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DEPARTMENT OF THE ARMY FIELD MANUAL

LOGISTICS

MATERIEL DEVELOPMENT MANAGEMENT

HEADQUARTERS, DEPARTMENT OF THE ARMY
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PART ONE

INTRODUCTION TO MATERIEL DEVELOPMENT MANAGEMENT

CHAPTER 1

GENERAL

1-1. Purpose

a. This manual contains Army doctrine on the management of materiel development. It is designed to provide a basis for appropriate courses of instruction in the Army school system; to stimulate productive and economical approaches to the problem of managing materiel development; and to furnish guidance for personnel engaged in the research and development, or support, of new materiel required for the effective equipment of the Army. It is neither regulatory nor directive in nature, and personnel engaged in the management of materiel development will continue to be governed by the current provisions of Army regulations, policies, and directives. The materiel presented herein can be applied without modification to both nuclear and nonnuclear warfare.

b. Changes in organization, concepts and policy are of a continuing nature throughout the Department of the Army. This is equally true in the area of materiel development and in its management aspects. Users of this manual are encouraged to submit recommended changes and comments to improve the manual. Comments should be keyed to the specific page, paragraph and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be forwarded direct to the Commandant, U.S. Army Logistics Management Center (USALMC), ATTN: AMXMC-L-D, Fort Lee, Va. 23801. Source data cut off date for material contained in this publication is 1 March 1966 with the exception of references to the U.S. Army Materiel Command and the U.S. Army Combat Developments Command organizations. Source cut off date for these organizations is 25 July 1966.

1-2. Scope

a. Materiel development management is concerned with the principles, policies, organizations, and management processes involved in developing weapons and equipment that are qualitatively superior to those of any potential enemy, at the least possible cost in time and money. It covers management processes throughout the life cycle of an item, from the initial identification of the requirement through type classification to ultimate phase-out. It shows the interrelationships of the research and development and logistics functions, with emphasis on the plans and actions that are taken prior to the physical entry of the new item into the Army inventory, in contrast to the supply management function for items in the inventory. In this, it complements other Army Field Manuals of the 38-series on wholesale logistics.

b. The subject is developed in six parts.

(1) *Part One. Introduction.*

(2) *Part Two. Organization for Research and Development*—describes the principal organizational elements at Department of Defense level and within the Department of the Army that are involved in the research and development effort.

(3) *Part Three. Materiel Requirements*—discusses the Joint Staff and Department of the Army guidance documents that give direction to the Army research and development effort. It describes the documentation, processing, and approval of qualitative materiel requirements, including program and budget actions. In addition, it defines and discusses the categories of research and development and relates these categories to the requirements procedure. Finally, this part describes the complementary responsibility of the Atomic Energy Commission and the Department of Defense in the development of weapons, powerplants, equipment, or processes using nuclear energy.

(4) *Part Four. Materiel Development*—discusses management planning, source evaluation and selection, management tools, considerations that influence the development process, and materiel testing.

(5) *Part Five. Production and Support*—contains a limited discussion of quantitative requirements, production and procurement planning, the mobilization production base, support planning, technical assistance to operating and support elements, and other materiel management functions.

(6) *Part Six. Other Agencies with Interest in Research and Development*—describes other Government and non-Government agencies with interest in research and development.

CHAPTER 2

THE MATERIEL DEVELOPMENT PROCESS

2–1. Recent History

a. The explosive growth of science and technology in the years since World War II has contributed significantly to military materiel even greater than its impact on the civilian economy. The major developments of World War II—nuclear weapons, missiles, and electronics—have been exploited, refined, and applied in a variety of ways. At the same time, new techniques and products have appeared at an accelerating rate; many of these either have been developed specifically for military purposes or have been quickly adapted to military uses. Such developments range from improvements in materials (for instance, the use of aluminum as armor) to fundamentally new products (for example, the transistor and the laser).

b. The growing importance of military research and development is reflected in the defense budget. Total Department of Defense funds allocated for research, development, test, and evaluation were $2.1 billion in fiscal 1953; in fiscal 1963, they amounted to $6.3 billion. In fiscal 1963, missiles (a postwar category) accounted for 22 percent of the defense budget, and communications-electronics for 13.5 percent. (The latter category is now three times the size it was 10 years earlier.) From 1958 to 1964 Army research, development, test, and evaluation funds nearly doubled—jumping from $774 million to $1.386 billion. By 1965 the Army was conducting 470 research, development, test, and evaluation projects that involved almost 1,000 technical tasks, ranging from basic research to development of systems and equipment.

c. As the pace and complexity of technological advance have grown, the interaction between military materiel and operations has become increasingly important. Familiar weapons have undergone radical changes; for example, the 155-mm howitzer now has a nuclear capability. Totally new weapons, such as missiles, have been added to the inventory. Microminiaturization in electronics has lead to lighter, more reliable field and aircraft radios. The Special Purpose Individual Weapon is being developed to provide improved characteristics as to weight, accuracy, and killing power against point targets with an added capability for area fire. Light weight aluminum armor will make it possible to use the Sheridan vehicle in airdrops and in amphibious operations. The solid-fuel Pershing missile is easier to handle and has greater mobility than the liquid-fuel Redstone. The XM23 laser range finder will improve the accuracy of target location in field artillery. Even the World War II combat boot has been succeeded by various special issues, such as "breathing boots" for jungle warfare and thermal boots for use in the Arctic.

d. The development of new systems and equipment has also had a significant impact on the manner of accomplishing service missions. The Hawk missile has become a keystone in the Army's air defense organization, and the air defense of forces in the field is affected by developments such as the Redeye missile. Helicopters and short takeoff and landing aircraft, coupled with weight reductions in division equipment, have made possible the airmobile division, with its advantages of surprise, maneuverability, and avoidance of military and geographic obstacles. The flexible structure of the new ROAD division in turn exploits recent advances in firepower and mobility.

e. Although these improvements in performance and capability of materiel have resulted in

a stronger military posture, they have frequently been accompanied by increased complexity and rising cost, both for development and procurement of materiel. The Tube Launched Automatically Optically Tracked Wire Guided Missile system (TOW) is more complex than are gun type antitank weapons because of its guidance and control subsystems. The Sheridan vehicle, in addition to having the normal subsystems and components of an armed reconnaissance vehicle, includes either the rocket-firing and control systems of the Shillelagh missile or the TOW. On another level of complexity, all missile systems have large numbers of subsystems (rocket motors, guidance systems, hydraulic controls, warheads, airframes, electrical power sources, and other ancillary units). Since each subsystem is often developed specifically for the missile system, systems integration becomes a major element in the development process.

f. Organization for Materiel Development in the Department of Defense and the military services has been modified to meet the needs of rapid change, increased equipment complexity, and higher cost. By 1958 the Directorate of Defense Research and Engineering had been established in the Office of the Secretary of Defense. At that time, an implementing agency for special projects, the Advanced Research Projects Agency, was set up in the Office of the Secretary of Defense. Today the Directorate of Defense Research and Engineering and other elements of the Office of the Secretary of Defense coordinate, and control, research and development programs throughout the Department of Defense.

g. In 1962 the Army underwent a major reorganization with the objective of separating Army staff and operational functions. A major step in this reorganization was the formation of the Combat Developments Command and the Army Materiel Command. The Combat Developments Command is charged with formulating and documenting current doctrine pertaining to the Army in the field and, in anticipation of the nature of land warfare in the future, determining the kinds of forces and materiel needed and how they should be employed; and with making recommendations to Headquarters, Department of the Army, in this regard. The Army Materiel Command is responsible in assigned areas for research, development, engineering, test and evaluation, procurement, production, and logistics support of Army materiel. The materiel development responsibility of the Army Materiel Command is carried out by the commodity commands—Electronics, Missiles, Weapons, Mobility, and Munitions—with central coordination at Headquarters, Army Materiel Command.

h. The other services have carried out reorganizations similar to that of the Army, and for essentially the same reasons. In 1961 the Air Force reorganized its materiel activities, assigning research and development responsibility to the Air Force Systems Command and logistics support to the Air Force Logistics Command. In 1963 the Navy created the Naval Material Support Establishment, headed by the Chief of Naval Material and incorporating the four bureaus responsible for materiel development, production, and support.

i. In recent years a number of management information and control systems oriented to the materiel development process have emerged. Two well-known examples are the program evaluation and review technique and configuration management. Most of these systems address the problems of managing complex system development projects. They rely heavily on statistical analysis and the theory of probability to cope with inherent uncertainty, and tend to use computers for the great number of repetitive calculations made necessary by the complexity of the development process. In general, such management systems tend to impose increasing rigor and precision on the definition and monitoring of the discrete activities involved in materiel development.

2–2. The Materiel Development Cycle

a. The materiel development process transforms the needs that arise from Army planning into systems and equipment that will fulfill Army missions. The cycle progresses from the

definition of a qualitative operational requirement to the acceptance of an approved item into the Army inventory. It embraces research and exploratory development, advanced development, and engineering development; it also extends to operational systems development.

b. While Army plans define the Army's organizational structure against the predicted nature of operations in the future, Army research and development creates and exploits the technology that will ultimately yield materiel to support the operations. The guidance for Army research and development activities stems from research and development planning documents, which in turn are based on Army plans describing future operational requirements for forces and materiel.

c. The process of working from an operational objective to an approved item follows a well-defined pattern. It begins with the statement of a desired objective. This statement then triggers whatever research, exploratory development, or advanced development may be necessary to define technical concepts and approaches to the objective. Incident to the above is the need to consider concurrent planning associated with maintenance support of the equipment or system to include organization personnel, publications, training, special tools, and test equipment requirements. When total feasibility has been established—that is, when the objective and the means of meeting it are acceptable—the most promising technical approach is pursued with greater and greater precision and detail. At the same time, the objective may undergo successive refinements as the needs and the possibilities become clearer.

d. For the largest and most important developments, a rigorous management procedure is called into play—the technical development plan, contract definition, configuration management, and project management. For the most part, these procedures are initiated just before or during the engineering development phase—that is, at the time when the greatest investment of resources is required to yield a result. The engineering development phase normally ends with the completion of acceptance tests and the type classification as Standard A of a new item of Army materiel. Once an item has been type-classified as Limited Production or Standard A, and programing, budgeting, and procurement authority have been approved, it goes into production and is then distributed for use. For some major Army items, the development process may continue into the production phase, when operational requirements may call for limited production prior to completion of development.

e. The materiel development process itself is carried on within the framework of the Department of Defense program system. Long-term planning, including development planning, is essential if the services are to fulfill their missions. Although this planning process extends over periods of many years, the process of budgeting and funding is an annual one. The link between long-term plans and annual budgets is the Department of Defense programing system, which is oriented to military missions within a 5-year cycle. This programing system also affords centralized control and analysis of resources throughout the Department of Defense by measuring the time-phased relationship of resource inputs (money, material, equipment, for example) against military outputs (forces and materiel). All activities of the services, from research and development to operations and maintenance, are included in the Department of Defense programing system.

f. Budgeting flows out of programing. The annual estimate of resource requirements is translated from mission-related programs into the budgetary categories (Research, Development, Test, and Evaluation; Procurement of Equipment and Missiles, Army; and so forth) for which the Congress appropriates funds. The three milestones strived for in the budgetary process occur (1) in the fall, when the services present final updated requests for funds to the Office of the Secretary of Defense; (2) in the spring, when Congressional approval is granted; and (3) in the summer, when the

Bureau of the Budget apportions the funds through the Office of the Secretary of Defense.

2–3. The Management Process

a. The objective of materiel development management is to develop materiel which achieves stated performance requirements within stated time schedules at minimum cost for development, production, and operation. The management process involves achieving balance between these factors—assuring that unnecessary technical features are not designed into the equipment at the expense of time or cost, or that time or cost limitations do not degrade performance below stated requirements.

b. Two factors make the development process a peculiarly difficulty challenge to management. The first is technical uncertainty. Since to some extent every development project involves doing something for the first time, prediction is difficult; both schedules and costs are relatively hard to estimate. The second is technical complexity—a factor that becomes more and more important as the state of the art advances. This technical complexity contributes to the element of risk or uncertainty in the development. It also creates unprecedented demands on management. More and more organizational elements become involved in the development of a single item, and their activities must be coordinated. Engineering changes must be rigorously controlled to insure that the item can be operated and maintained in the field.

c. As the development of an item progresses, the manager must be constantly alert to this problem of keeping his objectives in proper balance. For example, he must know the state of technical progress; whether the development is on schedule; and whether it is within the established budget. In addition, he must be in a position to make trade-offs within the boundaries of his established objectives. He may have to accept additional weight in order to achieve the necessary electrical power output. He may have to accept a 2-month delay in order to obtain a fuel inlet that meets the design objectives. Or he may have to find additional resources to meet the objectives within the time scheduled. At the same time, he must be alert to the impact of development decisions on production, operation, and maintenance of the equipment. Thus, whether a component is designed to be repairable or consumable may make a great difference in the ease and cost of supporting and maintaining the entire item.

d. All recent innovations in the management of materiel development are meant to deal with problems of this sort. PERT, for example, originated in the need for increasing the reliability of schedule estimates in a top-priority military program. Project managers were established in the Army because of the need for concentrated, high-level management attention on key development projects. In general, the newer management systems and techniques try to provide a degree of "visibility" and control over the materiel development process that is comparable to the degree of control already achieved over the very different process of production.

PART TWO

ORGANIZATION FOR RESEARCH AND DEVELOPMENT

CHAPTER 3

DEPARTMENT OF DEFENSE (DOD)

Section I. INTRODUCTION

3–1. Background

a. The composition and the effectiveness of the armed forces are dependent on the nature and availability of the materiel supplied to them. For this reason, virtually every activity within the Department of Defense has an interest in the results of materiel development and may, at one time or another, be actively involved in the development process itself. Certain activities have specific, continuing responsibilities for the management of materiel development. However, the process is not a stratified one, but a cooperative undertaking, involving activities and organizations at all levels of the Department of Defense.

b. Although the emphasis in this chapter is on those offices at Office of Secretary of Defense—Joint Chiefs of Staff level that are directly concerned with materiel development, the general organization of the Department of Defense will also be discussed. The detailed explanation, provided in succeeding chapters, of the management of materiel development in the Army will thus proceed logically in the overall context of the Department of Defense.

3–2. Mission of the Department of Defense

This Department was established by Congress in the National Security Act of 1947. Its formation was part of a comprehensive program to provide for the future security of the United States by integrating the national security policies and procedures of the several departments, agencies, and functions of the Government. Broadly defined, the mission of the Department of Defense is to maintain the armed forces for national defense and to uphold and advance the national policies and interests of the United States. A critical part of this mission is the development of materiel for the armed forces. Since Congress specifically intended to eliminate any unnecessary duplication of effort in the new Department of Defense, particularly in research and engineering, the overall direction and coordination of this function is vested in the Secretary of Defense.

3–3. Organization

The organization of the Department of Defense is shown in figure 3–1. It includes the Office of the Secretary of Defense, the Joint Chiefs of Staff, the unified and specified commands, the Department of Defense agencies, and the military departments. The last are separately organized under service Secretaries, functioning under the direction, authority, and control of the Secretary of Defense.

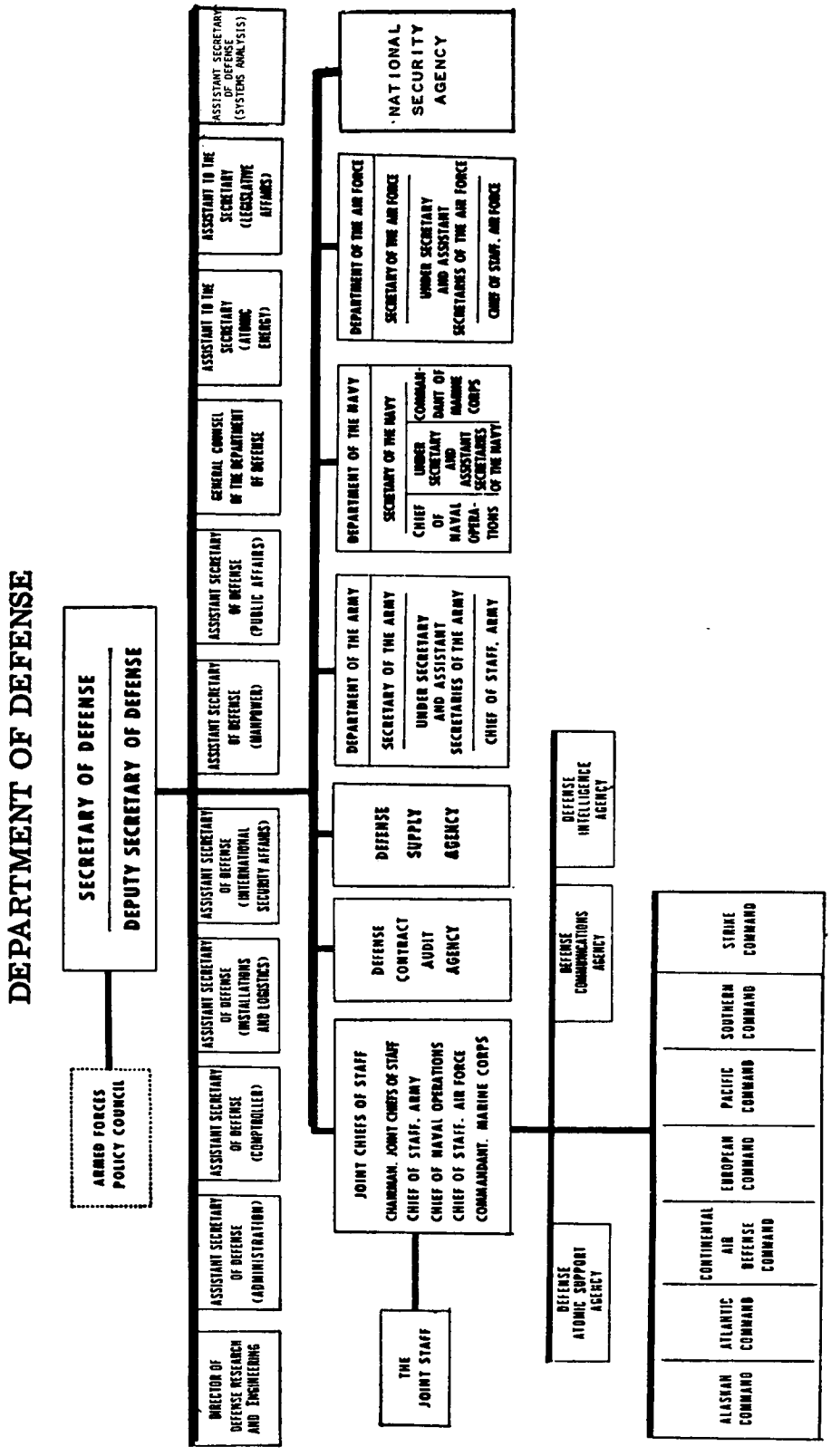


Figure 3–1. Department of Defense.

Section II. OFFICE OF THE SECRETARY OF DEFENSE

3–4. Organization

The Office of the Secretary of Defense, which provides direct staff assistance and advice to the Secretary, is organized along functional lines. It includes the Director of Defense Research and Engineering, the Assistant Secretaries of Defense, the General Counsel, and a number of staff offices. Some individuals, like the Director of Research and Engineering, have responsibilities that are concerned largely with the development of materiel. Others, like the Secretary himself, have many responsibilities outside the scope of materiel development, but nevertheless play vital, identifiable roles in the process.

3–5. The Secretary of Defense

a. General. The Secretary of Defense is the principal assistant to the President on matters of defense. His influence on materiel development is substantial, being exercised both through broad administrative responsibilities and specific actions on individual developments.

b. Administrative Responsibilities. As the chief executive of the Department of Defense, the Secretary of Defense is responsible for and controls the activities of the various components and offices of the Department. He controls and directs the implementation of the materiel development process through the Secretaries of the services.

c. Programing Decisions. The Secretary is directly involved in decisions about what developments will be undertaken and what resources will be made available. All new program elements in the programing structure of the Department require the approval of the Secretary or the Deputy Secretary, as do all program changes above specified thresholds (administrative restrictions on resources which limit approval authority for making changes in the base program). This means that before major research and development activities are begun or changed, or before they enter a new stage, a detailed analysis must be presented to the Secretary. After evaluation of the resources, force requirements, trade-offs, and so on, that are involved, he then decides what programs will be pursued. Smaller developments or research activities are processed in a similar way, although they normally are handled in related groups rather than singly.

d. Budgeting and Actions on Specific Systems. In addition to the longer-term decisions of programing, the Secretary is involved in the annual budgeting process. Requests for funds by the services undergo analysis and reappraisal within the Office of the Secretary of Defense prior to the Secretary's justification before Congress. After appropriation of the funds by Congress, the Bureau of the Budget makes apportionment to the services through the Assistant Secretary of Defense, Comptroller. The Secretary of Defense has some degree of latitude in this. While funds may not be transferred between services, they may be reapportioned among programs within a service. Funds authorized by Congress for particular programs may also be withheld for various reasons, such as a pending determination of technical feasibility or the need to validate the original requirement. After apportionment, the Secretary may affect funds availability within a budget year by reprograming. (The levels of reprograming authority depend on the nature and magnitude of programs.) When circumstances warrant, the Secretary may also maintain personal cognizance of specific materiel development situations—for instance, he is directly interested in the new main battle tank being jointly developed by the United States and the Federal Republic of Germany, and in source and design selection for the Air Force/Navy experimental tactical fighter.

e. National Security Council. In addition to his role in the Department of Defense, the Secretary, as a permanent member of the National Security Council, participates in defining the broad objectives of national security and relating them to coordinated missions for the executive departments. As this broad guid-

ance is developed into specific Defense missions, the nature and size of required forces are established. Both mission and force requirements inevitably affect materiel development. For example, the requirement for a limited-war response capability that grew out of the National Security Council guidance has resulted in the generation of Army requirements for lightweight, quickly transportable materiel, including new types of tactical weapons.

3–6. The Deputy Secretary of Defense

The Deputy Secretary of Defense is responsible for supervising and coordinating the activities of the Department of Defense as the Secretary directs. He acts for the Secretary during his absence or in the event of his disability.

3–7. The Assistant Secretary of Defense (Comptroller)

a. The Assistant Secretary of Defense (Comptroller) is the principal adviser and assistant to the Secretary of Defense on budgetary and fiscal matters. In this capacity, he administers procedures and systems that are integral to all Department of Defense management, including that of materiel development. He supervises preparation of the Department's budget estimates and establishes policies and procedures governing the administration of such functions as budgeting, accounting, reporting, internal auditing, and collecting and disbursing Department of Defense funds.

b. He plays an active role in the administration of the Department of Defense programing system, principally in the review, monitoring, and coordination of program submissions from the military departments. He also compiles and analyzes financial and nonfinancial data on Department of Defense programs to determine their economic impact and to develop or improve the systems and techniques used in managing these programs.

c. In the performance of his responsibilities, the Assistant Secretary of Defense (Comptroller) has the assistance of four deputies:

(1) *The Deputy Assistant Secretary of Defense (Accounting and Audit)* is responsible for policy and procedures in those fields.

(2) *The Deputy Assistant Secretary of Defense (Management)* performs internal audit and statistical services.

