, in addition to the usual temporary appointments:

TERM APPOINTMENT

A "term appointment" is a temporary appointment used to meet "project" requirements. Such appointments may be made where the employment on a project will be for more than one year but less than four years. In some instances this authority may be useful in appointing visiting scientists, engineers, and college faculty members. Characteristics of this appointment include:

- Prior Civil Service Commission authorization is required.
- Appointment outside the register may be made in the absence of adequate registers.
- Appointment from a register does not confer competitive status.
- Appointees are eligible for within-grade increases in salary.

- Appointees are entitled to annual and sick leave benefits.
- Group Life Insurance and Health Benefits are available, if desired.
- Civil Service Retirement is not afforded.
- Reassignments and promotions within a project are authorized.
- First year of service is a trial period.
- After completion of the trial period, appointees are covered by the reduction-in-force regulations until termination of the "project" and have the same protections against adverse action as career employees.

ONE YEAR APPOINTMENT

A "one-year appointment" is a temporary appointment, not to exceed one year, of college faculty members to positions of a scientific, professional, analytical, employee development, or instructional nature. Characteristics of this appointment include:

- Civil Service Commission approval is not required.
- Appointments may be made without regard to registers.
- Appointees are entitled to annual and sick leave benefits.
- Group Life Insurance, Health Benefits, and Civil Service Retirement benefits are not afforded.
- Reassignments, promotions, and transfers are not authorized.
- Trial period is not required.

In addition to enabling agencies to meet temporary staffing needs, the appointments described above may, by providing concrete experience in Government activities, encourage well-qualified persons to consider career type appointments.

THE FEDERAL PAY SYSTEM

Since 1962 the Federal service has had a modernized pay policy and pay system. Its most important feature is a basic policy for determining pay levels:

THE POLICY

> "*Federal Salary Rates Shall Be Comparable With Private Enterprise Salary Rates for the Same Levels of Work.*"

Each year the Bureau of Labor Statistics makes a survey of salary rates in private enterprise for many jobs that are the same in Government and industry. Included in the survey are jobs in chemistry and engineering, from junior levels to the levels of research leadership and program supervision. The survey yields national average salaries that are directly comparable with Federal salaries in the scale up to and including GS–15. On the basis of these comparisons, the President submits to Congress any salary recommendations he feels are justified.

THE PAY SYSTEM

Several special features help the Federal service compete in the labor market and stimulate high-quality performance:

- *Recognizing the Quality of Performance.* Two related steps give the manager additional control over the pay of staff members:
  - An extra within-grade increase, in addition to the regular one, can be awarded once a year for high-quality performance.
  - The regular within-grade increase may be given only if the employee's performance is of an acceptable level of competence; thus the marginal worker can no longer qualify for such an increase.

- *Special Salary Rates.* Authority to increase salary rates for shortage category jobs allows the Commission to raise the entire range of rates within the grade when necessary to meet private-enterprise salaries in shortage occupations. Such increases may be authorized on a nationwide, regional, or locality basis. They are subject to review once a year. This authority is now being widely used for professional engineering, scientific, and medical positions.

- *Special Recruitment Salary Rates for Individuals With Superior Qualifications.* For positions in grade GS–11 and above, the Commission has authority to give consideration to an individual candidate's existing salary, unusually high or unique qualifications, or a special need of the Government for his services, and to permit his appointment at a rate above the minimum rate of the appropriate grade. One major use of this authority is to recruit persons with doctorates.

- *Promotion Increases.* The minimum amount of additional salary an employee receives upon promotion is the equivalent of two within-grade increases. (Where there is no scheduled rate in the higher grade which is at least two steps above the previous rate, the employee receives the maximum salary for the grade or keeps his existing rate, whichever is higher.)