(3) *The Deputy Assistant Secretary of Defense (Budget)* is directly concerned with the materiel development programs, since he works closely with the services during the budget submission, approval, and apportionment process. He is also concerned with the administration and support of reprograming actions taken by the Secretary of Defense within the budget year.

(4) *The Deputy Assistant Secretary of Defense (Programing)* is the central point for operation of the programing mechanism (discussed in detail in ch 7). Service submissions for new programs or program changes are made through this office, which controls and monitors them. The Deputy Assistant Secretary of Defense (Programing) makes determinations on the adequacy and format of data submitted; coordinates with action and information offices in the Office of the Secretary of Defense and Joint Chiefs of Staff; consolidates analyses and recommendations for submission to the Secretary of Defense; transmits decisions to the implementing component; and obtains the required supplemental data from the implementing component. Within Deputy Assistant Secretary of Defense (Programing) the Directorate for Program Analysis receives various cost data and other information on existing programs, which it evaluates for use in Office of Secretary of Defense decision-making in a variety of areas. Outputs from this directorate are also used in establishing doctrine and management

techniques, such as the Cost and Economic Information System Program, which, among other things, is designed to improve cost estimating and progress reporting.

3–8. The Assistant Secretary of Defense (Systems Analysis)

a. The Assistant Secretary of Defense (Systems Analysis) is the principal adviser and assistant to the Secretary of Defense in the analysis of force requirements and related resources. The position of this Assistant Secretary was created in 1965; until that time, his functions were performed within the organization of the Assistant Secretary of Defense (Comptroller).

b. The responsibilities of the Assistant Secretary of Defense (Systems Analysis) include reviewing quantitative requirements, including forces, weapon systems, equipment, personnel, and nuclear weapons; initiating, monitoring, guiding, and reviewing requirements studies and cost/effectiveness studies; and conducting or participating in special studies as directed by the Secretary of Defense. In performing these responsibilities he uses a variety of analytical techniques, including cost/effectiveness studies and trade-off analyses.

c. The functions assigned to the Assistant Secretary of Defense (Systems Analysis) include the following:

(1) Develop measures of cost and effectiveness in order to make quickly and accurately analyses of a variety of alternative programs of force structure, weapons systems, and other military capabilities projected over a period of several years.

(2) Assemble, consolidate, summarize, and present data in various forms to show the total implications of alternative programs in terms of relative costs, feasibility, and effectiveness, and the problems of choice involved.

(3) Analyze and review quantitative requirements in the following functional fields:

(*a*) force structures;

(*b*) total manpower;

(*c*) weapons systems and major end items of materiel—e.g., bombs, torpedoes, ships, vehicles, ammunition;

(*d*) nuclear weapons;

(*e*) transportation, including mobility and deployment;

(*f*) information and communication systems closely related with the above requirements.

(4) Analyze and review quantitative military requirements of allied and other foreign countries.

(5) Assist the Secretary of Defense in initiating, monitoring, guiding, reviewing, and summarizing requirements studies.

(6) Participate in review of Consolidated Programs for command, control, communication, and intelligence functional activities.

(7) Develop planning guidance and effectiveness criteria to be used in the determination and compilation of requirements by Department of Defense components for materiel, weapons, transportation, and information and communications systems for command and control and intelligence.

(8) Review overall force guidance and associated plans.

(9) Analyze the impact upon the civilian economy of Department of Defense utilization of resources in the above functional areas.

(10) Provide special support to the Secretary of Defense for Department of Defense participation in those nondefense governmental programs assigned by the Secretary of Defense and in which the Department of Defense has strong interest, such as the Supersonic Transport Program and maritime subsidies.

3–9. The Assistant Secretary of Defense (Installations and Logistics)

a. The Assistant Secretary of Defense (Installations and Logistics) is the principal adviser and assistant to the Secretary of Defense in the area of quantitative materiel requirements, production planning, and scheduling; materiel acquisition, maintenance, distribution, and disposal; transportation, telecommunications, and petroleum; and industrial facilities and military construction.

b. He is vitally interested in the actions and decisions made during the development phase that will affect the procurement, production, and logistic support phases of the materiel life cycle. He studies the logistical implications of materiel development programs or changes to them included in the Five-Year Force Structure and Financial Program; this evaluation includes appraisal of industrial production and support capabilities and capacities, as well as certain cost aspects. The evaluation performed by this office often helps to guide and shape related materiel development decisions.

c. This Assistant Secretary also reviews service programs for integrated logistic support, including logistical participation in the development of qualitative requirements, technical development plans, contract definition, and various negotiation phases. Finally, the time-phased progress of materiel developments is closely followed to make certain that production and deployment schedules can be met.

3–10. The Assistant Secretary of Defense (International Security Affairs)

a. The Assistant Secretary of Defense (International Security Affairs) is the principal assistant to the Secretary of Defense for international security. In this role he coordinates National Security Council policy within the Department of Defense. In addition, he is responsible for the plans and procedures of the Military Assistance Program, for supervising this program, and for monitoring the activities of Military Assistance Advisory Groups. He is also active in developing and coordinating defense positions in international affairs, including foreign agreements, and coordinates Department of Defense affairs with the Department of State. Discharge of these responsibilities involves the Assistant Secretary of Defense (International Security Affairs) in the definition of materiel requirements and in cooperative development programs.

b. It is a Department of Defense policy to cooperate with our allies in research and development to meet joint requirements under the various international programs. The Assistant Secretary of Defense (International Security Affairs) provides policy guidance to the Director of Defense Research and Engineering in his monitoring of service-implemented cooperative research and development programs.

c. Although the Military Assistance Program is a responsibility of the Department of State, the Department of Defense is responsible for its implementation. The Assistant Secretary of Defense (International Security Affairs) acts for the Secretary of Defense; for example, he has the authority to permit use of Military Assistance Program funds for the exchange of technical and scientific information under the Mutual Weapons Development Data Exchange Program and the Defense Development Exchange Program. Materiel development and logistics support for the Military Assistance Program are performed by the individual services under overall coordination from the Assistant Secretary of Defense (International Security Affairs).

3–11. The Director of Defense Research and Engineering

a. Responsibilities. The Director of Defense Research and Engineering is the point of coordination for all research and development activity within the Department of Defense. It is his job to develop the policies, establish the procedures, and provide the guidance under which the materiel development effort is carried out. He also monitors particular projects or programs. The Director of Defense Research and Engineering is the principal assistant to the Secretary in scientific and technical matters; basic and applied research; research, de-

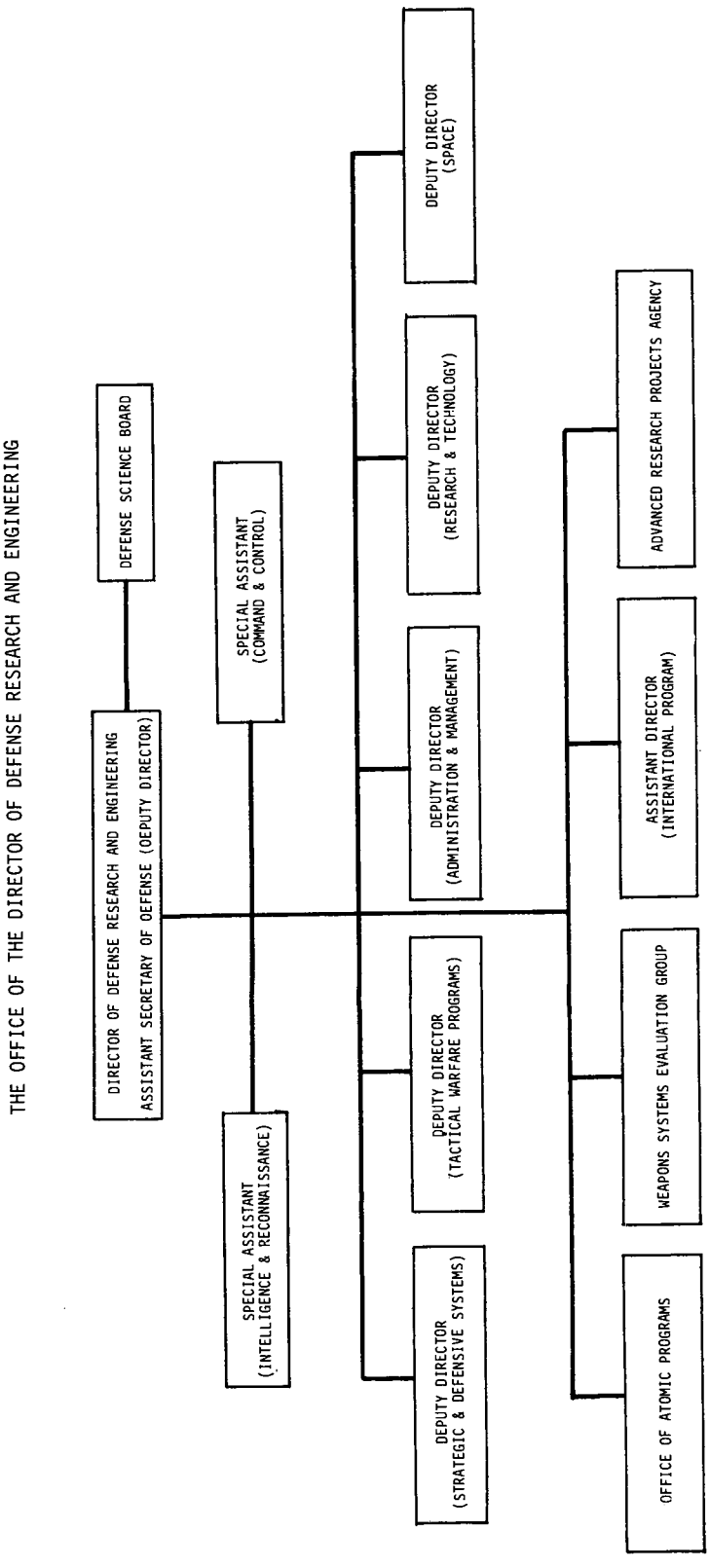


Figure 3–2. The Office of the Director of Defense Research and Engineering.

velopment, test, and evaluation of weapons, weapon systems, and defense materiel; and design and engineering for suitability, producibility, reliability, maintainability, and materials conservation.

b. The Office of the Director. The Office of Director of Defense Research and Engineering is composed of mission- and systems-oriented groups. The total complement of 150 military and 200 professional civilian personnel is organized as shown in figure 2. All research, development, test, and evaluation projects that represent Department of Defense program elements or parts of elements are assigned to one of the major groups for monitoring. Close, informal relationships are maintained with the project-implementing Defense component.

c. The Defense Science Board. This board is composed of members appointed from civilian life by the Secretary of Defense upon recommendation of the Director of Defense Research and Engineering. It advises the Secretary of Defense, through the Director of Defense Research and Engineering, on scientific and technical matters of interest to the Department of Defense. It is particularly concerned with policy matters in the area of long-range planning.

d. Functions of the Director. The Director of Defense Research and Engineering is responsible for a number of functions in the Department of Defense. He must—

(1) Recommend policies and guidance governing Department of Defense planning and program development.

(2) Plan and recommend an optimum integrated program of research and development to meet the requirements of national military objectives and initiate projects to fill important gaps which may exist.

(3) Review projects, programs, and objectives of programs of the military departments and other Department of Defense research and development agencies.

(4) Develop systems and standards for the administration and management of approved plans and programs.

(5) Evaluate the administration and management of approved policies, programs, and projects.

(6) Recommend the assignment or reassignment of research and engineering responsibility for the development of new weapons or weapons systems.

(7) Direct and control (including their assignment or reassignment) research and engineering activities that the Secretary of Defense deems to require centralized management.

(8) As approved by proper authority, engage in or designate appropriate research and development facilities to engage in basic and applied research projects essential to the responsibilities of the Department of Defense which pertain to weapons systems and other military requirements—

(*a*) by contract with private business entities, educational or research institutions or other agencies of government,

(*b*) through one or more of the military departments, or

(*c*) by utilizing employees and consultants of the Department of Defense.

(9) Recommend appropriate steps (including the transfer, reassignment, abolition and consolidation of functions) which will provide in the Department of Defense for more effective, efficient and economical administration and operation, will eliminate unnecessary duplication, or will contribute to improved military preparedness.

(10) Recommend to the Secretary of Defense appropriate funding for research, development, test, and evaluation, including allocations from the Emergency Fund, Department of Defense.

(11) Keep the Department of Defense informed on significant trends in scientific research relating to national se-

curity and recommend measures to assure continuing progress.

(12) Exercise administrative direction of the Weapons Systems Evaluation Group and assure its responsiveness to the needs of the Joint Chiefs of Staff and the Office of the Secretary of Defense for operations analysis.

(13) In coordination with the Assistant Secretary of Defense (International Security Affairs), engage in programs for assistance to friendly countries in military research and development and in the interchange of related scientific and technical information.

(14) Such other duties as the Secretary of Defense assigns.

e. Special Control Procedures.

(1) *General.* The liaison between the Office of the Director of Defense Research and Engineering groups and the project-implementing Department of Defense component provides informal but close control of research and development projects. However, in some cases more formal procedures than these are necessary. Three of the most important for development programs are the Technical Development Plan, Contract Definition, and the Programing System.

(2) *Technical Development Plans.* A Technical Development Plan is submitted periodically for major or specified projects in advanced development, engineering development, or operational systems development. The Technical Development Plan must describe the project's objective, technical aspects, management approach, resource requirements, and schedules. This not only provides the Director of Defense Research and Engineering with information and control, but also establishes the base lines from which developing agencies report deviations. The Technical Development Plan is discussed in detail in chapter 11.

(3) *Contract Definition.* The Contract Definition procedure is required for major or specified development projects. The purpose of this precedure is to develop a definitive technical approach, management plan and cost data as the basis for proceeding with engineering development. Contract Definition is discussed in detail in chapter 8.

(4) *The Programing System.* The Programing System provides the Director of Defense Research and Engineering with formal control of major changes in research and development programs. Program Change Proposals involving or affecting the research, development, test, and evaluation program are processed through the Director of Defense Research and Engineering for his recommendations to the Secretary of Defense; he is, therefore, one of the principal architects of the programs undertaken. During the annual budgeting process and again during apportionment, this Director performs a similar analysis and recommendation function on service submissions. The Programing System is discussed in detail in chapter 7.

(5) *Other Controls.* The Director obtains such other information and reports as he deems necessary to perform his assigned functions. To insure proper interaction of the total research and development effort with military strategy, he maintains close liaison with the Joint Chiefs of Staff and the military departments. When appropriate, he seeks formal statements of requirements.

f. Other Director of Defense Research and Engineering Responsibilities.

(1) The Director is active in a number of other areas affecting materiel development. These include the storage, retrieval, and exchange of information on research and development activi-

ties, and the supervision, coordination, and review of the Defense Scientific and Technical Information Program.

(2) The services are charged with insuring that the materiel and equipment developed are compatible with normally available transportation; the Director of Defense Research and Engineering supervises implementation of this process. Together with the Assistant Secretary of Defense (Installations and Logistics), the Director resolves conflicts between production and maintenance mobilization plans. By direction of the Secretary of Defense, the Director is specifically responsible for monitoring the Harmonization Programs of the military departments, and in this connection takes certain specified actions, such as negotiation of policy agreements with foreign ministries of defense.

g. The Advanced Research Projects Agency.

(1) The Advanced Research Projects Agency, established in 1958, is employed by the Director of Defense Research and Engineering to further the Department of Defense mission. Operating with a 1965 budget of $250 million, the Agency's 75-man professional staff pursues basic and applied research projects assigned by the Director of Defense Research and Engineering. In this it utilizes the services of the military departments, other Government agencies, industrial firms, and other organizations. The Agency is responsible for keeping Department of Defense components informed of technological advances; it maintains close liaison with the military departments and Defense Department agencies and sponsors work that they perform. Within the Army, the Chief of Research and Development and the Research and Development Directorate of the Army Materiel Command are the coordinating points for proposals on efforts sponsored by the Advanced Research Projects Agency.

(2) Typical of these efforts and their effect on Army materiel development is Project Defender, which involves basic research, experimentation, development, and systems feasibility demonstrations to obtain technologically advanced defenses against space vehicles and ballistic missiles. One outgrowth of Defender was the decision to proceed with development of a terminal A–ICBM system, after studies had ruled out launch-phase or midcourse interceptors as impractical. Consequently Nike–X is now under development by the Army as a terminal interceptor.

h. The Weapons Systems Evaluation Group.

(1) The Weapons Systems Evaluation Group, like the Advanced Research Projects Agency, is a separate body administered by the Director of Defense Research and Engineering. It was established in 1948 to conduct operations analyses and evaluations as directed by the Director and the Joint Chiefs, or by other elements of the Office of the Secretary of Defense as authorized by the Secretary. Although the results of these studies are not binding on any Defense Department group, they are used by the Director of Defense Research and Engineering, the Joints Chiefs of Staff, and others in planning.

(2) The Weapons Systems Evaluation Group's reports usually focus on the use, cost/effectiveness, and limitations of weapons systems. The studies may indicate that expansion or contraction of existing developments is advisable, or they may suggest new requirements. For example, studies conducted by the Group in 1959 on limited warfare, particularly in relation to internal de-

fense forces, have had a strong influence on Army materiel requirements. Such studies typically employ the services of contractors, especially the Institute for Defense Analysis. This institute, a nonprofit organization established in 1956, is a joint effort sponsored by eleven participating universities under a Ford Foundation grant. Its major activity is the support of Weapons Systems Evaluation Group studies, although it also engages in defense studies for other branches of the Government.

Section III. THE JOINT CHIEFS OF STAFF

3–12. Organization of the Joint Chiefs of Staff

a. The Joint Chiefs of Staff are the principal military advisers to the President, the National Security Council, and the Secretary of Defense. The organization comprises the Chairman, the Service Chiefs, the Joint Staff, the Joint Secretariat, the Directorate of Administrative Services, representatives on certain international treaty organizations, and various other special assistants and groups.

b. The Joint Staff is composed of approximately 400 officers organized by functions into Directorates of Personnel (J–1), Operations (J–3), Logistics (J–4), Plans and Policy (J–5), Communications and Electronics (J–6), and special assistants for military assistance affairs, arms control, and internal defense and special activities.

3–13. Responsibilities and Functions of the Joint Chiefs of Staff

a. Positioned in the chain of command between the President, the Secretary of Defense, and the commanders of unified and specified commands, the Joint Chiefs of Staff are the principal source of military planning and guidance in the Department of Defense. Their influence on materiel development is enormous, since they translate broad guidance from the National Security Council and the Secretary of Defense into military missions that shape the entire materiel development process.

b. The Joint Chiefs of Staff provide this guidance to the materiel development effort in a number of ways—

(1) The Joint Chiefs and the Joint Staff maintain close relationships with offices in the Office of the Secretary of Defense, particularly the Director of Defense Research and Engineering, and with the service components.

(2) The Joint Chiefs of Staff provide the Secretary (and/or the Director) with statements of broad strategic guidance for use in an integrated research and development program; statements of overall military requirements; statements of the relative importance of development programs with respect to unified and specified commands; and recommendations for the assignments of specific weapons to the armed forces.

(3) They also guide materiel development through formalized plans. The Joint Long-range Strategic Studies form the basis for evolving military philosophy and serve as major guidance for basic and applied research programs. The Joint Strategic Objectives Plan, projected for 5 to 10 years, takes national objectives and policies and expresses them as military objectives and strategy. This Plan serves as guidance for the size and composition of forces, which, in turn, affect materiel requirements in exploratory, advanced, engineering, or operational systems development.

(4) The Joint Chiefs of Staff provide direct guidance to the services in the development of service plans. The Basic Army Strategic Estimate, the Army Strategic Plan, and the Army Force Development Plan, all of which

are responsive to guidance by the Joint Chiefs, constitute a guide for Army materiel developments.

(5) The Joint Chiefs also provide materiel development guidance through the Programing System. The Joint Chiefs—automatically furnished all Program Change Proposals—advise on the strategic impacts of significant proposed new developments or changes.

Section IV. DEPARTMENT OF DEFENSE AGENCIES

3–14. General

The Department of Defense includes agencies established by the Secretary to meet specific requirements of the mission of the Department. The Defense Supply Agency, the Defense Contract Audit Agency, and the National Security Agency are responsible directly to the Secretary of Defense. The Defense Atomic Support Agency, the Defense Communications Agency, and the Defense Intelligence Agency are responsible to the Secretary through the Joint Chiefs.

3–15. Defense Atomic Support Agency

a. The Defense Atomic Support Agency provides support to the Secretary of Defense, the Joint Chiefs of Staff, the military departments and such other DOD components as may be appropriate, in matters concerning nuclear weapons, nuclear weapons effects, nuclear weapons testing, and such other aspects of the DOD nuclear energy program as may be directed by the Secretary of Defense.

b. The Defense Atomic Support Agency receives staff supervision from the Joint Chiefs in the deployment and handling of nuclear weapons and materiel, nuclear weapons training, and military participation in support of nuclear testing. The operational requirements and safety aspects of new weapons are reviewed. The Director of Defense Research and Engineering approves the research, development, test, and evaluation programs carried out by the Defense Atomic Support Agency and supervises their implementation. The Assistant to the Secretary of Defense (Atomic Energy) supervises the transmission of information to the Joint Committee on Atomic Energy, and provides for Defense Atomic Support Agency participation in processing agreements between the Department of Defense and the Atomic Energy Commission. The Assistant is also concerned with Defense Atomic Support Agency activities in logistics, safety, and applications in nonweapons fields.

c. Research on nuclear components and systems is conducted by the Atomic Energy Commission. Requirements for Department of Defense research are evaluated and processed to the Atomic Energy Commission through the Defense Atomic Support Agency and the Director of Defense Research and Engineering under Joint Chiefs of Staff guidance.

d. Development of nuclear weapons is also a complementary responsibility of the Atomic Energy Commission and the Department of Defense. After the Commission and the Department have made joint feasibility studies, the Defense Atomic Support Agency defines the military characteristics of service requirements, and the Director of Defense Research and Engineering then coordinates development with the Atomic Energy Commission and the service components that may be included in implementation.

e. In addition to overall surveillance of the deployment, handling, and stockpiling of nuclear weapons, the Defense Atomic Support Agency conducts the joint program for research in nuclear weapons effects. Defense Department components plan the research and test program to evaluate scientific phenomena and the response of materiel to the effects of nuclear detonations. Tasks to fulfill such plans are then established and supervised by the Defense Atomic Support Agency, which subsequently evaluates the results and disseminates them to interested Department of Defense agencies and commands. The Agency also maintains cur-

rent information on military research in radiac instruments, protective devices, decontamination procedures, and medical aspects of nuclear warfare. Recommendations in these areas are made to the Director of Defense Research and Engineering, the Joint Chiefs of Staff, and others, as appropriate. The Defense Atomic Support Agency also exercises command and administrative control over the Armed Forces Radiobiology Research Institute.

3-16. Defense Communications Agency

This Agency reports to the Secretary of Defense through Joint Chiefs of Staff. Its responsibilities include operation and management of the Defense Communications System; systems engineering and technical supervision of support for the National Military Command System; integration of the groundborne and spaceborne elements of defense communication satellite systems; and integration of these systems and the Defense Communication System. As part of its integrating and systems engineering responsibilities, the Defense Communications Agency provides inputs to materiel objectives and requirements.

3-17. The Defense Supply Agency

a. This Agency is directly responsible to the Secretary of Defense for providing the most effective and economical support of common supplies and services. It is active in the organization and management of commodities, functions, and services. It also operates the Defense Documentation Center, and in 1964 was assigned responsibility for management of consolidated contract administration offices. The Agency has the additional responsibility of recommending to the military departments research and development projects that will improve the materials, items, and methods within its assigned commodity jurisdiction.

b. The Defense Documentation Center is operated by the Defense Supply Agency under the policy guidance of the Director of Defense Research and Engineering. As an arm of the Defense Scientific and Technical Information Program, it actively seeks reports and information on Department of Defense research and development projects. It is also the repository of such information, and a secondary distribution point (the primary one remains the issuing office).

c. The Defense Contract Administration Services is of major importance to materiel developments being pursued under contract with the Government. Consolidated activity under this organization began in 1965 with "Project 60" at Philadelphia. The responsibilities of the Defense Contract Administration Service include inspection and acceptance of materiel, property accounting, security and disbursement. This program does not affect service plant representatives, nor does it apply to certain specifically exempted groups, one of which is the Army Corps of Engineers.

3-18. Defense Intelligence Agency

This Agency manages and controls the Department of Defense intelligence resources assigned to it, and coordinates with the intelligence functions of the individual services. Through the Agency's Assistant Chief of Staff for Research and Development and Assistant Director for Scientific and Technical Intelligence, the Defense Intelligence Agency processes information relating to technology and developmental requirements. The Agency is responsible to the Secretary through the Joint Chiefs of Staff.

3-19. The National Security Agency

a. The National Security Agency is an element of the Defense Department responsive to the direction and control of the Secretary. It has been assigned specific research, development, test, and evaluation responsibilities in communications intelligence, electronics intelligence, and communications security.

b. The Agency develops requirements for materiel in its assigned area, and coordinates with other Government agencies. It also provides guidance to service agencies such as the Army Security Agency. The National Security Agency may become directly involved in development and testing with developing activi-

ties of the services, or may simply exercise supervision over materiel developments in its assigned areas.

3–20. Defense Contract Audit Agency

The Defense Contract Audit Agency is an element of the Defense Department responsive to the direction and control of the Secretary of Defense. It has been assigned responsibility for performing all necessary contract audit for the Department of Defense and for providing accounting and financial services regarding contracts and subcontracts to all Department of Defense components responsible for procurement and contract administration. These services are provided in connection with negotiation administration, and settlement of contracts and subcontracts.

Section V. INTERNATIONAL PROGRAMS AND ORGANIZATIONS

3–21. Introduction

In a number of treaties negotiated since the end of World War II, the United States has joined with the other nations of the free world in the pursuit of collective security. The Rio Treaty for Inter-American Reciprocal Assistance, signed in 1947, was followed by the Atlantic Alliance (the North Atlantic Treaty Organization) in 1949 and the establishment of the Southeast Asia Treaty Organization in 1954. In furtherance of these and other international understandings, international agencies and activities pursue programs involving United States assistance to and cooperation with our allies and nations friendly to us. Many of these have a bearing on the materiel development process.

3–22. International Organizations

a. General. During World War II a number of commissions and agencies were established to consider matters of hemispheric defense. The Permanent Joint Board on Defense—United States and Canada considers broad problems of defense in the northern hemisphere. The Inter-American Defense Board, an autonomous body within the Organization of American States, is concerned with the collective self-defense of the Americas. The Joint Brazil-United States Defense Commission also considers mutual problems of defense. While, in general, the focus of these groups is on broad questions of policy and strategy, their conclusions and recommendations are eventually translated into force and materiel requirements. The Department of Defense is represented in these groups by representatives of the Joint Chiefs of Staff.

b. The North Atlantic Treaty Organization.

(1) This is one of the most important of the international organizations, and is concerned with collective security throughout the North Atlantic and Mediterranean areas. Through their representative on this Organization's Standing Group and Military Committee, the Joint Chiefs of Staff consider its plans and requirements in their planning.

(2) A number of programs operate within the context of the Organization. One, the Research, Development, and Production Program, is concerned with materiel developments among Organization members; another, the Infrastructure, permits facility development and construction for North Atlantic Treaty Organization command use.

c. Internal Department of Defense Groups. There are several agencies and groups within the Department that are exclusively concerned with international programs. The Military Assistance Advisory Groups are located in friendly nations for the purpose of administering the Military Assistance Program. The Military Assistant Advisory Groups are responsible to the United States unified or specified commander in the area, but also maintain close liaison with our ambassador to the host country. The Groups are the usual focal

point for overseas implementation of programs of assistance and cooperation with our allies, including materiel development programs. The Army Research Offices overseas receive and evaluate research and development proposals related to the Army research and development mission. These offices negotiate, administer, and control work funded by the Army for overseas research and development.

3–23. International Programs

a. General. The objectives of joint research and development activities with our allies are to maximize availability of technology, reduce duplication, and promote standardization. These activities are carried out through several programs, some under Department of Defense negotiated agreements, others as part of the Military Assistance Program.

b. The Mutual Weapons Development Data Exchange Program and the Defense Development Exchange Program. These two programs provide for the exchange of technical information with participating countries. Basic agreements are negotiated by the Director of Defense Research and Engineering and are implemented by the services, through Military Assistance Advisory Groups, as appropriate. Upon approval of the Assistant Secretary of Defense (International Security Affairs), Military Assistance Program funds may be used to further these efforts.

c. The Harmonization Program.

(1) The Harmonization Program is designed to adjust differences or inconsistencies in qualitative materiel requirements between the United States and its allies in order to avoid duplicative developments and to improve standardization. The program is pursued under various negotiated agreements, monitored by the Director of Defense Research and Engineering with Joint Chiefs of Staff guidance.

(2) A number of implementing programs have been established to carry out the objectives of the Harmonization Program and other cooperative research and development undertakings. These programs serve as the vehicle for information exchange, harmonization of requirements, and actual cooperative developments. Among these are the North Atlantic Treaty Organization Research, Development, and Production Program, discussed above; the American-British-Canadian-Australian Armies Standardization Program; the Air Standardization Coordinating Committee; the Technical Cooperation Program; the United States-Canadian Defense Development Sharing Program; Cooperative Research and Development Programs with specific countries; and various memorandums of understanding.

d. The Military Assistance Program.

(1) This program plays a significant role in the development of international materiel requirements. As noted above, the program itself is a responsibility of the Department of State, but is implemented by the Department of Defense.

(2) The general requirements of countries receiving military assistance are presented to the Assistant Secretary of Defense (International Security Affairs) through the Military Assistance Advisory Groups and the Joint Chiefs of Staff. Acting on guidance from the National Security Council and the Department of State, the Assistant Secretary develops guidelines for overall needs. After further inputs from the Groups, the Joint Chiefs, the Director of Defense Research and Engineering, the military departments, and others, actual requirements are established. These requirements are defined in terms of logistic support, equipment, and other materiel.

(3) The research and development aspects of the Military Assistance Program have two basic objectives. The first is

to encourage and expedite development of weapons of advanced design by friendly nations or organizations; the second is to develop specific equipments deemed necessary to the receiving country. Under the Military Assistance Program, research and development may be funded either for prosecution overseas or for development by the Department of Defense, but the developments do not necessarily have to represent a specific requirement of the United States Armed Forces.

CHAPTER 4

DEPARTMENT OF THE ARMY

Section I. HEADQUARTERS, DEPARTMENT OF THE ARMY

4–1. General

a. The Army's basic mission, as a major department of the Department of Defense, is to organize, train, and equip forces for assignments that are in accord with our national purpose. Since many aspects of tactical doctrine and combat effectiveness are directly related to the improvements and innovations in equipment achieved through materiel development, effective materiel development management is vital to this mission.

b. Materiel development is so closely interwoven with the general Army mission that it is impracticable to isolate it completely, either at the staff or the field command level. Although their basic missions may not be the development of materiel, nearly all major staff elements and field commands have some interest in or responsibility for the function. In this chapter, therefore, the basic activities of an organization or office are described primarily in terms of its interest in or responsibilities for materiel development.

c. In 1962 the Army underwent an extensive reorganization, during which its General Staff was relieved of numerous command-oriented and operating functions, and major field commands were established for requirements, materiel, command, and training functions.

d. Headquarters, Department of the Army, is the executive organization of the Department of the Army. It exercises directive and supervisory functions over the Department. It includes agencies and personnel in dispersed areas who perform "national headquarters" functions as distinguished from "field" or "local" functions. Figure 4–1 shows the structure of the Headquarters, DA, with the major field commands.

Figure 4–1. Organization of the Department of the Army.

[Located in back of manual.]

4–2. Office of the Secretary of the Army

a. The Secretary of the Army. The Secretary is responsible for the conduct of all affairs of the Army, subject to the direction, authority, and control of the Secretary of Defense and the President. His primary duties are to insure that presidential and Department of Defense policies are implemented by lower echelons. The responsibilities of the Secretary of the Army, while generally parallel to those of the Secretary of Defense, are specifically directed toward accomplishment of the Army mission. In managing the complex activities of the Army, the Secretary exercises broad powers created by Congress to provide him with administrative flexibility.

b. The Under Secretary of the Army. The Under Secretary is the Secretary's deputy and his chief assistant. His principal interests are manpower, international affairs and operations research.

c. The Assistant Secretaries.

(1) *General.* Three Assistant Secretaries provide specialized assistance to the Secretary in functional areas. Functionally and organizationally, they are the counterparts of the Assistant Secretaries in the Office of the Secretary of Defense, as discussed in chapter 3.

(2) *The Assistant Secretary of the Army (Research and Development).* This

Assistant Secretary is responsible for all research, development, test, and evaluation of the Army's materiel development efforts; for the budgeting and funding of these efforts; and for the planning, acquisition, and use of development facilities or other support requirements. He is the direct counterpart of the Director of Defense, Research and Engineering at the Office of the Secretary of Defense level.

(3) *The Assistant Secretary of the Army (Installations and Logistics)*. This Assistant Secretary acts for the Secretary of the Army in the area of logistics, including determination of materiel requirements, procurement and production, materiel management, logistics services, Military Assistance Program, and industrial mobilization. He also has installation responsibilities, including planning facilities and real property management, construction, and public housing. Because of his interests in the follow-on materiel production phase, the Assistant Secretary of the Army (Installations and Logistics) has a significant influence on and interest in materiel development. His principal counterpart in the Office of the Secretary of Defense is the Assistant Secretary of Defense (Installations and Logistics).

(4) *The Assistant Secretary of the Army (Financial Management)*. This Assistant Secretary has supervisory and review authority over the Army's programs and budgets. As the Assistant Secretary to whom the Comptroller of the Army reports, he is responsible for budget and funding, accounting, disbursement and collection of funds, claims, audit activities, the Automatic Data Processing Equipment Program, and Management Engineering. He is also responsible for the development, coordination, and evaluation of programing concepts and systems. His most direct counterpart in the Office of the Secretary of Defense is the Assistant Secretary of Defense (Comptroller).

4–3. The Army Staff

a. Organization. The Army Staff consists of the part of the Secretary of the Army's staff at the seat of Government that is presided over by the Chief of Staff. It includes a Special Staff and a General Staff, and is organized in a balanced functional and process-oriented fashion. Each of its members is charged with performing certain specifically identified functions which, taken as a whole, embrace all elements of the mission of the Army. Each member represents the Chief of Staff in his own special field of interest, and is responsible, through prescribed channels, to the Chief of Staff and the Secretary of the Army. Under the guidance of their designated superiors, staff members also represent the Army on matters under their cognizance to their counterparts in the Office of the Secretary of Defense, and to other governmental agencies, the Congress, and the public. Collectively, the Army Staff represents the Secretary and the Chief of Staff in supervising the plans, duties, and operations of all Army organizations. Individually, each of its members is concerned either directly or indirectly with all Army affairs. Interchange of information and integration of staff actions among members are essential to the Army Staff's effective functioning as a single coordinating unit.

b. The Army General Staff.

(1) *Introduction.*

(*a*) The General Staff consists of designated officers assigned to the Office of the Chief of Staff; the Offices of the Deputy Chiefs of Staff; the Office of the Comptroller of the Army; the Office of the Chief of Research and Development; the Office of the Chief, Office of Reserve Components; the Offices of the Assistant Chiefs of Staff; the General Staff Committees on Army National Guard and Army Reserve Policy (resident members only); and such other offices (called Army General

Staff agencies) as may be designated by the Secretary of the Army.

(*b*) Under the direction of the Chief of Staff, the Army General Staff renders professional advice and assistance to the Secretary, the Under Secretary, and the Assistant Secretaries of the Army in developing basic policies, plans, and programs for the guidance of the Department of the Army. It also assists the Secretary of the Army in preparing and issuing directives and programs to implement such department-wide plans and policies and in supervising the execution and implementation of these directives and programs.

(2) *The Chief of Staff.* The Chief of Staff is responsible directly to the Secretary of the Army and to the President for efficiency within the Army, its state of readiness, and its plans for readiness. In carrying out these responsibilities, he renders advice to the Secretary of the Army with respect to the planning, development, execution, review, and analysis of Army programs.

(3) *Office of the Chief of Staff.* This Office is composed of the Chief of Staff, Vice Chief of Staff, Secretary of the General Staff, Special Assistant to the Chief of Staff for Special Warfare Activities, Special Assistant to the Chief of Staff for Army Information and Data Systems, Director of Special Studies, Director of Army Programs, Director of Coordination and Analysis, Deputy Secretaries of the General Staff, and such additional staff as may be required.

(4) *Deputy Chief of Staff for Military Operations.* This Deputy Chief has Army General Staff responsibility for the establishment of requirements for and the utilization of Army forces. He also exercises General Staff responsibility for the establishment of operational readiness requirements and for the review of unit readiness reports to monitor Army capability to accomplish assigned missions. In addition, he serves as principal adviser to the Chief of Staff on joint service matters.

(5) *Deputy Chief of Staff for Personnel.* This Deputy Chief has Army General Staff responsibility for the formulation of policies, plans, and programs relating to the procurement and management of Department of the Army military and civilian personnel of all components of the Army on active duty.

(6) *Deputy Chief of Staff for Logistics.* This Deputy Chief has Army General Staff responsibility for the management of Department of the Army logistical activities. He is responsible for the formulation and execution of Army logistics policies and is the staff adviser on logistics matters to the Chief of Staff. In addition, he exercises General Staff supervision over the Chief of Engineers and the Chief of Support Services, and monitors the activities of the Department of Defense agencies that provide logistic support to the Army. However, his responsibilities do not extend to the civil functions of either the Chief of Engineers or the Chief of Support Services.

(7) *The Comptroller.* The financial control function within the Army is performed by the Comptroller of the Army under the functional supervision of the Assistant Secretary of the Army (Financial Management). The Comptroller integrates the review and analysis of Army programs. He formulates, coordinates and supervises the accounting, fiscal, budgetary, statistical and management engineering activities of the Army, including the supervision of legislative policies and programs pertaining to appropriation acts.

(8) *Chief of Research and Development.* The Office of the Chief of Research

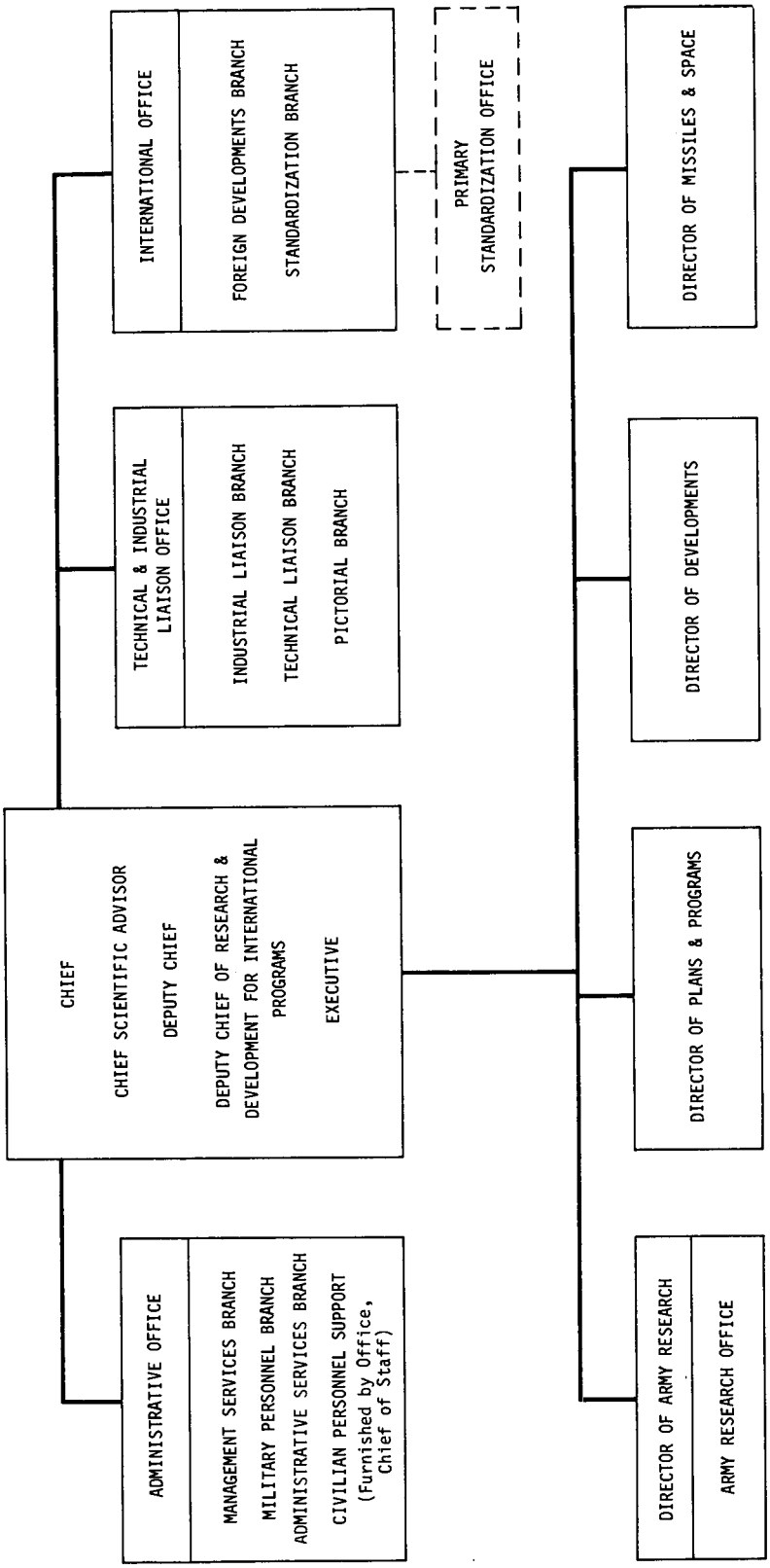


Figure 4–2. Office of the Chief of Research and Development.

and Development is shown in figure 4–2. Under the functional supervision of the Assistant Secretary of the Army (Research and Development) and responsible to the Chief of Staff, the Chief of Research and Development has Army General Staff responsibility for—

(*a*) Planning, coordinating, and supervising all Army research, development, test, and evaluation, including review and analysis, research and development objectives, policies, and funds essential to the discharge of this responsibility.

(*b*) Research, development, test, and evaluation plans, projects, tasks, and their related priorities.

(*c*) Qualitative Materiel Requirements and Small Development Requirements for all Army materiel.

(*d*) Supervising the American-British-Canadian-Australian Armies Standardization Program, the United States-Army Canadian Development Sharing Program, and the United States-United Kingdom Cooperative Research and Development Program; United States Army participation in research and development aspects of the American-British - Canadian - Australian Air and Navy Standardization Programs; the Technical Cooperation Program; the Mutual Weapons Development Program; the North Atlantic Treaty Organization Research, Development, and Production Program; the Defense Development Exchange Program; all other international military research and development programs; and the exchange of classified research and development of information with foreign nations.

(*e*) Within the overall guidance and policies developed by the Director of Army Programs and the Comptroller of the Army, formulating, justifying, and supervising the execution of those portions of Army programs and annual military budgets that pertain to research, development, test, and evaluation.

(*f*) Data processing systems in support of all assigned areas of responsibility.

(*g*) Determining requirements and their priorities for the intelligence needed to support research and development activities, and insuring that this intelligence is utilized in the research and development of weapons systems, materiel, and equipment for the Army.

(*h*) Monitoring all activities of the Army and other Government agencies relating to space, including advising the Deputy Chief of Staff for Military Operations on the development of policy, plans, objectives, and requirements having to do with space.

(*i*) Within his area of staff responsibility and within governing procurement policies and procedures of the Department of Defense and the Department of the Army, procuring the supplies and services necessary to effectuate the Army Research Program.

(*j*) Establishing Army requirements for information on nuclear weapons effects; planning, coordinating, and supervising Army participation in nuclear weapons effects research and tests. Also, in accordance with Department of Defense and Atomic Energy Commission procedures for research and development of nuclear materiel, functioning as Department of the Army Staff agent in nuclear weapon, nuclear power reactor systems, and safety and reliability matters with the Defense Atomic Support Agency, Director of Defense, Research and Engineering, and the Atomic Energy Commission.

(9) *The Assistant Chief of Staff for Force Development.* This Assistant Chief of Staff has Army General Staff responsibility for the development of Army forces (fig. 4–3). His interest in materiel development stems from certain of the responsibilities he carries out, including the following:

(*a*) Developing Qualitative Materiel Development Objectives and total feasibility studies, and establishing operational priorities and requirements for the procurement of materiel.

(*b*) Determining operational priorities for the development and procurement of nuclear weapons, and providing assistance, as appropriate, to the Army Staff in the development of atomic aspects of Army plans.

(*c*) Coordinating combat developments and related policy in conjunction with the research and development functions assigned to the Chief of Research and Development.

(*d*) Coordinating all Army chemical, biological, and radiological activities (plus Department of Defense responsibility for these same functions when directed); all Army aviation activities; all Army nuclear activities (including supervision of the Nuclear Weapons Systems Operational Surety Program, and nuclear weapons systems safety within the policy, scope, and responsibilities of the Army Safety Program); and all Army air defense system activities.

(*e*) Administering, establishing and maintaining the Department of the Army System Staff Officers System. Acting as the Department of the Army point of contact and monitoring the overall status, through Department of the Army System Staff Officers, of selected materiel items, weapons systems, communications and other systems. Preparing and submitting to the Chief of Staff, Master Schedules including a milestone listing of the selected items/systems life cycle event against which monthly status/progress reports are submitted.

(*f*) Promoting international military standardization by administering the international programs as a single, integrated effort.

(10) *Assistant Chief of Staff for Intelligence.* This Assistant Chief of Staff has Army General Staff responsibility for all matters pertaining to the intelligence and counterintelligence activities of the United States Army. He has an interest in materiel development because of the following specific responsibilities:

(*a*) Planning, coordinating, and fulfilling Army intelligence and counterintelligence requirements, and supervising Army intelligence and counterintelligence collection, production, and dissemination activities.