- *Structural Features.* The internal structure of the General Schedule has been improved significantly. For example, it now provides for:

  - Regular and meaningful salary differences between grades.
  - Uniform and meaningful rate ranges at most grades. (For grades up to GS–15, ranges are about 30% of the minimum rate of the grade.)
  - Uniform and meaningful within-grade increases, with nine increases available at most grades, each amounting to about 3.3 percent of the entry rate.

- *Absence of Numerical Restrictions on Top Grades for Certain Occupations.* Professional engineering positions primarily concerned with research and development and professional positions in the physical and natural sciences and medicine are not subject to the numerical limitations covering positions at GS–16, 17, and 18. Thus agencies may recommend to the Commission as many such positions in these grades as duties and responsibilities warrant.

RELATIONSHIP OF POSITION CLASSIFICATION TO QUALITY STAFFING

A close relationship must exist between the function of classifying a position and the function of filling it with a well-qualified person. In recent years the Commission and the agencies have made much progress in bringing these two vital functions into a harmonious relationship. The following tools and techniques for relating the job and the man are available to enhance the development of a high-quality staff:

IMPACT OF THE MAN

Federal jobs are classified on a basis of duties, responsibilities, and qualifications required. The system recognizes, particularly in R&D and many other professional positions, that the qualifications and abilities of an outstanding incumbent will attract greater responsibilities to him to the point where a higher grade may be justified. Some classification standards make specific reference to this factor and provide specific guidance for its consideration; the lack of such reference in a standard, however, does not mean that it is not present.

TWO TRACK SYSTEM

Positions may be classified at the higher grade levels, without requiring supervisory or administrative responsibilities, on the basis of individual research effort and required professional qualifications. Thus, the junior scientist can choose the "track" most suited to his talents, whether as an individual researcher or as a scientific administrator, and prepare himself accordingly.

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TAILORING JOBS—NOT MEN

Almost all research positions and, in some cases, other types of positions can be tailored to the qualifications of candidates. For example, if an outstanding candidate is over-qualified for a given vacancy the agency can, after determining the level for which the candidate is qualified, either establish a new position at that grade level or, if possible, expand the duties and responsibilities of the vacant position so that it is classifiable at that grade level.

INTERDISCIPLINARY POSITIONS

Interdisciplinary positions are positions which involve work in two or more professional fields and which may be filled by persons qualified in any of the pertinent disciplines. A vacant interdisciplinary position may, without rewriting the position description, be reclassified to the occupational series fitting the qualifications of a particular candidate.

MOBILITY BETWEEN DISCIPLINES

The Commission has modified the basic education requirements for professional scientific and engineering positions so that employees may move easily from one subject matter emphasis to another in their jobs.

A panel of professionally qualified examiners may exercise professional knowledge and judgment in evaluating the qualifications of scientists and engineers whose completed education does not fully satisfy specified course requirements, but whose experience and education clearly demonstrate possession of the knowledges and abilities required for professional work in a given occupation.

RELATIONSHIP OF POSITION CLASSIFICATION TO PERSONNEL DETAILS AND ORGANIZATIONAL PATTERNS

DETAILS

The classification and qualification system allows management to "detail" an employee from his current job to another one of higher or lower grade or laterally to one for which he does not meet the regular requirements.

Details may be made for periods of up to six months without Commission approval or for longer periods with the approval of the Commission. They are useful for making emergency assignments and they are particularly valuable in training and developing employees. For example:

- An employee may be detailed to another type of position or another agency for the purpose of cross training.
- An employee may be detailed to a higher level position for the purpose of developing and reinforcing higher skills or for determining ability to perform at that level.
- An employee may be detailed to an understudy type position.

Details of the latter two types should be made in accordance with the agency's merit promotion program. If the individual selected for the detail performs according to expectations, he may then be promoted to the position without again invoking the procedures of the merit promotion program.

ORGANIZATIONAL PATTERNS

The classification system does not control the type of organizational pattern, the numbers of employees to be used, or the shape of individual positions. These are all completely under management's control, within mission and budget limitations. Thus, the manager may decide to have a "flat" or a "narrow" form of organization, and to divide the work among many specialists or to use a generalist approach. The classification system is neutral towards these decisions and stands ready to reflect whatever job structure management designs.