(*b*) Communications and electronics intelligence and security responsibilities originating within or placed upon the Army.

(*c*) Monitoring projects of intelligence interest in the research and development program.

c. The Special Staff.

(1) *General Role.* The heads of Special Staff agencies provide advice and assistance to the Secretary of the Army, the Chief of Staff, other members of the Army Staff, and all other elements of the Department of the Army on specialized matters within their respective fields of responsibility. As staff officers of Headquarters, Department of the Army, they are responsible for the preparation of plans, estimates, and orders; the review and coordination of technical doctrine; and the coordination of their technical,

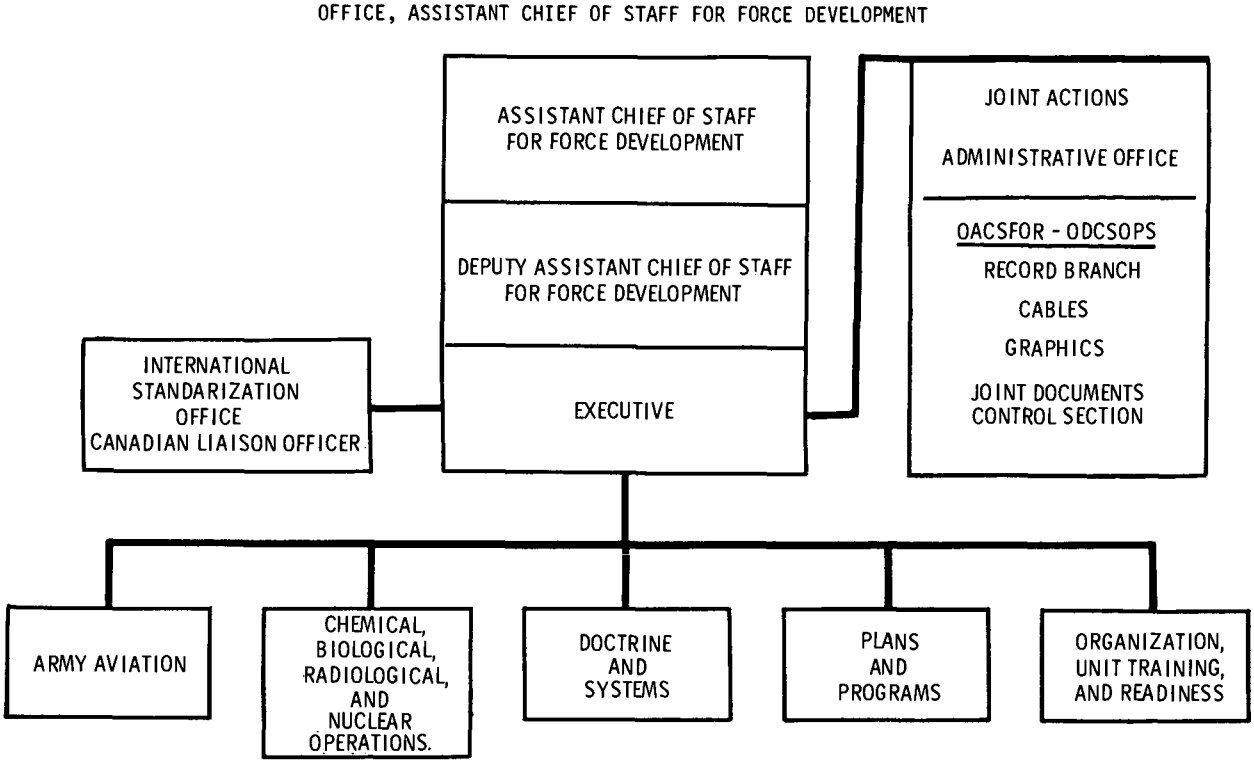


Figure 4–3. Office, Assistant Chief of Staff for Force Development.

administrative, and operational plans and activities with other agencies of the Army Staff. The heads of certain Special Staff agencies (for example, the Chief of Engineers) exercise dual functions of staff and command. These two functions, although vested in a single individual, are separate and distinct in that each involves different responsibilities and duties; the exercise of one should not be confused with the exercise of the other.

(2) *Special Staff Agencies with Assigned Materiel Development Responsibilities.*

(*a*) *The Chief of Engineers.* The Chief of Engineers is responsible for the materiel development of mapping and geodetic systems, equipment, and techniques (except those for the Army in the field); nuclear power reactor systems and associated electrical power generation equipment; and certain types of test activities of nuclear weapons effects.

(*b*) *The Surgeon General.* The Surgeon General is responsible for materiel development as it pertains to medical materiel and related areas, such as medical and allied sciences, nuclear research and aviation medical research. The Army Medical Research, Development, Testing and Evaluation Program which is designed to meet the health needs of the Army in the field is delegated to the Commanding General, U.S. Army Medical Research and Development Command who also commands U.S. Army medical research and development laboratories or activities located throughout the United States and overseas as

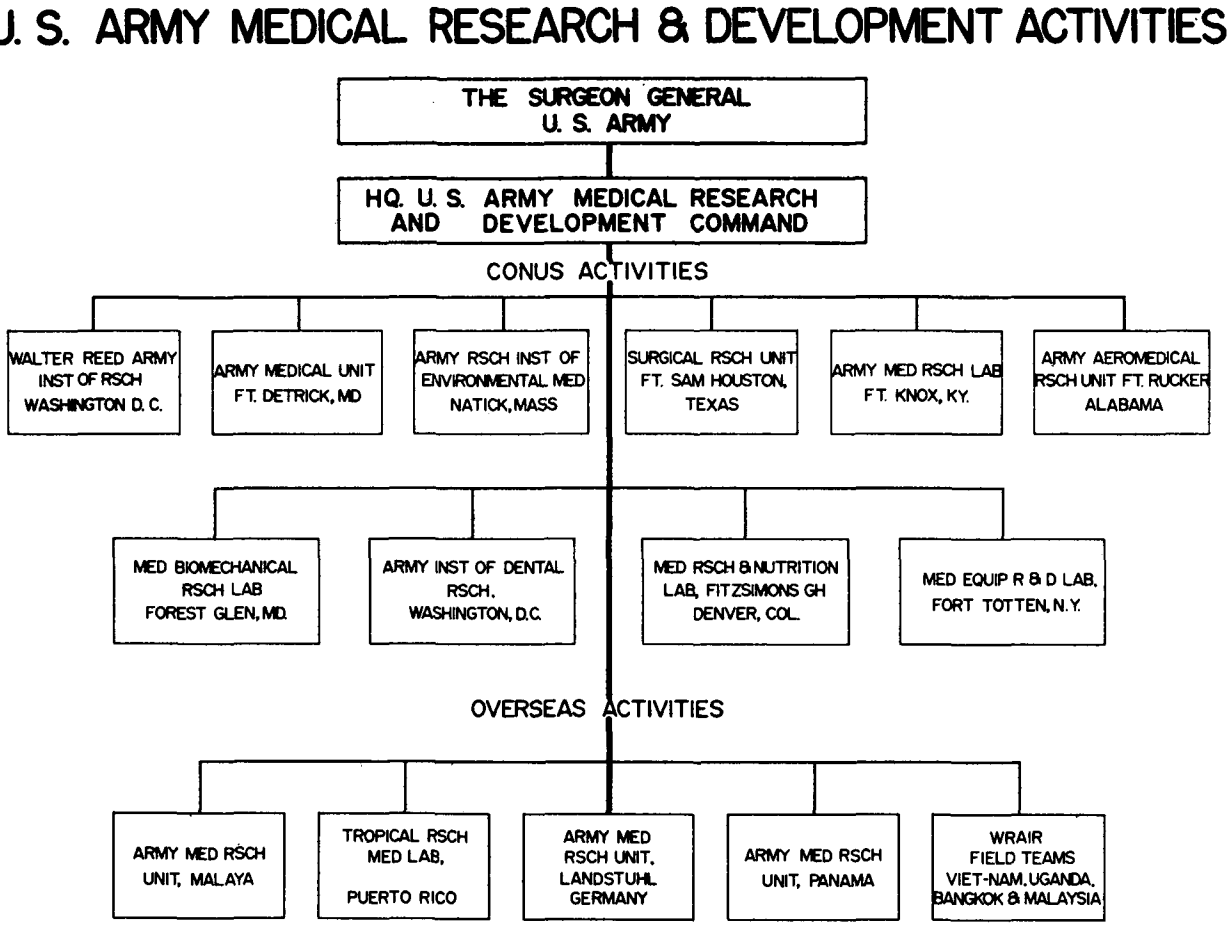


Figure 4–4. U.S. Army Medical Research and Development Activities.

shown in figure 4–4. The Commanding General of this Command is also the Special Assistant to The Surgeon General for Research and Development. The Surgeon General effects coordination of his Research, Development, Test, and Evaluation program within the Army as depicted in figure 4–5.

(3) *Other Special Staff Agencies.* Other offices of the Special Staff include the Chief of Finance; the Office of The Adjutant General; the Chief of Chaplains; The Judge Advocate General; The Inspector General; the Chief of Communications-Electronics; the Chief of the National Guard Bureau; the Chief of Information; the Chief of Military History; the Chief of the Army Reserve; The Provost Marshal General; the Chief of Personnel Operations; the Chief of the Army Audit Agency; and the Office of the Chief of Support Services. None of these agencies has *assigned* materiel development responsibilities. However, the Chief of Communications-Electronics closely reviews developments of strategic communications materiel.

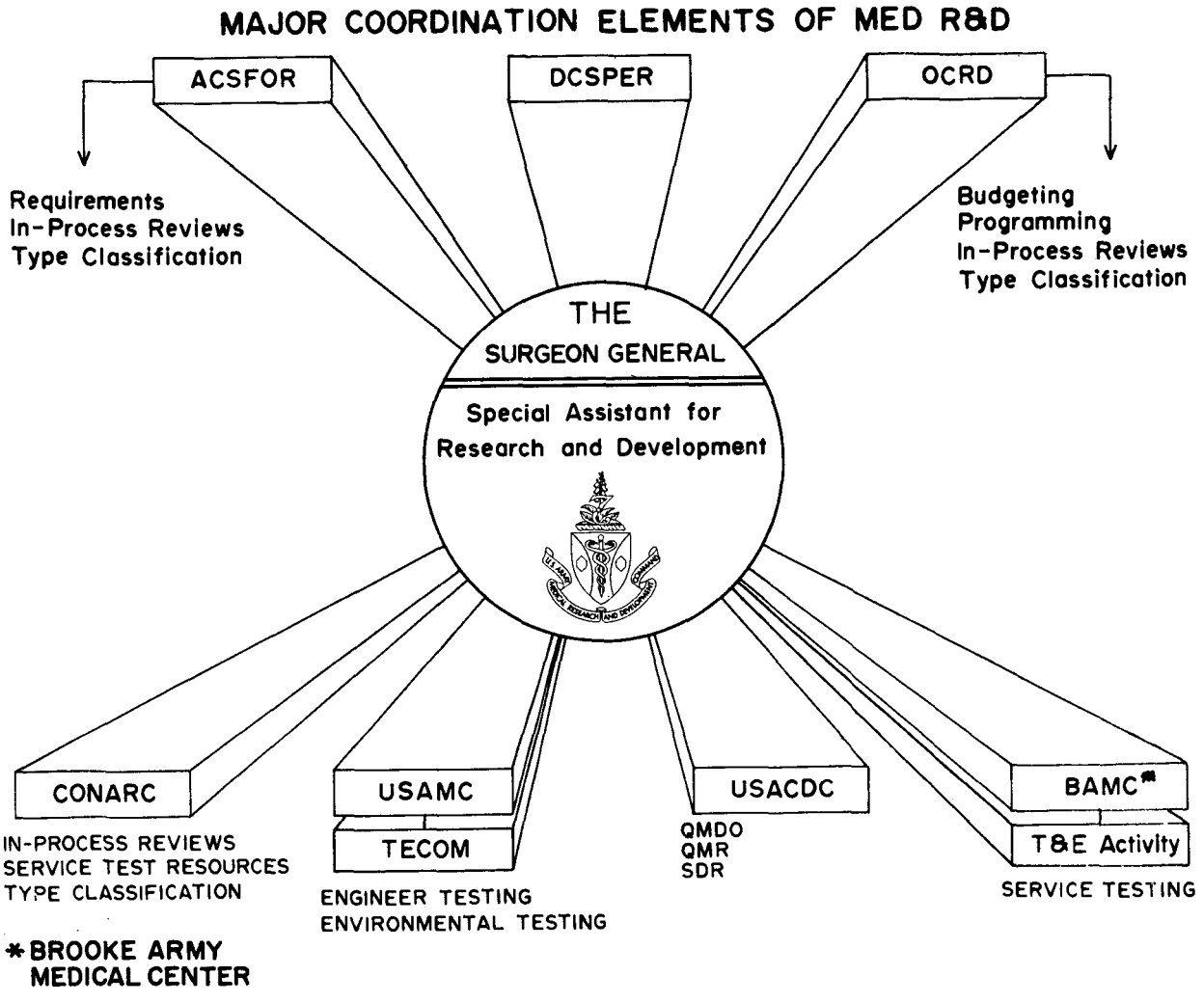


Figure 4–5. Major Coordination Elements of Medical R&D.

Section II. ARMY FIELD COMMANDS

4–4. General

a. The thirteen Army field commands, shown in figure 4–1, Organization of the Department of the Army, include all elements of the Department of the Army except its Headquarters. Army field commands comprise all field headquarters, forces, Reserve components, installations, activities, and functions under the control or supervision of the Secretary of the Army. These commands are represented by major Army combat forces, by specialized security and communications organizations, and by organizations with special interests in the development of combat concepts and materiel.

b. The Army Materiel Command and the Army Combat Developments Command are emphasized in the following discussions because of their deep involvement in materiel development. Both were created during the Army reorganization in 1962. The Combat Developments Command performs functions previously assigned to the Continental Army Command and to elements of the Army Staff. The Army Materiel Command performs most functions pre-

viously assigned to seven technical services and to certain elements of the Army Staff. (Certain responsibilities of the former technical services, like training, were assigned to the Continental Army Command.) The Army Materiel Command has responsibility for most Army materiel development, including new equipment training, and for support of most types of Army materiel throughout its life cycle of usage.

4–5. Combat Developments Command

a. Mission. The mission of this command is to—

(1) Formulate and document current doctrine for the Army in the field; for Army participation in the unified defense of the United States against air attack; and for Army support of civil defense.

(2) Determine, in anticipation of the nature of land warfare in the future, the kinds of forces and materiel needed and how these forces and materiel should be employed.

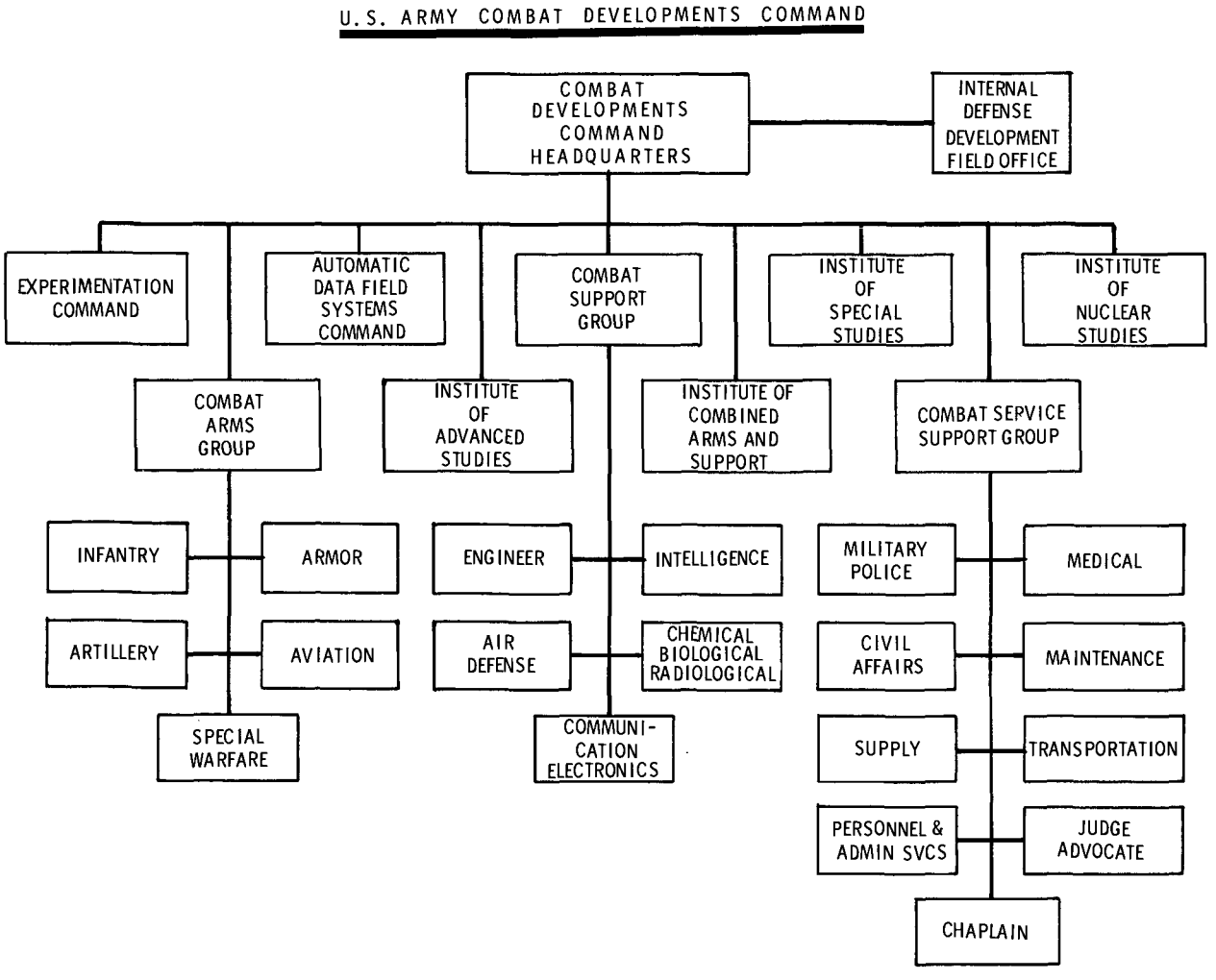


Figure 4–6. U.S. Army Combat Developments Command.

(3) Make recommendations to Headquarters, Department of the Army, in regard to the above matters. Figure 4–6 illustrates the organization of the Combat Developments Command for carrying out its mission.

b. Functions. The functions of the Army Combat Developments Command significantly affect materiel development. Briefly, the command—

(1) Recommends establishment, revision or elimination of Qualitative Materiel Development Objectives, Qualitative Materiel Requirements, and Small Development Requirements, and recommends priorities for them.

(2) Monitors research and development activities to insure that developments meet the objectives and/or requirements set for them; provides guidance to the developing agencies during all phases of the development process regarding objectives and requirements from the user's viewpoint; provides representation on coordination groups for major materiel projects; provides representation to all development project "in-process" reviews; and participates in type classification actions.

(3) Prepares and maintains tables of organization and equipment, and field manuals.

(4) Develops and recommends basis of issue (upon which initial requirements computations for principal end items are based).

(5) Develops in conjunction with developing agencies recommended Operational Capability Objectives to assist in the guidance of early research effort.

c. Organization.

(1) *General.* The Army Combat Developments Command is organized into a headquarters staff, an Internal Defense and Developments Field Office, and nine intermediate-level groups, plus supporting field agencies. The Field Office is responsible for monitoring the U.S. Army Combat Developments Command program to promote maximum integration of principles, tactics, techniques, materiel requirements and organizations pertaining to internal defense and development into all combat development studies. The intermediate commands concern themselves with studies, concepts, and doctrine related either to tactical employment in combat, combat support, and combat service support, or to testing and experimentation in relation to newly developed concepts.

(2) *The Army Combat Developments Experimentation Command.* This Command located at Fort Ord, Calif. develops and provides experimentation derived data as input for the models, simulations, or war games used by the U.S. Army Combat Developments Command agencies and institutes in the scientific analysis and evaluation of various alternative solutions to combat development actions. It tests, analyzes and provides experimentally derived data on developmental option(s). The command verifies, through field experimentation, recommended solutions for operational concepts, materiel requirements and organizational structures.

(3) *The Automatic Data Field System Command.* This Command is comprised of the U.S. Army Combat Developments Command Augmentation Element, Automatic Data Field Systems Command and the U.S. Army Materiel Command Augmentation Element, Automatic Data Field Systems Command. The Automatic Data Field Systems Command is responsible concurrently to the Commanding Generals, U.S. Army Materiel Command and U.S. Army Combat Developments Command. Its mission is to command and manage the efforts and resources as specified in the Charter for this

organization issued by the U.S. Army Materiel Command and the U.S. Army Combat Developments Command and as set forth in the Department of the Army Implementation Plan for "Automatic Data Systems within the Army in the Field."

(4) *The Army Combat Developments Command Combat Arms Group.* As its name implies, this Group addresses the problems of the organization and utilization of the Army's combat arms elements in the field. It consists of five agencies: Infantry, Armor, Artillery, Aviation and Special Warfare. The Group integrates the various functions of the combat arms in the same way that the Combat Support Group and Combat Service Support Group combine the combat support and support services. It works in conjunction with these groups in areas that involve combat, combat support, and combat service support elements of the field Army.

(5) *The Army Combat Developments Command Institute of Advanced Studies.* The Institute, located at the Army War College, concentrates on broad studies involving matters at the departmental, national, and international levels. These studies encompass both combat and support activities and concepts. The Institute develops tactical and logistical doctrine relating to the theater Army, to include combined and joint operations. Its major purpose is to keep Army thinking in consonance with national policy.

(6) *The Army Combat Developments Command Combat Support Group.* This Group is involved with all activities necessary for combat support—that is, engineer, intelligence, air defense, chemical-biological-radiological, and communications-electronics. The Combat Support Group coordinates with the Combat Arms Group and Combat Service Support Group on matters that are essential to combat support.

(7) *The Army Combat Developments Command Institute of Combined Arms and Support.* The Institute, located at Fort Belvoir, Va., concentrates on the development of combat, combat support and combat service support doctrine for the Army in the field at Army group through division level and corresponding combat service support type unit level for each Army Concept Program.

(8) *The Army Combat Developments Command Combat Service Support Group.* This Group is involved with all activities necessary for combat service support—that is, medical, transportation, personnel administrative services, Judge Advocate, military police, civil affairs, chaplain, supply and maintenance. Most of the Combat Service Support Group-commanded agencies are collocated with their respective schools. Close coordination is maintained with the Army Combat Developments Command's Combat Arms Group and Combat Support Group in matters that are essential to combat service support.

(9) *The Army Combat Developments Command Institute of Special Studies.* The Institute is responsible for conducting, managing, developing, coordinating and evaluating assigned special studies. (A special study is defined as a Department of the Army directed study not meeting the criteria for a concept or a doctrine study.)

(10) *The Army Combat Developments Command Institute of Nuclear Studies.* The Institute is concerned with the employment of and defense against nuclear energy by the Army in the field. It is also involved with the supporting forces required and the methods of operation of nuclear weaponry.

4–6. Army Materiel Command

a. Formation. One of the most significant features of the 1962 Army reorganization was the merger of most of the materiel activities of the technical services into a single field unit. As a result of this merger, nearly all materiel activities, from early research to final disposal, became the responsibility of the Army Materiel Command. Exceptions to the transfer of technical service functions to this Command were few; e.g., The Surgeon General retained responsibility for all medical materiel, the Chief of Engineers retained responsibilities considered as specialized activities, and the Commanding General, U.S. Army Security Agency for materiel as delineated in AR 10–122.

b. Mission. The mission of the Army Materiel Command, as a major field command, includes the following duties:

(1) To perform assigned materiel functions of the Department of the Army, including research and development; maintenance, production, and product engineering; testing and evaluation; procurement and production; integrated materiel inventory management; new equipment training; wholesale logistics training; technical intelligence; mutual security programs; and, as related to the Continental United States wholesale supply and maintenance system, storage and distribution, transportation, maintenance, demilitarization, and disposal. In addition, the Army Materiel Command is responsible for Army-wide technical control for petroleum logistics assigned to the Army for all military services and other customers, and participation in developing and maintaining interservice supply support (including Defense Supply Agency).

(2) To develop materiel and related services and provide them to the Department of the Army, to Army Department elements of unified and specified commands, and to other United States and foreign customers, in accordance with objectives and specific requirements established by Headquarters, Department of the Army.

(3) To command subordinate commands, installations, and activities as may be assigned by Headquarters, Department of the Army, and plan, program, budget, and coordinate requirements for resources, supervise and review utilization, and provide resources for all headquarters, installations, and activities commanded.

(4) To provide worldwide the technical and professional guidance and assistance required for the support of Department of the Army materiel, including all international research, development, and standardization programs.

c. Organization. The Army Materiel Command is a complex that includes five large commodity-oriented commands, a Test and Evaluation command, and numerous separate activities, laboratories, procurement offices, and project management offices, all operating under the control of a headquarters in Washington, D.C. The total organization is depicted in figure 4–7. Command headquarters is composed of personal, supporting, and coordinating staff elements, special assistants for certain functions, a varying number of project management offices, and various major directorates through which the bulk of the work is conducted. Each directorate has an interest in the Army's material development effort, as does practically every organization within the Command. However, the extent of the involvement and influence varies.

d. Basic Operating Elements of the Army Materiel Command.

(1) *Classification of Commands.* The basic operating elements of the Army Materiel Command are the six major subordinate commands (fig. 4–8). Five of these are classified as commodity commands because they are responsible for the total or integrated management of specific commodities or materiel groupings. They are responsible for the management of materiel

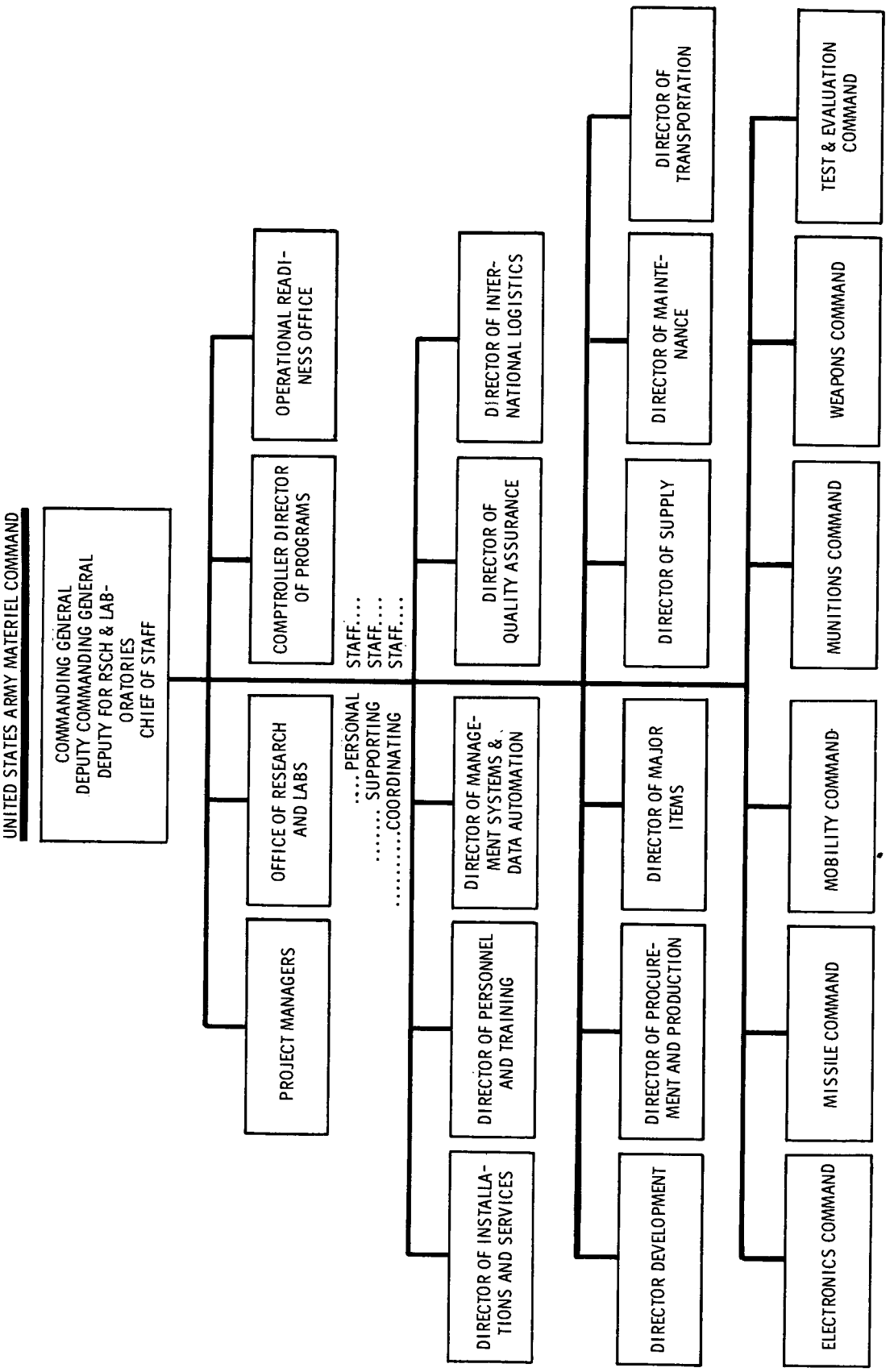


Figure 4-7. United States Army Materiel Command.

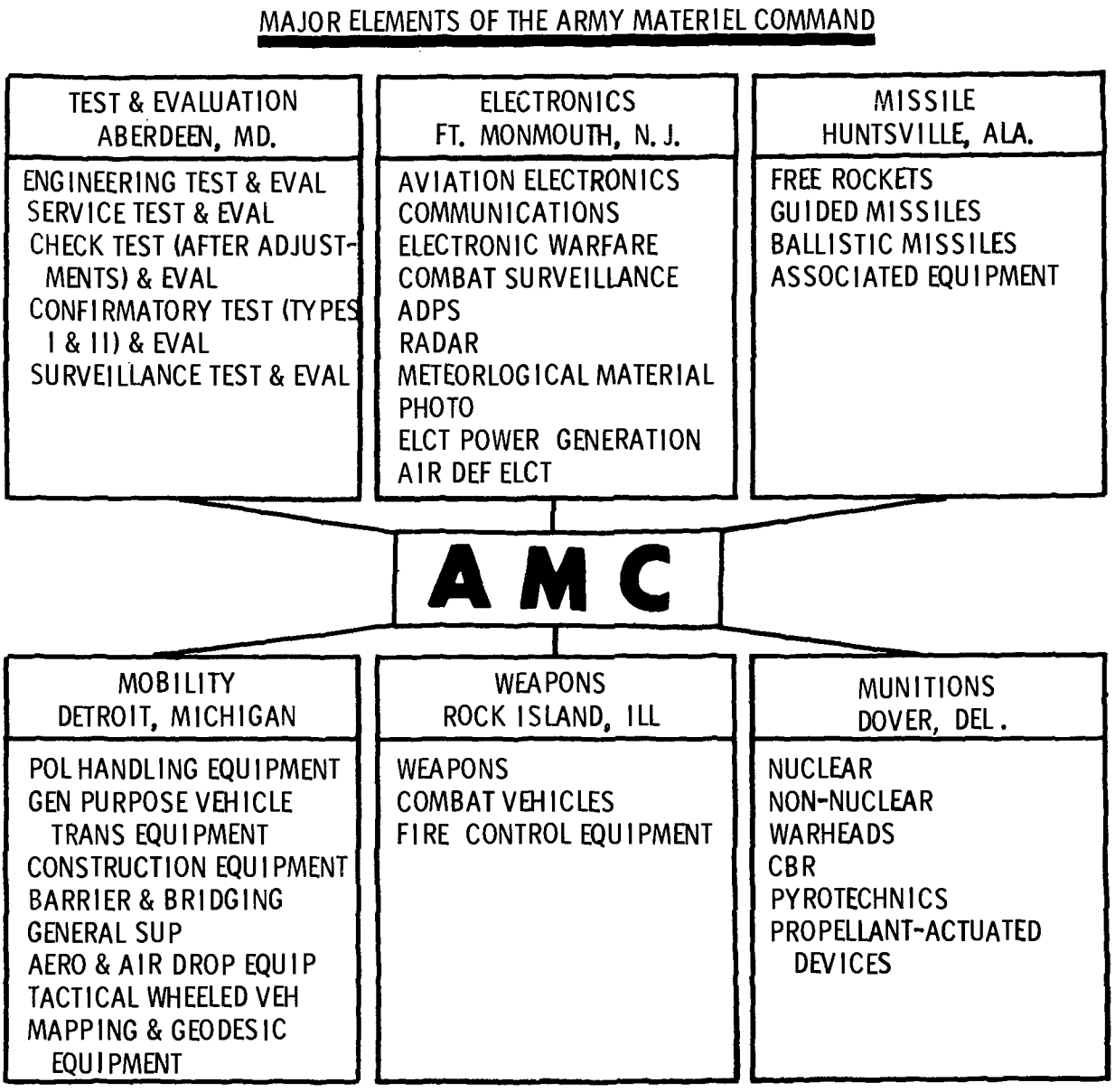


Figure 4-8. Major Elements of the Army Materiel Command.

throughout its life cycle, that is, during the research and development phase, the production and operational phases, and its ultimate disposal. Each of these five commands is responsible for specifically assigned commodities or materiel groupings. The activities of a sixth command are devoted exclusively to test and evaluation. The mission of each of these commands is discussed below, starting with the commodity commands.

(2) *Army Mobility Command.* This command is responsible for the integrated commodity management of aeronautical and air delivery equipment; tac-

tical wheeled and general-purpose vehicles; other surface transportation equipment; mapping and geodetic equipment for the field armies; engine generators and other general purpose electric power generating systems having a sustained output of 1 kilowatt and above based on fuels normally available in the military supply system; construction and services equipment; barrier equipment (including mine warfare and demolitions equipment); bridge and stream crossing equipment; petroleum handling and dispensing equipment; and general support equipment and supplies.

(3) *Army Missile Command.* This Command is responsible for the integrated commodity management of free rockets, guided missiles, ballistic missiles, and target missiles; air defense missile fire coordination equipment and related special-purpose and multisystem test equipment; missile launching and group support equipment; missile fire control equipment; and other associated equipment.

(4) *Army Weapons Command.* This Command is responsible for the integrated commodity management of weapons, combat vehicles, and fire control equipment and test equipment which is part of, or used with, assigned materiel.

(5) *Army Munitions Command.* This Command is responsible for integrated commodity management of nuclear and nonnuclear ammunition, rocket and missile warhead sections, chemical, biological and radiological materiel, demolition munitions and pyrotechnics propellant actuated devices, and test equipment which is a part of, or used with assigned materiel.

(6) *Army Electronics Command.* This Command is responsible for integrated commodity management of communications equipment, communications-electronics intelligence equipment, electronic warfare equipment, aviation electronics (avionics) equipment and systems, and surface navigational systems, combat surveillance and target acquisition equipment, night vision equipment, photographic and microfilming equipment, identification-friend or foe (IFF) systems, automatic data processing equipment, radar (excluding that used in fire control and fire coordination of air defense systems assigned to another command for management), meteorological materiel, and electronic radiological detection materiel, assigned batteries and nonroting electric power generating systems up to 1 kilowatt including solar, thermal, and fuel cell systems, test equipment which is a part of, or used with, assigned materiel, and electronic parts and materials common to electronic materiel throughout the Army.

(7) *Army Test and Evaluation Command.* This Command plans and conducts for the Army Materiel Command engineering, service, and confirmatory tests and evaluation of Army materiel; supports engineer design, production, and postproduction tests; and participates in troop test planning.

(8) *Other Army Materiel Command Elements.* More specialized materiel research and development work is carried on at a number of laboratories and separate activities under the direct control of Headquarters, Army Materiel Command. Among the organizations engaged in this work are the Ballistics Research Laboratories, Coating and Chemical Laboratory, and Human Engineering Laboratories, all located in Aberdeen, Md.; Harry Diamond Laboratories and the Foreign Science and Technology Center, both in Washington, D.C.; Materials Research Agency, Watertown, Mass.; Nuclear Defense Laboratory at Edgewood Arsenal, Md.; Cold Regions Research and Engineering Laboratories, Hanover, N.H.; and the Natick Laboratories, Natick, Mass.

e. Army Materiel Command-Defense Contract Administration Interface. Although materiel development is not a function of procurement offices as such, the contribution that these offices make to the process is a vital part of the overall development effort. Within the Command, procurement actions are carried out either by procurement offices in the subordinate commands and installations or through a nationwide system of procurement district offices. Part of the function of the district procurement offices has now been assumed by Defense Contract Administration Regional Offices; local procurement offices, however, will retain responsibility for certain other parts of the process. Whether procurement is accomplished by an office within the Army Materiel Command or one within the Defense Contract Administration is immaterial to this discussion—the volume and dollar value of contracts for materiel development and the variety of contract types that can be used for these efforts make all procurement offices essential participants in the materiel development process.

f. Project Management.

(1) Project management is a management technique used in the Army Materiel Command to control large materiel development procurements. Instituted in the command in 1962, it represents a radical departure from earlier methods of managing the development of military hardware. Project management is based on the use of a designated, centralized authority which is responsible for planning, directing, and controlling the definition, development, production, and initial logistical support of a materiel project. This centralized authority is supported by functional organizations, which are responsible to it for the execution of specifically assigned project tasks. Once an item has been assigned to a project management office, contractors work closely with the project manager and the contracting officer during performance of the contract. Project management offices may be located at Headquarters, Army Materiel Command; at some other facility, but reporting directly to the Commanding General, Army Materiel Command; or in commodity commands, reporting to the Commanding General, Army Materiel Command, through the commodity command.

(2) Once the chartering authority has delegated executive authority to a project manager for a designated project, weapon, or item, the project manager has a number of responsibilities. He must coordinate the efforts of contractors, supporting commodity commands, test and evaluation agencies designated to support his project, troop testing and training commands, and other Defense and Government agencies. Although he has immediate access to the Commanding General, Army Materiel Command by direct communication, the project manager is expected to use this "red line" only as a last resort to report conditions that are apparently insoluble at his level and to recommend actions to resolve them. The project manager initiates the project plan, the annual program, and the budget request. As prescribed in his charter he takes reprograming actions as necessary to satisfy Army requirements. Because of his authority and responsibilities, he has a direct influence on the materiel development process.

(3) Items chosen for this exceptional management must satisfy certain criteria. These criteria, as set forth in AR 70-17, are as follows:

(*a*) *Mandatory*—all those new (or major modification of existing) production projects, or new Engineering and Operational Systems Developments as defined in AR 705-5, and having one or both of the following characteristics shall be project managed:

—Are rated in the BRICK-BAT category of national and military urgency requirements.

—Are estimated to require total cumulative research, development, test and evaluation financing in excess of twenty-five million dollars, or are estimated to require total production investment in excess of one hundred million dollars.

(*b*) *Otherwise designated*—other projects that may be designated for project management by the Secretary of the Army when they possess one or more of the following characteristics:

—Have a significant effect on United States military posture.

—Are closely related, and when taken collectively, would qualify for project management under the threshold established in (*a*) above.

—Are conducted on a substantially concurrent basis, particularly when significant technical problems are anticipated.

—Involve unusual organizational complexity or technological advancement.

—Require extensive interdepartmental, national or international coordination or support.

—Present unusual difficulties that need expeditious handling to satisfy an urgent requirement. However, due to the importance of supporting fully the critical and costly projects identified in (*a*) above, discretion must be exercised in the optional application of project management technique.

4–7. Continental Army Command

a. This Command is a major field command of the Department of the Army. The Commanding General, Continental Army Command, commands all numbered armies within the continental United States and the Military District of Washington; all troop units located within the continental United States (except when they are specifically assigned to another command or agency); and all Army installations and activities as assigned by Headquarters, Department of the Army.

b. The Continental Army Command is not directly involved in the Army's materiel development effort. However, its agencies are early users of developed items because of this Command's responsibility for providing troops and other support for troop tests (ch 12) and training. The latter responsibility includes individual training, done in training centers and in the Army school system, and subsequent troop training within organized Army elements. Thus, much of the direct effort to accomplish the Army mission to organize, train, and equip rests with the Continental Army Command, while associated but earlier tasks, such as materiel development, are accomplished by the field commands of the Army Materiel Command, and the Combat Developments Command. The Continental Army Command Organization is depicted in figure 4–7.

4–8. Other Army Field Commands

a. Army Security Agency. The Army Security Agency is responsible for research and development of security equipment and systems peculiar to its mission. It is also responsible to the Commanding General, Army Materiel Command, for the materials and methods for packaging, preservation, and packing of materiel under its cognizance, and for transportability of such materiel. It is responsible for planning, programing, budgeting, justifying, coordinating, and supervising its assigned research and development effort.

b. Army Strategic Communications Command. This field command is primarily responsible for operations pertaining to long-haul, point-to-point field station and transportable communications facilities, and for the management of Army Strategic Communications and strategic communications projects. This command performs systems planning and preliminary engineering for new and operating systems involving the development of concept and network layout. It allocates channels (traffic engineering); determines standards of quality and reliability; and does frequency engineering. It establishes installation schedules; develops system materiel requirements; formulates criteria, standards, and practices for design, establishment, engineering, installation, opera-

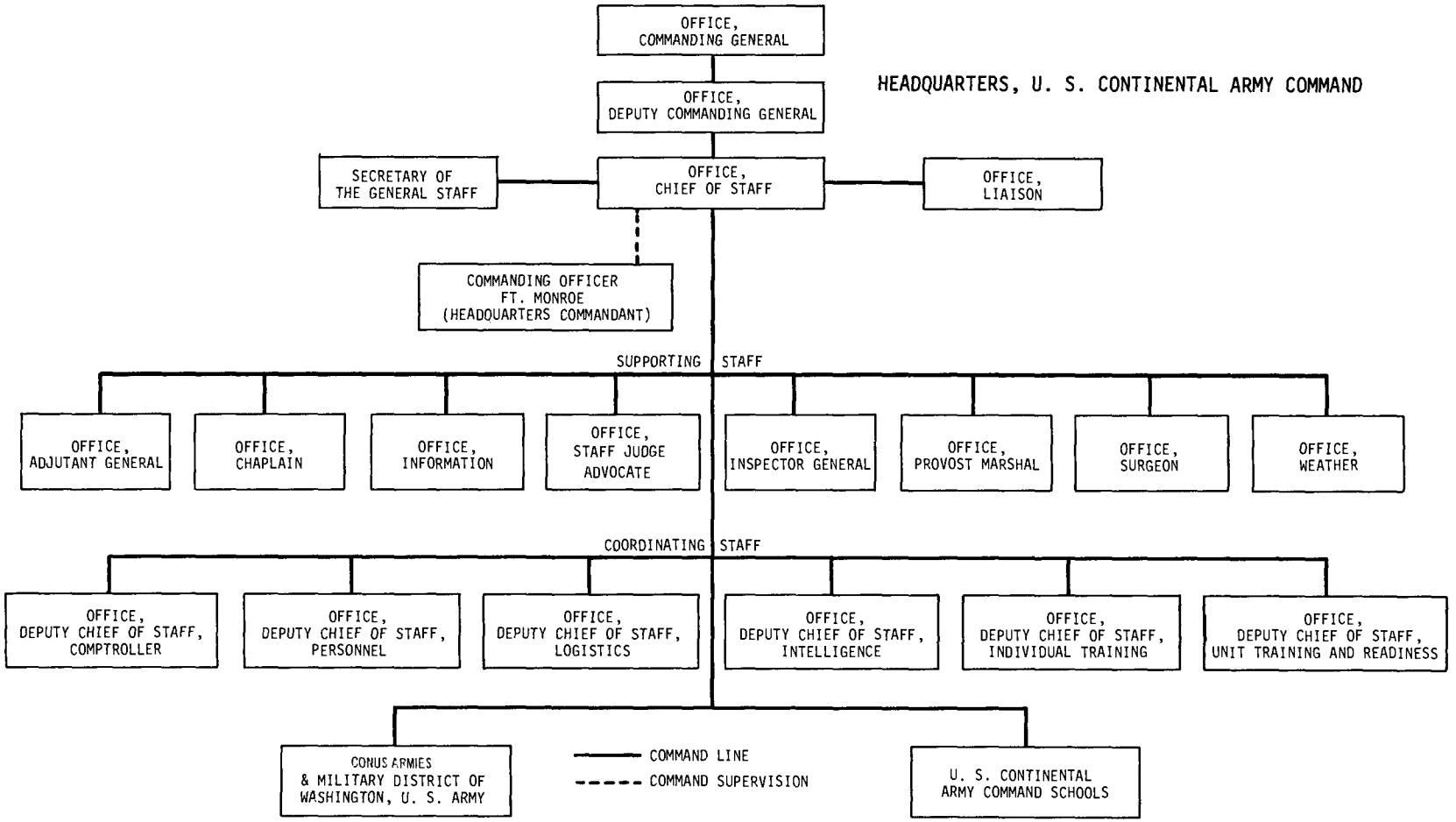


Figure 4–9. Headquarters, U.S. Continental Army Command.

tion, and maintenance; and plans for personnel, training, and logistical support requirements. It also develops system materiel requirements for new and operating systems for strategic and other assigned communications, including development of the detailed annual and midrange equipment and systems procurement lists. It develops and recommends, as required, Qualitative Materiel Development Objectives, Qualitative Materiel Requirements and Small Development Requirements to the Commanding General, Army Combat Developments Command, for new strategic communications systems. It arranges with the Commanding General, Army Materiel Command, for new materiel and services required for new strategic communication systems. Finally, it performs on-site user test and evaluation and final acceptance of communications equipment and systems utilized for strategic communications purposes.

c. Army Components of Unified Commands. These field commands listed below (see fig. 4–1) are the Army components of the major combat elements of the Department of Defense. These elements, identified as unified commands, are under the direct operational control of the Joint Chiefs of Staff. The individual establishment, mission, and organization of a unified command are set forth in the Department of Defense directives. The Army components of the unified commands are as follows:

United States Army Component	*United States Unified Command*
Army Air Defense Command	Continental Air Defense Command
Army Forces, Strike Command	Strike Command
Army Alaska	Alaskan Command
Army Forces, Southern Command.	Southern Command
Army Europe	European Command
Army Pacific	Pacific Command

4–9. Summary

a. The Army Materiel Command, the Combat Developments Command, and the Continental Army Command are the major field commands participating in the Army materiel development process. Except for specialized materiel development responsibilities, such as those of the Chief of Engineers, the Army Security Agency, and The Surgeon General, and the general observer-reviewer functions of other commands, the materiel development task is concentrated in the Army Materiel Command, with the Combat Developments Command and the Continental Army Command performing associated functions. All three Commands direct field activities.

b. Within these commands, there are organizational elements that participate in the materiel development process in a special way; for example, Army Materiel Command boards, Combat Developments Command, Combat Development agencies, and Continental Army Command service schools. There are many similar boards, agencies, and schools spread throughout the Continental United States; these will be described further in chapter 12 in connection with their testing responsibilities. In brief, these boards provide a user-level materiel test and evaluation capability for the Army Materiel Command. The Combat Developments Command agencies, the Army Materiel Command boards and the Continental Army Command service schools are usually collocated, providing a close tie-in between the command stating the requirement, the developer, and the command responsible for training associated with the materiel. This collocation allows an exchange of ideas at the working level, and thus permits each major command to have a better understanding of the combined materiel development task.

c. There is no distinct one-to-one relationship between the field commands and the elements of the Department of the Army Staff, although there are certain areas for which the functional tie is closer than others. In general, however, the field commands are the agencies that execute the plans formulated by the Army Staff within Headquarters, Department of the Army, and the Department of Defense. This total set of relationships is complex. It should be noted that the functions described in this chapter are subject to change and continuous clarification as each organizational element strives to perform its part of the basic mission—to organize, train, and equip Army forces.