Congress has made the Commission responsible for insuring that the numerical limitation imposed on non-scientific and non-research and development engineering positions in grades GS-16, 17, and 18 are not exceeded. Other than this the Commission does not control the total number of positions, or the number of positions at any particular grade level, established in an agency. This is a responsibility of management, for only the agency management has the broad authority to determine how work is to be organized and what duties and responsibilities are to be assigned to any given employee.

In addition, the Commission, in delegating authority for personnel administration, does not normally specify the level to which agency heads must or may redelegate this authority, nor does the Commission prescribe an agency's organization for personnel administration. Although the Commission urges, at every opportunity, the redelegation of authority to levels as close to the work level as possible, agency officials are free to redelegate as much or as little of their authority as they feel is necessary or appropriate to the successful accomplishment of agency objectives.

The fact that discretionary areas, broad at the national level, have a disquieting habit of appearing narrow at the laboratory level has been commented on by Chairman Macy in these words:

> "I am constantly amazed when I find that a certain discretionary area, which is broad at the national level, as enunciated by the Commission, appears to be narrow when it reaches the laboratory. . . . I would hope that we would have enough confidence in laboratory managers and that we would have an effective enough administrative pattern so that these discretions could be applied at the laboratory level."

TRAINING FOR EXCELLENCE

A law passed in 1958 was a landmark in the Government's pursuit of excellence. Its many flexible provisions are especially suitable for meeting the need of Federal research and engineering activities to keep professional and technical staff abreast of rapidly changing developments. Thus, laboratories can build in training as a part of the regular careers of their professionals.

THE TRAINING LAW AUTHORIZES

- Employee training at full pay within the agency or at outside facilities.
- Training at colleges, universities, professional institutes, industrial laboratories, or research foundations.
- Payment for all or part of tuition and related costs.
- Acceptance by employees of contributions and awards incident to training in non-Government facilities.
- Payment of travel expenses and registration fees for attendance at professional meetings.
- Cooperation among agencies in opening up training courses across agency lines.

THE LAW HAS CERTAIN RESTRICTIONS BUT ALSO PROVIDES FOR APPROPRIATE WAIVERS

- Employees must have at least one year of civilian service before training at a non-Government facility can be authorized. [HOWEVER, IF THE AGENCY HEAD FINDS THAT POSTPONEMENT OF THE TRAINING IS CONTRARY TO THE PUBLIC INTEREST, HE MAY WAIVE THIS RESTRICTION.]
- Employees may receive only one year of training in a non-Government facility during any 10-year period of service. [HOWEVER, THIS RESTRICTION MAY BE WAIVED BY THE CIVIL SERVICE COMMISSION AT THE REQUEST OF THE HEAD OF THE AGENCY.]
- University training may not be undertaken for the *sole* purpose of obtaining a degree. [HOWEVER, IF THE TRAINING IS FOR THE PURPOSE OF DEVELOPING SKILLS, KNOWLEDGES, AND ABILITIES WHICH WILL BETTER QUALIFY AN EMPLOYEE FOR THE PERFORMANCE OF OFFICIAL DUTIES, AND THE DEGREE IS ATTAINED IN THE PROCESS OF RECEIVING SUCH TRAINING, THE DEGREE IS AN INCIDENTAL BY-PRODUCT OF THE TRAINING, RATHER THAN ITS SOLE PURPOSE.]

A number of agencies have sent staff members to universities for full-time training for periods of up to one year. In addition, several laboratories have worked out arrangements with nearby universities under which senior staff members of the laboratory serve as part-time faculty members and give graduate courses to their junior colleagues, often using projects of the laboratory as course or thesis subjects.