PART THREE

MATERIEL REQUIREMENTS

CHAPTER 5

GUIDANCE DOCUMENTS

Section I. NATIONAL PLANNING

5–1. Introduction

Preceding chapters have discussed the organizations and offices active in military research and development. In the execution of their responsibilities, these activities develop and disseminate a number of documents that define and direct research and development programs within the Department of Defense. Some of these documents flow from the top down, providing guidance formulated at upper echelons to operating levels at the base. In others the flow is reversed—information and experiences gathered at the operating levels move upward to the management and planning levels. The purpose of this chapter is to identify those documents that relate wholly or in part to the materiel development process, to describe how and by whom they are prepared, and to define their purpose, use, and interrelationship briefly.

5–2. Formulation of National Security Policy

a. The President. National policies provide the broad framework within which the executive branch of the Government carries out the laws and wishes of Congress. As Chief of the executive branch of the Government, the President allocates missions among the departments and agencies, sees that the required resources are made available for these missions, and directs and coordinates their execution. To insure that the missions and actions of the executive branch are properly related to the basic national interest, the President directs and participates in the formulation of national policy. In national security policy, principal assistance is provided by the National Security Council.

b. National Security Council. The members of this Council are the President, the Vice President, the Secretaries of State and Defense, and the Director of the Office of Emergency Planning. The Special Assistant to the President for National Security Affairs and the Executive Secretary of the National Security Council are officers of the Council. To fulfill its function of advising the President on the integration of domestic, foreign, and military policies relating to national security, the Council itself seeks advice from experts in the fields of politics, economics, the military, and so forth. Among those who advise the Council in the determination of objectives and the formulation of policy are the Joint Chiefs of Staff, the Director, Central Intelligence Agency, the military services, and the Secretary of the Treasury. The policies and guidelines formulated by these means provide the basis for military planning by the Joint Chiefs of Staff and by the Army and the other military departments.

5–3. Joints Chiefs of Staff Planning

a. In Department of Defense planning, interaction between plans and the groups that formulate them is fundamental to success. Joint planning, which covers all the military services, is of necessity broad in scope. It serves as guid-

ance to the Secretary of Defense in budgeting, programing, and long-range planning, and to the services in the formulation of their plans. The three major planning documents of the Joint Chiefs of Staff are the Joint Long-Range Strategic Study, the Joint Strategic Objectives Plan, and the Joint Strategic Capabilities Plan. All three reflect the inputs of the National Security Council, the services, unified commands, and other elements of the Department of Defense.

b. The first two of these documents have a significant influence on materiel development programs. The Joint Long-Range Strategic Study is a long-range planning document that covers the period 10 to 14 years in the future. In projecting long-range military requirements, this plan anticipates technological developments, and thus helps to determine the research and exploratory development programs that the Department of Defense will undertake. The Joint Strategic Objectives Plan is a midrange planning document that covers the period from 3 to 10 years in the future. Translating national objectives and policies into military objectives, strategy, and undertakings, it provides guidance on the size and composition of forces and the use of resources—factors that bear heavily on materiel development. Included is Annex K which addresses research and development. The Joint Strategic Capabilities Plan, which is developed in terms of existing capabilities and programs, does not influence the materiel development process directly.

c. The bridge between current statements of capability (the Joint Strategic Capabilities Plan) and the midrange Joint Strategic Objectives Plan is the Five-Year Force Structure and Financial Program, which sets forth the size and composition of forces and the financial resources required over each of the next 5 years. Constantly updated by the programing system, this program is kept in harmony with the annually developed Joint Strategic Objectives Plan and the resources that are made available to achieve the objectives.

Section II. ARMY PLANNING

5–4. Army Family of Plans, Concept Programs, and Studies

a. General. The Army planning system, as set forth in AR 1–1, is designed to provide an integrated Army strategic concept; a basis for the statement of Army force objectives and capabilities; Army input for joint planning; guidance for the formulation of the Department of the Army Five-Year Force Structure and Financial Program; and planning guidance in areas other than strategy and force objectives, such as the research and development effort.

b. Influence on Materiel Development.

(1) The importance of Army planning to the materiel development process cannot be fully grasped without understanding the materiel life cycle itself. This cycle typically covers about 30 years. Although the cycle necessarily varies with the specific items, it is generally illustrated by radar systems put in operation in World War II. Disposed of in the postwar period, these equipments can trace their research origins back many years before the war. Figure 5–1 portrays this life cycle.

(2) The objectives and requirements established in the planning process are formulated in terms of resource requirements by means of the programing process, which produces the Five-Year Force Structure and Financial Program, discussed in chapter 7. The resource requirements, in turn, are stated and funds are provided annually by means of the budgeting process, also discussed in chapter 7.

(3) The combat development and materiel development cycles stem from the Army Family of Plans whose long-range aspects identify areas of priority operational requirements and establish broad objectives. The midrange aspects of these plans guide

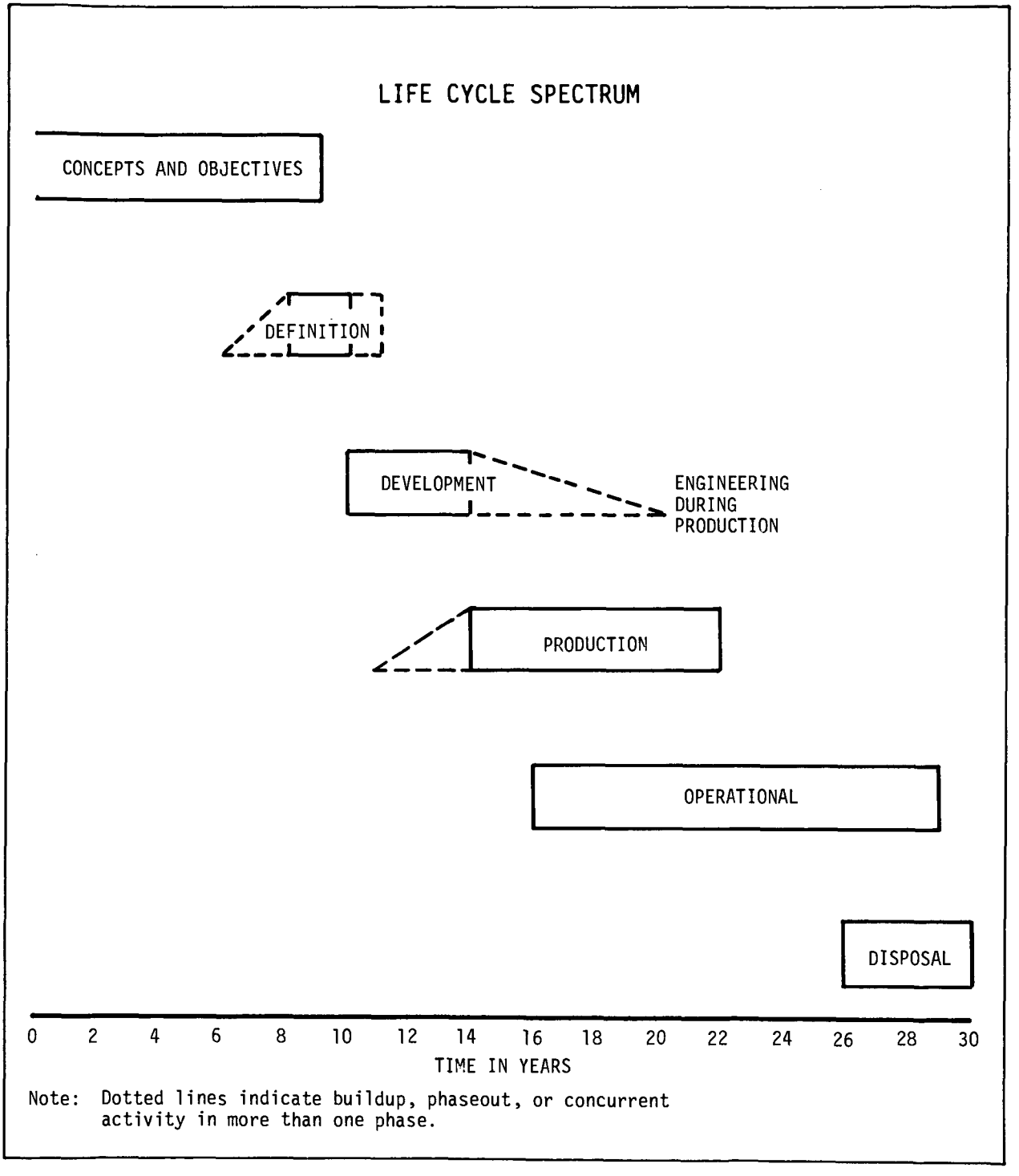


Figure 5–1. Life Cycle Spectrum.

programing as activities move into development. Finally, current and short-range aspects have a heavy impact on deployment and ultimate disposal. As materiel becomes increasingly significant to forces, and as technological advances occur more rapidly, planning for the materiel development process at all stages becomes more crucial than ever before. Failures in basic Army planning now could cause fundamental limitations in force capabilities in the near term, as well as 15, 20, or 25 years from now. Clearly, Army planning must be of the highest order, whether it is concerned with the next year, 5 to 10 years from now, or 20 years hence. Such plans must be fully integrated within the Army; they must be directly integrated into Department of Defense planning as well. Finally, plans must be dynamic and subjected to continuous revision as the environment changes.

c. Basic Army Strategic Estimate. This estimate is the cornerstone of all Department of the Army planning. It reflects national policy and objectives, intelligence and resource capability estimates, technological forecasts, Joint Chiefs of Staff guidance, and other staff inputs. The estimate covers a 25-year period, from the immediate to the long-range. It evaluates threats to national security as they affect the land battle, and develops strategic concepts to meet such threats under conditions that range from general war to incidents and domestic emergencies. A 20-year forecast of technological advances is included as an annex. In preparing this plan, long-range trends in technology, economics, and the political and international environment are considered for their impact upon the Army. Basic Army Strategic Estimate is the responsibility of the Deputy Chief of Staff for Military Operations. It has three principal applications: it constitutes the Army position in Joint Chiefs of Staff plans, particularly in the Joint Long-Range Strategic Studies, and it is used as the basis for the Army Strategic Plan as well as the Army Force Development Plan. Through these plans (particularly the Army Strategic Plan and the Army Force Development Plan), Basic Army Strategic Estimate has a considerable effect on the development of materiel.

d. Army Strategic Plan. This Plan also covers a 20-year time frame. Within this period it presents total Army objectives and forces (and their deployment) and Army position on other service requirements by program in the context of the strategy intelligence, and the technological forecast of Basic Army Strategic Estimate. Prepared by Deputy Chief of Staff Operations, the Army Strategic Plan is a realistic objectives level plan. It outlines broad force structures and states the Army's needs, unconstrained by limitations of resources or by the Five-Year Force Structure and Financial Program. Like the Basic Army Strategic Estimate, it constitutes an Army input to Joint Plans, and especially, in its 2- to 10-year time frame, to the Joint Strategic Objectives Plan. The Army's research and development activities are particularly sensitive to the longer-range (10 to 20 years) aspects of this plan. This part of the Army Strategic Plan identifies advances in system concepts and scientific areas of probable high interest to the Army, and establishes the Priority Operational Requirements which describe broad objectives of research and exploratory development. The Army Strategic Plan and the Army Force Development Plan are interrelated efforts. The Army Strategic Plan establishes strategic priorities and objectives. The Army Force Development Plan identifies and evaluates the risks to be expected when force levels are below the priorities and objectives implicit in the Army Strategic Plan.

e. The Army Force Development Plan. This Plan, prepared by the Assistant Chief of Staff for Force Development, also cover short-, middle-, and long-range periods. It develops balanced Army capabilities to support the concepts embodied in the Basic Army Strategic Estimate and amplified in the Army Strategic Plan. However, unlike the latter, it recognizes the resource constraints of manpower and funds, materiel, and production. The Army Force Development Plan places priorities on the forces and associated resources and operational re-

quirements developed by the Army Strategic Plan. This makes it possible to program the maximum capabilities obtainable within the limits of available resources in a descending order of importance—that is, the most important ones come first. As a realistic appraisal of required capabilities and the priorities among them, the Army Force Development Plan is set up to allow changes in plans as the availability of resources changes, or as unexpected eventualities occur. It is a primary instrument for changing the Army's Five-Year Force Structure and Financial Program, and suggests revisions and alterations in that program to correct shortfalls, redress imbalances, and improve the force structures. In guiding the programing that establishes the Army's Five-Year Force Structure and Financial Program, the Army Force Development Plan deals with the introduction and phase-out of forces, weapons systems, and other materiel. It thus provides a basis both for planning by materiel development agencies and for the programing actions that schedule research and development and identify required resources. It is designed to produce the best possible Army response to the concepts initially established in the Basic Army Strategic Estimate, within the limits of resources available.

f. Army Concept Programs. The Army Concept Programs integrate all the studies, field manuals, Qualitative Materiel Development Objectives, Qualitative Materiel Requirements, Small Development Requirements, Tables of Organization and Equipment, troop tests, field experiments and other derivative actions necessary as the basis for introducing new or improved doctrine, materiel, and organizations into the Army in the field during designated 5-year implementation periods. The current Army Concept Program is Army–70. It is in the process of implementation and covers the period 1 July 1965 through 30 June 1970. Each Army Concept Program derives its nature from the period addressed. Thus Army–70 is concerned with the introduction of new equipment, organizations, and operational methods during the next 5 years, while Army–85 is free of most restraints and is aimed at stretching the capabilities of the scientific community and setting operational and materiel goals to be achieved in the period, 1980–85. Operational Capability Objectives are identified in the formulations of concepts for this period. The Army Concept Program is discussed in detail in chapter 6.

g. Army Master Study Program.

(1) Among the major informational inputs to Army planning and programing are the studies conducted or sponsored by Headquarters, Department of of the Army agencies. These may be investigations of standard topics, conducted on a continuing basis over long periods of time, or they may be special one-time studies, undertaken to examine a specific subject, and terminated upon completion.

(2) Initiation of Department of the Army special studies is monitored by the Director of Special Studies, Office of the Chief of Staff, Army. To insure adequate coverage of subjects requiring special study and to prevent duplication of study effort, the directorate publishes an annual Army Master Study Program that identifies current and approved studies originating in the Department of the Army, cross-references the studies of the Joint Chiefs of Staff, the Army Combat Development Command, and the Army Materiel Command, and indicates areas for future study. Although it is not in itself a guidance document for research, development, test, and evaluation, the Army Master Study Program has an impact on plans and programs that influence these activities.

5–5. Research and Development Planning

a. Function. Research and development planing has two functions. First, it generates technical and technological information for the Army Family of Plans, which, as noted above, deals with strategic concepts, objectives, and forces. Second, it provides guidance for execution of the research and development effort. Just as the Joint Plans and Army Family of Plans mutually support one another, so does Army research and development plan-

ning both contribute to and receive guidance from the Army Family of Plans. Integrated with the overall planning function, combat development activities develop new knowledge and technical capabilities from which can be derived imaginative operational and organizational objectives and concepts. These include or are accompanied by developmental objectives for military materiel. Based on these concepts and objectives, research is initiated in a definition phase to examine technical feasibility. In the paragraphs that follow, the Army's major research and development plans and documents are discussed.

b. The Army Long-Range Technological Forecast.

(1) This forecast is concerned with what will be happening for the next 20 years—with the advances in knowledge, capabilities, and materiel that technology can be expected to produce if it is supported by an effective program of research and development. An annual publication of the Army Materiel Command under the supervision of the Chief of Research and Development, the forecast is presented in three parts or volumes that move progressively from technological possibilities to their potential application. The first volume deals with the scientific opportunities of the future and their potential in relation to the Army's objectives. The second volume, somewhat more specific, discusses the technological capabilities that are considered to be obtainable. Finally, the third volume matches these capabilities with advanced systems concepts. In preparing the Army Long-Range Technological Forecast, Army Materiel Command scientific and engineering personnel consider worldwide scientific and technological progress utilizing available sources in industry and other Government agencies as well as those within the Department of Defense.

(2) Since it provides support for new concepts, requirements, and plans, the Army Long-Range Technological Forecast is used extensively by operational and organizational planners, by the Combat Developments Command, and by the Office of the Chief of Research and Development. The Forecast has relevance throughout the Army Family of Plans.

c. The Army Research Plan.

(1) The Army's efforts in Program VI (Research and Development) are directed by three types of plans or requirements documents. Basic and applied research activities are guided by the Army Research Plan which is responsive to Operational Capability Objectives and Qualitative Materiel Objectives, while development activities, occurring later in the cycle, are governed by Qualitative Materiel Requirements and Small Development Requirements. These documents are discussed in chapter 6.

(2) The Army Research Plan is prepared annually by the Office of the Chief of Research and Development. Its primary objective is to insure that the Army's research efforts are responsive to the Army's Operational Capability Objectives and materiel requirements. Basic and applied research projects should be undertaken in response to Operational Capability Objectives or Qualitative Materiel Development Objectives. The Army Research Plan shapes the basic and applied research activities that produce technology to be considered in formulation of the concepts, which ultimately become future materiel developments. Where appropriate, this Plan focuses on specific scientific areas in detail as well as dealing with overall Army research activity. It is a major source of guidance in the programing and budgeting actions taken by Army agencies in support of basic and applied research.

d. The Combat Development Objectives Guide.

(1) This guide is a Department of the

Army publication which defines those operational and organizational objectives and concepts, materiel developmental objectives, and materiel requirements that are approved. It serves as both a guidance and a control document. It provides guidance to all developing agencies in research and development planning and decision-making activities of that command. As a compendium and cross-reference of approved concepts, objectives, and requirements, it is a control device for the Army General Staff in reviewing approved programs and initiating new plans.

(2) The basic input to the Combat Development Objectives Guide is prepared by the Combat Developments Command and approved by the Department of the Army. It is revised continually on the basis of Department of the Army guidance and the proposals of the Combat Developments Command, with the major revisions occurring in March and September of each year. Its chapters are organized functionally by branch (for example, infantry) and by combat mission (for example, logistical support operations). Each chapter defines approved Army operational and organizational objectives. Each chapter also includes summaries of the relevant Qualitative Materiel Development Objectives, Qualitative Materiel Requirements, and Small Development Requirements that support the concepts and objectives stated, plus pertinent Army studies, field experiments, and troop tests. The general objectives and Operational Capability Objectives are projected as far as 20 years. The Operational Capability Objectives and Qualitative Materiel Development Objectives define broad materiel objectives upon which to base research and exploratory development. The Qualitative Materiel Requirements and the Small Development Requirements are usually concerned with development efforts required for the short-range and midrange time frames.

(3) The Combat Development Objectives Guide is based on the operational and organizational goals developed initially by the Army Family of Plans; inputs from developing agencies, such as the objectives for technology and technological forecast; and other information that the Combat Developments Command must acquire in order to meet its functional responsibilities.

(4) For purposes of clarification an Operational Capability Objective is defined as: "A Department of the Army approved description (qualitative to the extent practicable) of an operational capability desirable of achievement primarily in the long-range time frame (10–20 years in the future)."

e. Project Listings.

(1) The Chief of Research and Development prepares and distributes summary project listings to the commands three times a year. These listings, covering all Army research, development, test, and evaluation projects, show funding for the year of execution and the next five program years. The October distribution states the funding, by project, that the Department of the Army has requested of the Office of the Secretary of Defense during the budget submission. The January issue reflects decisions and deferrals decided on during the budgeting process.

(2) In response to project listings, the developing agencies furnish the Chief of Research and Development with command schedules in March of each year. Here they show, by project, their latest funding plans for the new fiscal year and the next five program years. These schedules are considered by the Chief of Research and Development during the apportionment proceedings with the Office of the Secretary of Defense in the spring.

(3) In June, revisions resulting from the Chief of Research and Development review are included, and the list sets forth the actual funding for the closing fiscal year, the expected funding for the new fiscal year, and the latest funding programs for the next five program years. (The June distribution is supplemented by later memorandums to developing agencies, covering new fiscal year funding.)

(4) The project listings are important as transmittal devices. They provide the commands with up-to-date information about current actions and decisions at the Department of the Army and Office of the Secretary of Defense levels, and thus insure knowledge of budgeting actions and later-year reprograming actions that fall below Program Change Proposal thresholds (ch 7).