Training on the job continues to be the most important and economical method of training large numbers of people in the skills and knowledges required in our complex civilization. This type of training has proved its effectiveness regardless of level and kind of work. It should not be neglected in favor of academic training.

The Commission has authorized a variety of techniques which agencies are encouraged to utilize.

TRAINING AGREEMENTS

Agencies may enter into special agreements with the Civil Service Commission which provide that satisfactory completion of a special course of in-service training qualifies a participant for reassignment or promotion to a specific job.

For example, an agreement may be effected which provides for a promotion after satisfactory completion of six months training to a position for which the individual would not otherwise qualify.

Training programs of this type may be used to bring performance levels of professionals recruited at GS–5 and GS–7 to the GS–7 and GS–9 levels quickly.

EXECUTIVE DEVELOPMENT AGREEMENTS

Agencies may enter into special executive development agreements with the Civil Service Commission which authorize the movement of individuals from professional, scientific, and technical fields to administrative fields in order to prepare them for supervisory assignments in their professional fields.

The agency must show that, within a reasonable time after assignment to the positions covered, employees will acquire the knowledges necessary to perform fully their new duties.

Under such an agreement, agencies can make these movements of personnel without the prior approval of the Commission. If no such agreement has been made, such movement can be accomplished only with the prior approval of the Civil Service Commission.

CO-OP TRAINING PROGRAMS

These are long range programs designed to attract quality personnel to full-time Federal employment upon attainment of their degrees. A program is usually arranged so that the student alternates about six months of academic training at an accredited college or university with six months of work experience in the Government agency.

RECOGNIZING ACHIEVEMENT

Two ways in which the personnel system recognizes achievement have already been outlined: quality increases within the grade and impact of an outstanding staff member on his assignment. Some important additional methods follow:

MERIT PROMOTION PROGRAM

Under guidelines published by the Commission, each agency develops a promotion program to insure that broad areas of consideration are used and that selections are made from among the best qualified when vacancies are to be filled by promotion. (As indicated earlier, management may fill vacancies by methods other than promotion.) By promoting the best qualified, management recognizes achievement and sets the tone of the entire enterprise. To insure valid judgments, some Federal agencies convene panels of senior colleagues so that professionals are rated for promotion by persons who are expert in the area concerned.

INCENTIVE AWARDS

Agency heads are authorized to grant cash awards or honorary awards, or a combination of both, to employees for achievements that improve operations or are in the public interest. These are important vehicles for recognizing high quality performance, particularly when quality increases would not be appropriate. Cash awards of up to $25,000 and honorary awards ranging from an official commendation up to the "President's Award for Distinguished Federal Civilian Service" have been granted to scientists and engineers. For example, 17 of the 21 largest cash awards—ranging from $5,000 to $25,000—were made for scientific and technical achievements; and 18 of the 46 Presidential Awards for Distinguished Federal Civilian Service have been awarded to Federal scientists.

For outstanding R&D achievement some Federal agencies have established special medals or awards named for distinguished scientists who served the agency in the past. For example, the Office of Naval Research has established an annual Navy-wide science award known as the Captain Robert Dexter Conrad Award for Scientific Achievement. This award was named in honor of the first head of the Planning Division of ONR, who was the primary architect of the Navy's basic research program. The Naval Research Laboratory annually grants the E. O. Hulburt Award to a NRL scientist or engineer for a scientific accomplishment of significant value to the Navy. This award was named in honor of the Laboratory's first Director of Research. The Bureau of Standards annually awards the Stratton Award to a Bureau scientist or engineer for an unusually significant contribution to some area of science or engineering. This award was named in honor of the Bureau's first director.

Name awards have also been established by some laboratories for the best technical paper-of-the-year published by a staff member. For example, Cambridge Research Laboratories has established the Dr. Marcus D. O'Day Award. The Air Force Navigation and Guidance Laboratory has established the Samuel M. Burka Award.