5–6. Long-Range Technical Planning

a. The preceding paragraphs have reviewed the guidance documents, plans, and programs developed at the Joint Chiefs of Staff, Army Staff, and major command levels. The interrelationship among them, and their effect on all stages in the materiel development process, are apparent. It is equally clear that these guidance documents have the initial impact on the research and exploratory development stages of research and development. The ultimate result is the evolution of the requirements documents—Operational Capability Objectives, Qualitative Materiel Development Objective, Qualitative Materiel Requirements, and Small Development Requirements. These documents, which are discussed in succeeding chapters, control and guide the later stages of research and development—advanced, engineering, and operational systems development. Long-Range Technical Planning is a process for establishing how the Army will go about implementing this guidance for research on an individual case basis to achieve its goals and objectives. Long-Range Technical Planning covers the 10- to 20-year time frame and deals with basic research and the applied research portions of exploratory development. It is concerned with both materiel-oriented and nonmateriel-oriented research. This discussion is concerned with the first of these.

b. Long-Range Technical Planning has tremendous possibilities. Unrestricted by existing technology, it is predicated on wide-ranging activity by scientific and technical groups, and can lead to spectacular materiel successes. However, it is also faced with some very real and difficult problems. Because of the time frame, for example, programs will inevitably extend beyond the tenure of individual personnel. This makes it necessary to provide a management system that is stable and coherent without being too conservative or unimaginative. The time range also makes for large uncertainties in the availability of new knowledge both in type and in timing. In addition, the ever-present constraints on resources mean that choices must be made as to the most promising areas for research in terms of ultimate benefit to the Army. As a result, plans must be under constant review and revision to meet requirements of changes in environment, knowledge, and research results. Finally, the Army's long-range technical planner must recognize that he is dependent on a great number of large, widely dispersed groups, whose actions, like their plans, are heavily interacting.

c. Responsibility for Long-Range Technical Planning rests essentially with the developing agencies. Activities in the Army Materiel Command, which has responsibility for most Army materiel development, best illustrate the process. The Army Materiel Command is charged with conducting research and development to serve Priority Operational Requirements and Operational Capability Objectives as well as the operational and organizational objectives, Qualitative Materiel Development Objectives, Qualitative Materiel Requirements, and Small Development Requirements, spelled out in the Combat Development Objectives Guide. To achieve this end, it proposes research and development projects and tasks to the Chief of Research and Development for approval. If such projects fall within approved plans, programs, and budgets, they move ahead. If not, new approval may be sought. The Commanding

Range Technical Plans to meet the goals and objectives developed by guidance documents. The subcommands also prepare the Research and Technology Resume (DD Form 1498) that defines the tasks to be undertaken in support of the plan.

d. The sources that must be exploited in the Long-Range Technical Plan process are many. The guidance documents and plans—Combat Development Objectives Guide and Army Research Plan—identify objectives dealing with specific areas of research. The Army Long-Range Technological Forecast provides valuable inputs on technological prospects and opportunities. Objectives for technology are developed within the commands. Among the many inclusions are intelligence reports, study results, and prior knowledge.

e. To maximize planning possibilities in the face of difficult problems, the Army Materiel Command follows a definite methodology. The steps involved are sequential, but they do require continuous feedback and review. First the technological areas that have the greatest prospects for improving the materiel capabilities of the Army of the future must be identified. Goals for research must be established, using long-range operational objectives for guidance. To attain these goals, tasks must be defined and established. The relationship between these tasks, and organizations and facilities and their capabilities, must be considered; resources needed for pursuing the tasks must be identified. Finally, continuing supervision, review, and analysis must be provided for.

f. Among the principal techniques and procedures that have been established for carrying out this process are networks, narrative summaries, and Research and Technology Resumes (DD Form 1498). The networks relate tasks to objectives: they identify hypothetical concepts, consider performance parameters, and pinpoint particular technological barriers. The narratives simply expand on the networks, describing the concepts and technological considerations. The resumes (DD Form 1498), which cover the tasks and concepts embodied in the plan, are used for review and approval at Army Materiel Command, Office of the Chief of Research and Development, and Director of Defense Research and Engineering levels. In them is presented justification of the efforts. The results of the Long-Range Technical Planning, then, are identification of the areas of research and the goals to be pursued, establishment of the projects and tasks needed to attain the goals, and determination of the organizations and resources required. The outputs of research conducted by the Army affect the total capabilities of forces for the next 10 to 20 years.

CHAPTER 6

ESTABLISHING REQUIREMENTS

Section I. ORIGINATION OF MATERIEL REQUIREMENTS

6–1. General

a. As it is stated in AR 705–5, Army policy governing the establishment of qualitative materiel requirements and the development of this materiel emphasizes the following points:

(1) Speed of execution and quality of product.

(2) Development of items that represent real progress in combat effectiveness.

(3) Concentration on features and characteristics that contribute directly to operational effectiveness to the exclusion of "nice to have" but nonessential features.

(4) Assessment of cost against expected improvement in operational capability.

(5) Emphasis on reliability and maintainability.

(6) Consideration of state-of-the-art trends in other countries, and potential threats to present and future materiel or systems.

(7) Consideration of national science and technology to insure that significant advances are exploited and that materiel objectives and requirements are defined so as to take full advantage of scientific and technical trends and prospects.

b. These points suggest something of the complexity involved in deciding what materiel the Army should develop, in what time span, at what cost, and for what use. The Army does not have unlimited resources, nonetheless, it must maintain a force that is capable of meeting a great variety of threats from points everywhere on the globe. Modern warfare depends to an unprecedented degree on the fruits of science and technology, and these are often years in the making. Thus the establishment of materiel requirements—deciding what materiel the Army of the future should have—is a crucial and particularly demanding function.

c. Major advances in materiel rarely result solely from the recognition of an operational need or from new technological developments. In most cases these two forces interact. Changing operational needs call for new materiel, and technology responds to the need, as in the emphasis of recent years on vertical and short takeoff landing (V/STOL) aircraft, for increased mobility. On the other hand, new technology often makes it possible to achieve greater operational effectiveness, as in the application of the laser to range-finding. In order to establish materiel requirements, therefore, it is necessary to integrate both the Army's foreseeable objectives and the best capabilities of science and technology into a single coherent program.

6–2. Sources of Requirements

a. Proposed requirements for materiel development come from many sources, both within the Army and outside it. These proposals may be targets of necessity arising from Army needs, or targets of opportunity suggested by technological or engineering advance. *Any* organization concerned with the development or use of materiel may propose the development of new systems or equipment. Nevertheless, certain elements play more dominant roles than

others. Headquarters, Department of the Army, for example, addresses the fundamental problems of mission and strategy and is deeply involved in defining the composition of forces. Both of these functions result in requirements for new materiel. The most active Headquarters elements in this area are the Assistant Chief of Staff for Force Development, the Chief of Research and Development, and the Deputy Chief of Staff, Operations. Contributions are also received from the Assistant Chief of Staff, Intelligence, and the Deputy Chief of Staff, Logistics. The Combat Developments Command is responsible for formulating doctrine for the Army in the field over the next 20 years. In carrying out this role, the Combat Developments Command must consider the kinds of forces and materiel needed and how they will be used (AR 10–12). It must then initiate the new materiel objectives and requirements that grow out of its studies.

b. In addition to these planning elements, materiel requirements also originate from a wide range of users. The operating commands of the Army, for example, generate requirements for materiel and review proposals for major new developments designed to improve their operating capabilities. Similarly, the unified/specified commands, through the Joint Chiefs of Staff, provide proposals for new materiel. The Continental Army Command is responsible for proposing and reviewing requirements for training devices, while the Army Air Defense Command is directly concerned with materiel related to Continental Air Defense.

c. At the other end of the spectrum are the developers of materiel and technology. Developing agencies such as the Army Materiel Command and its laboratories submit many proposals for new materiel that have originated from advances in technology or engineering. Industry also contributes to the process of determining requirements. While its most important role is in meeting established requirements, it also contributes ideas for new requirements through formal unsolicited proposals for research or development of new materiel. (Industry's contribution to the establishment of materiel requirements is discussed further in para 6–15 and 6–16.)

d. The other military services also play a role in the establishment of Army materiel requirements. They often originate requirements that have a direct bearing on the Army Research and Development program. Much of the Marine Corps' materiel, for example, is developed by the Army, and Army support requirements from other services involve considerable interplay with the Navy and Air Force. Finally, foreign governments also influence materiel requirements, either as a source of requirements or, more often, as potential users of materiel that the Army proposes to develop. This source is discussed more fully in paragraphs 6–17 and 6–18.

e. The formal requirement procedures described in the following sections of this chapter are, of course, supplemented by much informal communication during the actual process of establishing requirements. As has already been pointed out, there is and must be considerable interplay between those who view requirements from the standpoint of operational needs and those who consider them in the light of technological possibility. The Army's procedures are designed to bring together both the needs and the possibilities and crystallize them into specific materiel requirements.

Section II. REQUIREMENTS DOCUMENTS

6–3. General

a. Qualitative requirements for Army materiel development are established through a series of formal procedures and documents that define the objective, establish its feasibility, and specify the nature of the materiel needed to meet it. Key documents in the requirements process are the Qualitative Materiel Development Objective, the Qualitative Materiel Requirement, and the Small Development Requirement. In 1965, the Operational Capability Objective, the Advanced Development Objective

and the Qualitative Materiel Approach were approved for inclusion in the requirements process. The remaining paragraphs of this section will discuss these documents.

b. The desirability and need for establishing meaningful long-range goals for combat development and research and development planning are clearly recognized. An Operational Capability Objective is a Department of the Army approved description (quantitative to the extent practicable) of an operational capability desirable of achievement, primarily in the long-range time frame (10–20 years in the future). It is responsive to envisioned future operational concepts, and recognizes the constraints of probable technological capabilities. The Operational Capability Objectives provides guidance for combat developments and research and, together with Qualitative Materiel Development Objectives, for exploratory development, Operational Capability Objectives are related to Qualitative Materiel Development Objectives and Qualitative Materiel Requirements. The Operational Capability Objective describes the capability desired; a Qualitative Materiel Development Objective states, in qualitative terms, a materiel objective. Several solutions, including applicable competing conceptual approaches, may become apparent during execution of a Qualitative Materiel Development Objective Plan. Analytical trade-offs among solutions are undertaken, resulting in the selection of the single solution which will be the basis for a Qualitative Materiel Requirement.

6–4. The Qualitative Materiel Development Objective

a. This document is a Department of the Army-approved statement of a military need for the development of new materiel. In most cases, no concept exists as yet by which to measure or prove the feasibility of developing materiel to meet the objective. The Qualitative Materiel Development Objective is the justification for exploratory development efforts undertaken to determine whether the need can be met, and if it can, by what means.

b. A draft of a proposed Qualitative Materiel Development Objective can originate anywhere in the Army. The majority originate at the Combat Developments Command, the field command primarily responsible for coordinating draft proposals with developing agencies and other interested parties; the Combat Developments Command also prepares the formal proposal for submission to Headquarters, Department of the Army, where the Assistant Chief of Staff for Force Development is responsible for staff coordination and approval. Upon approval, a summary of the new Qualitative Materiel Development Objective is incorporated in the Combat Development Objectives Guide, and responsibility is assigned to a developing agency.

c. The Qualitative Materiel Development Objective has a prescribed format, set forth in the Appendix to AR 71–1.

(1) *Section I—Statement of Objective*—calls for a descriptive name or title for the item to be developed and a brief statement of the objectives to be achieved. These include employment, operational capability, reliability, maintainability, and transportability objectives. The Qualitative Materiel Development Objective does not specify the technical approaches to be explored; instead, it leaves the developing agency the widest possible latitude in seeking solutions. However, the objectives expressed in the Qualitative Materiel Development Objective should reflect a synthesis of the operational needs expressed by the Combat Developments Command on the one hand, and the technical potential of the developing agencies on the other.

(2) *Section II—Operational Concepts*—has two parts:

(*a*) a statement of the operational or logistical concepts involved and

(*b*) a description of probable personnel, organizational, and training implications.

(3) *Section III—Justification and Priority.* This section explains the reason for the proposed development and states the priority it should receive.

(4) *Section IV — Other Considerations.* The final section provides for additional information to help clarify the nature and necessity of the objective.

6–5. The Qualitative Materiel Approach

a. The Qualitative Materiel Approach is a recently approved document designed to facilitate transition from the statement of the need (Qualitative Materiel Development Objective) to the initiation of development (Qualitative Materiel Requirement). It will be used by the developing agency working under a Qualitative Materiel Development Objective to inform the agency representing the user (Combat Developments Command) that the technical feasibility of the objective stated in the Qualitative Materiel Development Objective is apparent.

b. The Qualitative Materiel Approach will be prepared by the developing agency after sufficient exploratory development has been accomplished to demonstrate that one or more solutions are feasible to satisfy the Qualitative Materiel Development Objective in whole or in the majority of its objectives with specific designated exceptions. The Qualitative Materiel Approach will then be sent to the Combat Developments Command. If the proposed technical approach (or approaches) meets the stated materiel objective, the Combat Developments Command can prepare a Qualitative Materiel Requirement to replace the Qualitative Materiel Development Objective. If the proposed approach fails to meet all the objectives of the Qualitative Materiel Development Objective, the Combat Developments Command may either prepare a Qualitative Materiel Requirement based on lesser objectives, or it may suggest further exploratory or advanced development effort.

c. If the decision is made to proceed from exploratory to advanced development rather than directly to engineering development, the Qualitative Materiel Approach will serve as the basis for the Advanced Development Objective. Development activity for systems or equipment generally will move from exploratory development to advanced development in projects where additional development work is required to show the feasibility of overcoming high risk areas. In other projects, the development effort will move from concept formulation in exploratory development to contract definition (para 8–9 and 8–10).

d. Though all details have not been clarified the requirement for an Advanced Development Objective is expected to be met by the Qualitative Materiel Approach, accompained by a letter from the Combat Development Command. The letter and Qualitative Materiel Approach will be forwarded to Headquarters, Department of the Army for approval.

6–6. The Qualitative Materiel Requirement

a. The Qualitative Materiel Requirement is a definitive Department of the Army-approved statement of the need for a new item, system, or assemblage for which a specific and feasible technical solution has been selected. The Qualitative Materiel Requirement is addressed to the engineering and operational system development phases of the research and development program. It represents a project of some magnitude, on the order of $2.5 million or more in development cost and $10 million or more in production cost.

b. Drafts of proposed Qualitative Materiel Requirements may be submitted to the Combat Developments Command by various groups, including user commands, user agencies, and developing agencies. Most proposals originate with the developing agencies, often as a result of exploratory work on a Qualitative Materiel Development Objective. They may also originate with the Combat Developments Command, which has prime responsibility for preparing the Qualitative Materiel Requirement and submitting it to Headquarters, Department of the Army. At this Headquarters Qualitative Materiel Requirement is reviewed and coordinated within the Army Staff by the Chief of Research and Development. New Qualitative Materiel Requirements of major importance are reviewed for total feasibility by the Materiel Requirements Review Committee, discussed in paragraphs 6–9 through 6–14.

c. The Qualitative Materiel Requirement has a prescribed format, set forth in appendix II,

AR 705-5. The document comprises six sections:

(1) *Section I—Statement of Requirement* —describes the item and indicates its relationship to other Qualitative Materiel Development Objectives and Qualitative Materiel Requirements in the Combat Development Objectives Guide, and to other items currently in use. It also describes the characteristics of the item, distinguishing, when appropriate, between those that are "essential" and those that are merely "desirable." In addition, it presents the broad concept of the item's employment, other items with which it must be compatible, desired transportability and mobility features, and the expected development time frame. Section I of the Qualitative Materiel Requirement is reproduced in the Combat Development Objectives Guide.

(2) *Section II — Operational, Organizational, and Logistical Concepts*—describes how the item will be used and supported. The discussion of operational concepts includes a statement of geographical areas where the item will be used, whether continuous or intermittent operation (peacetime, wartime, all-weather) is planned, what the item will do (strategically, tactically, technically, administratively), and how and by whom it will be used and controlled. The discussion of organizational and logistical concepts covers the types of organizations for which the item is intended, and how and in what quantities it will be distributed and supported.

(3) *Section III—Justification, Feasibility, and Priority*—explains the need for the item's development in terms of threats and missions; cites the basis for its technical feasibility; and assigns it a proposed priority.

(4) *Section IV — Characteristics* — describes the item's characteristics in some detail, as follows:

(*a*) *Performance characteristics*—such as environmental characteristics, velocities, endurance, and reliability.

(*b*) *Physical characteristics*—such as weight, configuration, access, durability, health and safety criteria, and vulnerability.

(*c*) *Maintenance characteristics*—such as mean downtime and design features for the elimination, reduction, or simplification of maintenance.

(*d*) *Human engineering characteristics* —such as protective equipment, environmental factors, and information needs for operator decisions.

(*e*) *Priority of characteristics*—the relative priority of the characteristics (*a*) through (*c*), described above. (Human engineering is considered as an associate characteristic to all the others and is not given a separate priority listing.)

(5) *Section V—Personnel and Training Considerations* — indicates total personnel requirements needed to operate and maintain the item, the new skills or knowledge that will be required, how such training should be accomplished, and the quantities of new equipment that will be required for training.

(6) *Section VI—Associated Considerations*—covers the need for training devices and related materiel necessary to support the new item. It includes a consideration of concealment or deception requirements, probable interest of allied nations in the equipment related existing or developmental items of other countries, communications and electronic security requirements, and any appropriate additional information.

d. In addition to its six sections, the Qualitative Materiel Requirement includes an appendix that analyzes in some detail the technical feasibility and risk involved; the estimated total costs and funding requirement, including development, production, operation, and main-

tenance; the impact of the item on national production capacity; and the developing agencies likely to be involved in the development.

e. If the Qualitative Materiel Requirement involves a nuclear warhead or reactor, its format and processing are modified to meet the requirements of the Atomic Energy Commission and the Defense Atomic Support Agency. The special procedures for nuclear energy are discussed in paragraphs 6–9 through 6–14.

6–7. The Small Development Requirement

a. The Small Development Requirement is the equivalent of the Qualitative Materiel Requirement for items when the cost will not exceed $2.5 million in development and $10 million in production. These items have proven feasibility and can be developed in a relatively short period. Many Small Development Requirements, for example, are prepared for training devices in support of an item being developed under a Qualitative Materiel Requirement.

b. Small Development Requirements originate from the same sources as Qualitative Materiel Requirements and, in many instances, are an outgrowth or accompaniment of a Qualitative Materiel Requirement. Although, like the Qualitative Materiel Requirement, they are prepared by the Combat Developments Command for submission to Headquarters, Department of the Army, the procedures for staffing and coordination are much simpler. Small Development Requirements are coordinated by the Combat Developments Command with the developing agency, with the Chief of Personnel for personnel implications, with Continental Army Command for training and training device implications, and with other commands or agencies as appropriate.

c. The format of the Small Development Requirement is set forth in Appendix III, AR 705–5. It covers the following points:

(1) Purpose and operational characteristics.

(2) Supporting justification and data, such as the cost of development, production, operation, and maintenance; technical feasibility; relation to existing equipment; and technical and military characteristics.

(3) Recommended priority.

(4) Maintenance concept.

(5) Background information, such as additional justification, training implications, personnel implications, and other items of materiel that might be affected.

6–8. Summary

a. The requirements documents discussed above stand in an integral relation to each other. They all originate from Army plans and the general developmental objectives that grow out of those plans. These objectives, in terms of materiel development, are stated as Operational Capability Objectives in the Combat Development Objectives Guide. Specific development objectives whose feasibility is uncertain are stated as Qualitative Materiel Development Objectives. After technical feasibility has been established, the developing agency will describe the proposed approach in a Qualitative Materiel Approach. If the user (Combat Developments Command) agrees that the approach meets the objective, a definitive requirement is established. For relatively large efforts, this requirement will be stated as a Qualitative Materiel Requirement; for relatively small efforts, the document is a Small Development Requirement.

b. The documents discussed above are also related to the developmental phases of the research and development program. Qualitative Materiel Development Objectives are not written for the research phase, where guidance derives primarily from Combat Development Objectives Guide objectives and the Army Research Plan. However, they are used to initiate or guide effort in exploratory development. The Qualitative Materiel Approach is the instrument which will be used for indicating feasibility. It will serve, with a Combat Developments Command letter, as an Advanced Development Objective supporting work in advanced development. It also will serve as the

basis for the subsequent Qualitative Materiel Requirement or Small Development Requirement. Either Qualitative Materiel Requirements or Small Development Requirements launch engineering development efforts and may continue to serve as justification for activity in operational systems development. (The relation between these documents and the categories of the Research and Development program is discussed more fully in ch 7.)

Section III. PROCESSING QUALITATIVE REQUIREMENTS

6–9. The Army Concept Program

a. The documents discussed in paragraphs 6–3 through 6–8 are coordinated with the particular Army Concept Program that will be operational when the new materiel is scheduled to come into active use. Army Concept Programs, prepared by the Combat Developments Command, are based on five successive future time spans, each of 5-year duration. Army–85, for example, is the Army Concept Program for the period 1980–85.

b. Each Army Concept Program is a detailed description of the Army for the specific 5-year period. It states how the Army will fight, how it will be equipped, and how it will be organized to perform its projected missions. The development of each Concept Program begins with a concept study. This study is prepared for approval 20 years before implementation is scheduled to begin; thus, there is some interplay between the concept study and the plans (primarily the Basic Army Strategic Estimate and the Army Strategic Plan) to which it is addressed. The concept study is subsequently refined and elaborated through doctrine studies and derivative studies and actions, including the development of materiel objectives and requirements. Figure 6–1 shows the relationship of Army plans and other guidance documents to the Concept Program.

c. The concept study and related combat development actions address the five basic Army functions—intelligence; mobility; firepower; command, control, and communication; and service support. These functions are analyzed in relation to the Army tasks projected for the implementation period. At present, Army planning envisages seven such Army tasks:

(1) High Intensity Conflict (Nuclear War)—involving the application of the most modern military technology in intelligence; mobility; firepower (including nuclear, chemical, and other advanced weapons); command, control, and communications; and service support.

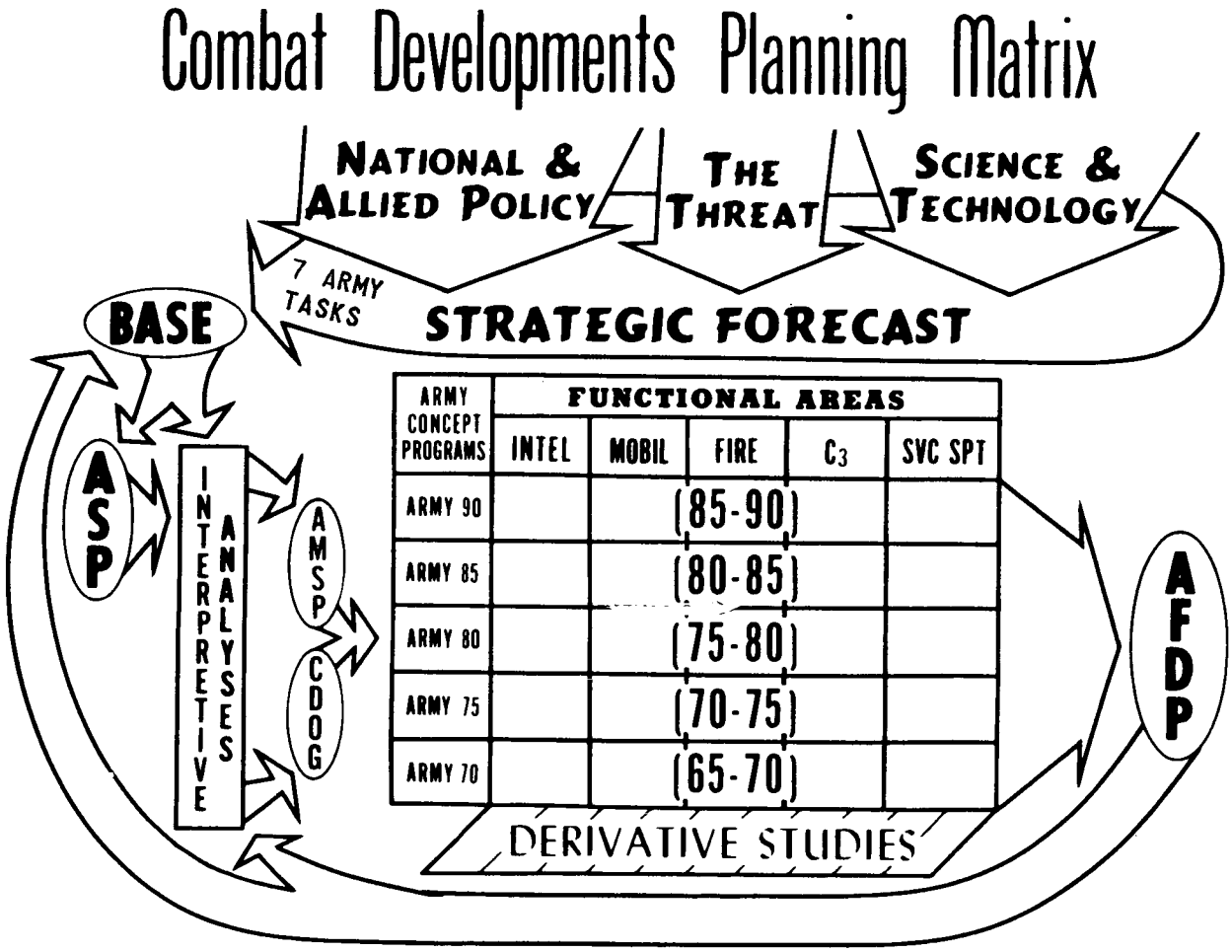
(2) Mid Intensity Conflict (Conventional War)—involving a capability to fight successfully for limited objectives under definitive policy limitations as to the extent of destructive power that can be employed or the extent of geographical area that might be involved.