There is room for considerable ingenuity in establishing award programs for special purposes. The Commission's pamphlet *Awards and Honors for Scientists and Engineers* provides further information on this subject.

PERFORMANCE RATING PLANS

The Commission may approve a wide variety of rating plans for use within the agencies. Except for certain broad principles, there is no requirement for uniformity between agencies nor between occupations or components within the same agency. Thus, agencies are encouraged to develop performance rating plans tailored to the specific environment in which they will be used.

A well-conceived, conscientiously administered performance rating plan can assist in the identification of the type of training or higher education needed by an individual to work at his maximum capacity. It can also assist in the identification and recognition of staff members who have made important scientific and technical contributions. However, because of the recognition possible under the incentive awards program, it is perhaps true that the "Outstanding" rating is little used today.

Regardless of how individuals or groups are recognized for their achievements, administrators must realize that, to be effective and meaningful, recognition must be reserved for real contributions.

ENCOURAGING A CREATIVE ENVIRONMENT

This, then, is the Federal personnel system as it applies to scientists and engineers in most departments and agencies--a group of principles, policies, and procedures within which laboratory directors can shape the particular environment they seek for their staffs in the light of the missions and goals assigned to the organization.

The development of an environment to foster high productivity and innovation is a large subject, beyond the scope of this pamphlet, and one abounding in subtleties that go far beyond adequate salary rates or generous vacation time. But many personnel factors, as well as other management factors such as the extent to which authority is delegated to the laboratory director, undoubtedly enter into this challenging and complex subject.

Some factors such as those related to pay policies and career development opportunities are mentioned elsewhere in this pamphlet. Among others that should be considered are the following:

- Attendance at conferences of professional societies.
- Giving credit lines or otherwise acknowledging contributors to publications of the laboratory.
- Freedom to publish, teach, or lecture outside of duty hours.
- Scheduling of vacation time. (One definite advantage of Federal employment is that normally vacations do not have to be taken only at certain seasons when an entire operation shuts down.)
- Flexibility in hours of work. (Agency heads have the discretion to authorize variations in the standard 40-hour week. Thus, staff members may work on a "first 40 hours" basis—for example, working late one evening on an experiment and coming in late the next day; or they may work a 40-hour week scheduled to allow them to attend classes during the normal workday when the training is not authorized under provisions of law.)
- Position titles adapted to the profession. (Official titles such as "Supervisory Physicist" are used for personnel and payroll purposes, but agency heads may authorize more professionally meaningful titles for publication on papers, correspondence, etc. Examples are "Member of Technical Staff," "Research Associate," or "Senior Scientist.")

Granted, the laboratory director, like all Federal managers, has to work within a framework of statutes, Commission regulations, and internal agency instructions. Nevertheless, there are real flexibilities built into the framework for personnel management, flexibilities that are not always fully known and less often fully utilized. This pamphlet is designed to help the science and engineering manager keep in mind the whole range of special resources available to him in the difficult task of developing a good laboratory environment.

APPENDIX L

THE LIBRARY OF CONGRESS—LEGISLATIVE RESEARCH SERVICE

PRINCIPAL PUBLICATIONS RELATING TO THE FUTURE USE OF GOVERNMENT LABORATORIES

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Growing interest in the future use of Government laboratories has prompted the compilation of the following listing of principal publications and references. The listing is in two parts. First, principal documents and reports relating to use of Government laboratories are cited. Second, actual inventories of Government laboratories are identified. All items are listed chronologically to show the development of interest.

Many of these items are summarized briefly in the report, "A Case Study of the Utilization of Federal Laboratory Resources," published by the Research and Technical Programs Subcommittee of the House Committee on Government Operations as a committee print in November 1966.

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1954: Executive Order No. 10521, 19 FR 54, March 19, 1954, pp. 1499–1500. [This order directed the Interdepartmental Committee to see that Federal agencies engaged in research ". . . keep informed of major equipment and facilities which could serve the needs of more than one agency."]

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