(3) Low Intensity Conflict Type I—stability operations involving action by U.S. combat forces to establish, regain, or maintain control of land areas threatened by guerrilla action, revolution, subversion, or other tactics aimed at internal seizure of power.

(4) Low Intensity Conflict Type II—stability operations involving United States advice and combat support for indigenous or Allied forces engaged in establishing, regaining, or maintaining control of land areas threatened by guerrilla action, revolution, subversion, or other tactics aimed at internal seizure of power.

(5) Air and Missile Defense—involving primarily the Army's part in the multi-Service missions of defense of the Continental United States but related to the *similar* mission overseas in any of the types of conflict outlined.

(6) Military Aid to U.S. Civil Authorities—involving possible future requirements for active Army and National Guard forces in the traditional role of assisting State and Federal au-



BASE	Basic Army Strategic Estimate
ASP	Army Strategic Plan
AMSP	Army Master Study Program
CDOG	Combat Development Objectives Guide
AFDP	Army Force Development Plan
INTEL	Intelligence
MOBIL	Mobility
FIRE	Firepower
C_3	Command, Control, and Communications
SVC SPT	Service Support

Figure 6–1. Combat Developments Planning Matrix.

PROGRAM MATRIX
(7X5X5)

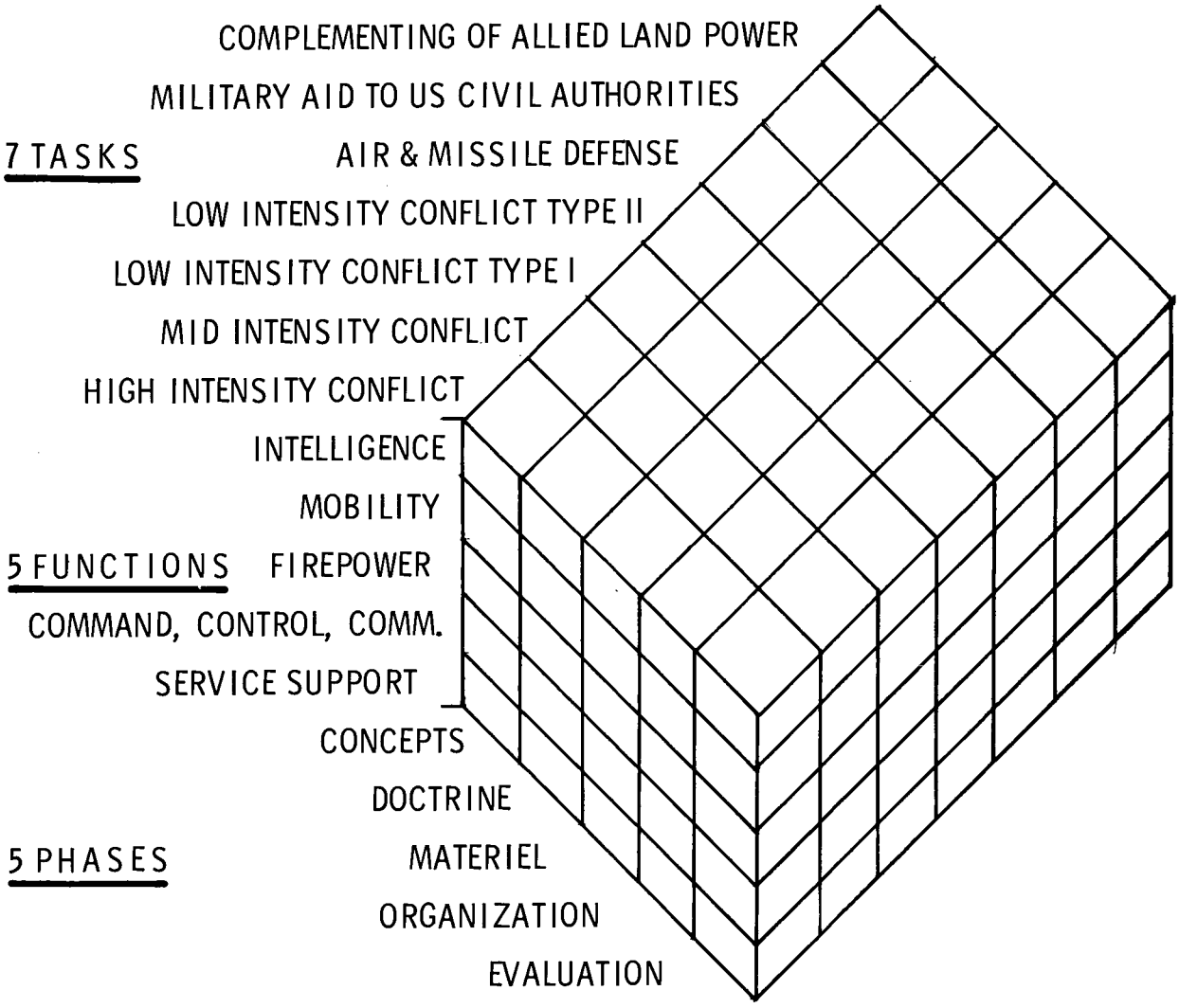


Figure 6-2. Program Matrix.

thority to preserve law and order under the Constitution.

(7) Complementing of Allied Land Power (Aid to Allies)—involving all aspects of peacetime military assistance. This includes meeting personnel, materiel, logistical, and organizational requirements as well as responding to the planning and organizational requirements which insure maximum wartime effectiveness of the assisted forces.

The tasks and functions are then further related to the five phases of combat development, which are (1) concepts, (2) doctrine, (3) materiel, (4) organization, (5) evaluation. The Combat Developments Command formally elaborates the three-way relationship between functions, tasks, and phases in a three-dimensional matrix (figure 6–2). Each Army Concept Program is managed in terms of this matrix.

d. The five phases of combat development are not wholly sequential. The concept phase, of course, provides the basic building blocks. It is addressed primarily to operational and organizational considerations, although it also specifies materiel objectives and may identify materiel requirements for systems or major items. The doctrine phase elaborates the concepts in terms of operation, organization, and support of field units. Materiel and organizational requirements emerge more specifically as a result of doctrine studies, and are further defined through derivative studies and actions, such as the initiation of a Qualitative Materiel Development Objective, Qualitative Materiel Requirement, or Small Development Requirement.

e. The Army Concept Programs are coordinated at Headquarters, Combat Developments Command, by the Program Coordination Office. Concept studies are developed by the Combat Developments Command Institute of Advanced Studies with staff guidance and coordination provided by the Director of Plans at Headquarters, Combat Developments Command. The doctrine, materiel, organization, and evaluation phases of the Concept Programs are each headed and coordinated by a Director at Headquarters, Combat Developments Command. Four subordinate elements of the Combat Developments Command, the Institute of Combined Arms and Support, the Combat Arms Group, the Combat Support Group, and the Combat Service Support Group, produce doctrine studies, derivative studies, and proposed combat development actions, such as Qualitative Materiel Requirements and Small Development Requirements. The Combat Developments Command experimentation command is the primary field activity for evaluation of the Concept Program and its component parts.

6–10. The Initiation of Materiel Requirements

a. The materiel phase of the Army Concept Program is addressed to the question, "How shall the Army be equipped?" This phase is related to the organizational phase of the program in terms of using units, personnel resources, and the skills necessary for operation and maintenance. It is also related to the evaluation phase in that it employs analytical techniques, ranging from war-gaming to troop-testing, to validate the materiel concept and its implementation.

b. The process by which a Concept Program is developed and refined is shown graphically in figure 6–3. As this chart shows, the Operational Capability Objective can begin as much as 20 years before program implementation while the Qualitative Materiel Development Objectives and Qualitative Materiel Requirements begin to appear about 15 years before implementation of the program starts. Ideally, Qualitative Materiel Development Objectives for major, long-lead-time items should be developed and approved no later than 12 years before the target date of the program, and for minor items no later than 8 years before the target date. A Qualitative Materiel Requirement should be approved no later than 8 years, and a Small Development Requirement no later than 5 years, before the target date. This schedule permits type classification in the period 6 to 8 years before the target date, and subsequent production and delivery of items for training and troop-testing in the period beginning 3 to 4 years before the target date.

c. Once the concept study for an Army Concept Program has been approved, it becomes the basis for identifying materiel requirements for systems or major items. From this point, the Combat Developments Command and the developing agencies work together to develop statements of materiel objectives and requirements. (The process of developing a materiel requirement is shown graphically in fig. 6–4.)

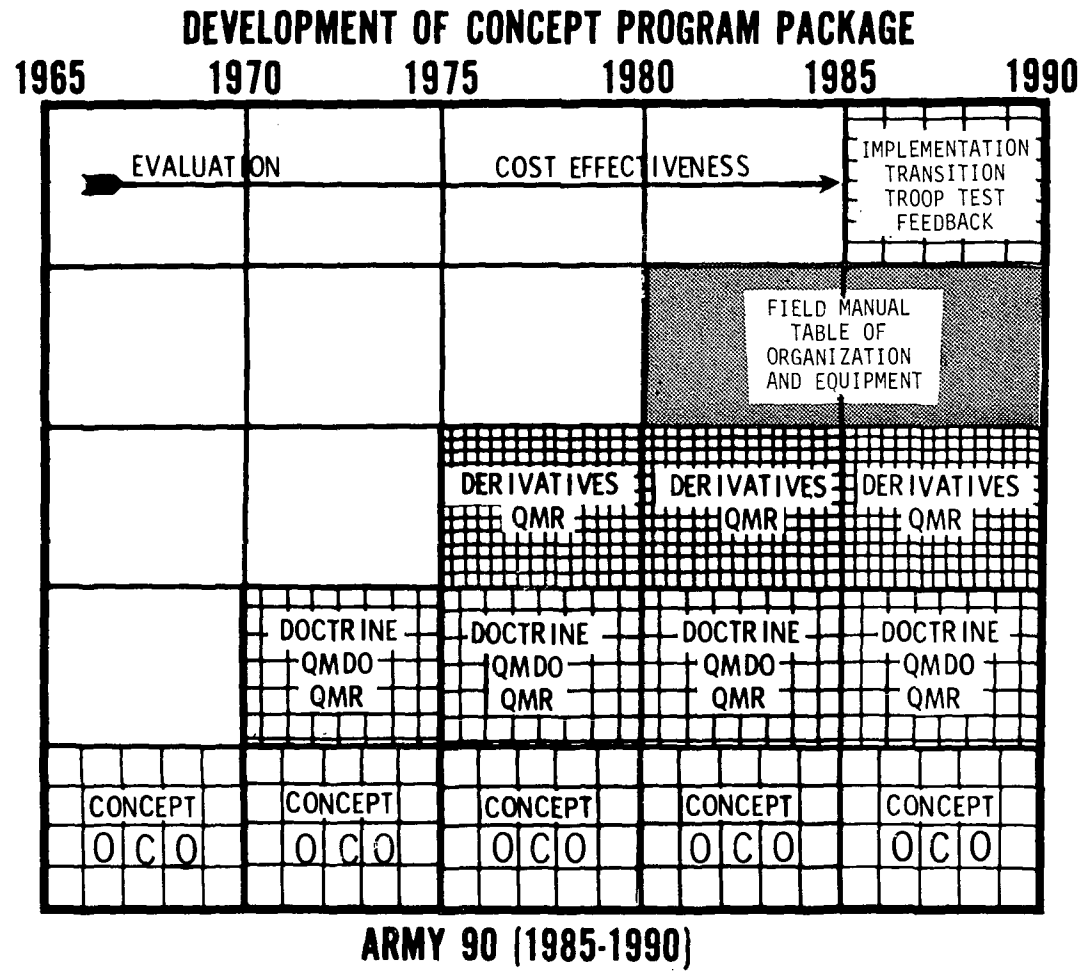


Figure 6–3. Development of Concept Program Package.

Throughout this process, technical inputs are provided by the developing agencies, and comments are solicited from major commands, such as the United States Continental Army Command and United States Army, Pacific. In every instance, the Qualitative Materiel Development Objective, Qualitative Materiel Requirement, or Small Development Requirement must support one or more of the concepts set forth in the concept study; this is a key criterion for admission of the materiel action to the Concept Program.

d. If the Combat Developments Command determines from the developing agency that a proposed development is not yet feasible, the development is stated as a Qualitative Materiel Development Objective. If, on the other hand, the Command determines the development to be feasible, it is stated as a Qualitative Materiel Requirement. In either case, the proposed materiel action is submitted to Headquarters,

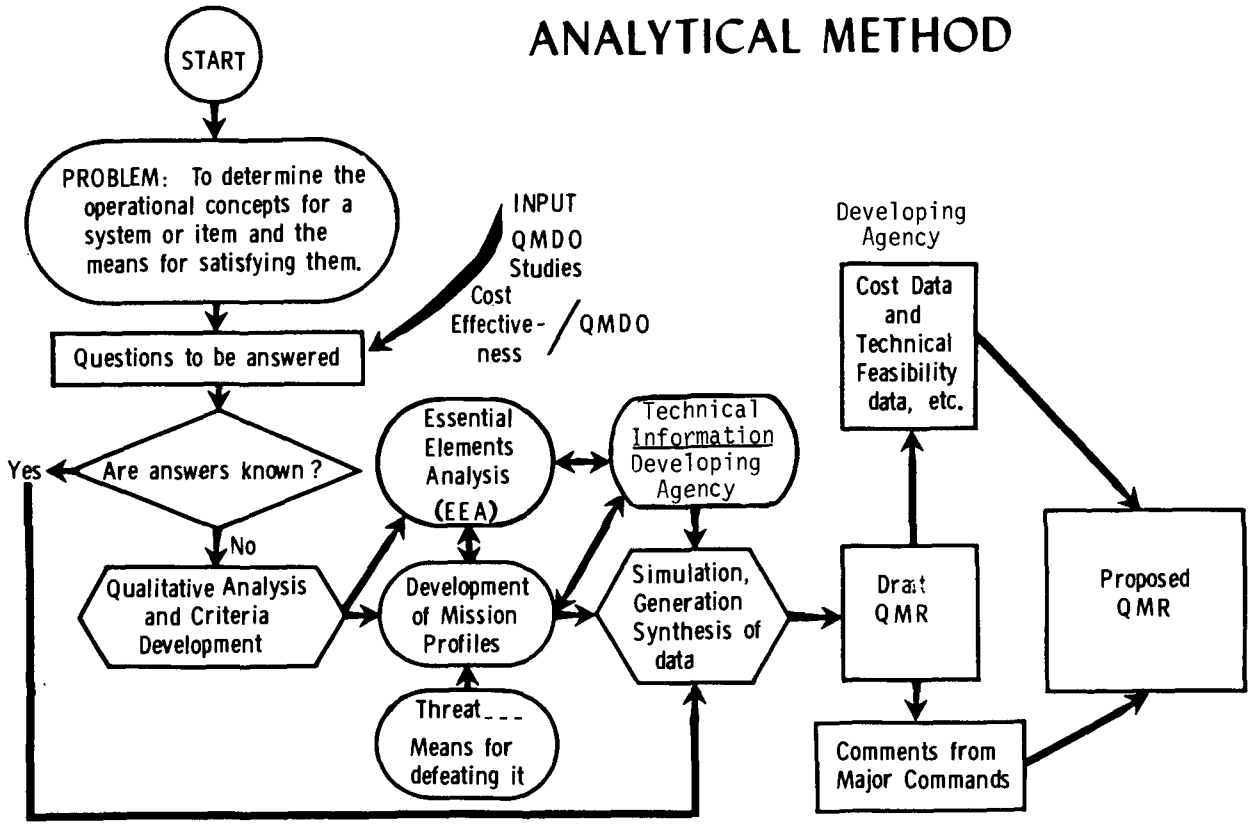


Figure 6–4. Analytical Model.

Department of the Army, which approves, revises, or disapproves the action. Depending on the timing of the submission and the state-of-the-art decision by the Department of the Army, it may be necessary for the Command to realign the Concept Program in order to maintain balanced overall development within the established schedule.

e. All combat development actions are assigned a Combat Developments Command priority consonant with their scheduled completion dates. This priority is also based on the action's relation to the budget cycle and the Five-Year Force Structure and Financial Program; the total manpower and financial requirement involved; the initiator of the action; its operational urgency; and its criticality to the Combat Developments Command Program. The Combat Developments Command uses four priority designations:

(1) *Priority 1* combat development actions are those Department of the Army-directed actions in which the Secretary of the Army, the Chief of Staff, the Vice Chief of Staff, a Deputy Chief of Staff, an Assistant Chief of Staff, or a principal higher level official has stated a personal interest; those which provide essential support to a Program Change Proposal for the fiscal year following the next 1 March; those which support the next budget cycle at the Department of the Army; those approved by Headquarters, Department of the Army or by major subordinate commanders as being basic or critical to the development of an Army Combat Developments Command Army Concept Program; those actions directly supporting

United States elements actively engaged in combat operations; and those supporting actions which are essential to the accomplishment of all the foregoing.

(2) *Priority 2* combat development actions are those Department of the Army-directed actions which are not included in Priority 1 but which are critical to the Army Five-Year Force Structure and Financial Program for other than the next succeeding fiscal year; those which provide essential support to a Program Change Proposal for a fiscal year later than the one following the next 1 March; those actions approved by Headquarters, Department of the Army or by major subordinate commanders as critical to the execution of the Army Combat Developments Command Program but less urgent than those accorded Priority 1 (primarily because of time available for completion) ; and those actions which are approved by Headquarters, Department of the Army or by major subordinate commanders in support of other major commands or agencies.

(3) *Priority 3* combat development actions are those generated by Headquarters, Combat Developments Command, subordinate groups, or agencies, to fill voids in matrix positions in the Army Combat Developments Command Program; and those Department of the Army actions, or actions in support of other major commands or agencies, which are not included in Priorities 1 and 2.

(4) *Priority 4* combat development actions are those generated by Headquarters, Army Combat Developments Command, subordinate groups, or agencies, to update or improve an action which already fills a matrix position in the Army Combat Developments Command Program; and all other combat development actions which are required but which do not fall within a higher priority category.

f. Combat development actions are identified and controlled within the Combat Developments Command by means of the Action Control Record (United States Army Combat Developments Command Form 87–R). Actions are placed in the Combat Developments Command program system as soon as the need for them is recognized. When the action must be initiated, detailed information is developed concerning the scheduled dates of initiation and completion, man-months of professional effort anticipated, costs, and so on. Each new action requires a separate Action Control Record. A new Qualitative Materiel Requirement, for example, might appear twice—once as a proposed Qualitative Materiel Requirement and again as an approved Qualitative Materiel Requirement.

6–11. Studies and Evaluation

a. General. As materiel requirements are defined, they must be validated and refined in terms of technical feasibility, operational effectiveness, total cost, and so on. Special studies are conducted for this purpose, primarily by the Combat Developments Command and the developing agencies.

b. Technical Feasibility Studies. Technical Feasibility Studies normally are required to establish a means of reaching the objective set forth in a Qualitative Materiel Development Objective. They may draw on a variety of research projects and tasks to determine whether the objective is attainable and, if so, by what means. These studies are usually conducted by the developing agencies and are addressed primarily to the major technical barriers identified in the preparation of a Qualitative Materiel Development Objective. Study results are forwarded to the Chief of Research and Development, Combat Developments Command, and using agencies, as appropriate. If a proposed development exceeds the current state of the art, the developing agency is ex-

pected to provide an estimate of the time and effort required to achieve the desired level of performance.

c. Concept Selection Studies. Concept selection studies are conducted for proposed major items or systems to select the most promising technical approach. These studies, a joint responsibility of the Combat Developments Command and the developing agency, are required for all projects designated for Contract Definition (projects involving more than $25 million in research, development, test, and evaluation funding or more than $100 million in production investment).

d. Cost/Effectiveness Studies. Cost/Effectiveness studies are made to determine and justify the best choice among alternative approaches to a given objective. They require an exhaustive analysis of the total cost and overall effectiveness of the alternatives under consideration—either competing systems or different approaches to a single system. Cost considerations include research, development, test, and evaluation; procurement; operation; and maintenance, for the anticipated life of the system, in terms of the number of units involved. Effectiveness considerations include operational characteristics, maintainability, reliability, logistical support, service life, and so on. Studies of cost/effectiveness are often used to support the approach set forth in a proposed Qualitative Materiel Requirement. The Office of the Secretary of Defense requires them for most proposed major developments. They normally are conducted by the Combat Developments Command or the developing agency.

e. Total Feasibility Studies. Total feasibility evaluation is used to assess all aspects of a proposed major development before a commitment is made to that development. These evaluations are usually required in support of a proposed Qualitative Materiel Requirement. They may include, or be based on, a detailed cost/effectiveness analysis as well as other studies of the proposed development. The Assistant Chief of Staff for Force Development is responsible for the assessment of total feasibility, which includes consideration of the following factors:

(1) Technical feasibility, including the capability of supporting the project within foreseeable research, development, test, and evaluation funding levels. This information is provided by the Chief of Research and Development, based on data from the developing agency.

(2) The nature of the threat, where appropriate, and a description of similar enemy equipment and developments, as determined by the Assistant Chief of Staff for Intelligence.

(3) Organizational, doctrinal, and operational implications, as determined by the Assistant Chief of Staff for Force Development.

(4) Acquisition objectives and the capability of procuring and supporting the item within foreseeable funding levels, as determined by the Deputy Chief of Staff for Logistics.

(5) Personnel implications, as determined by the Deputy Chief of Staff for Personnel.

(6) Feasibility of supporting the item within foreseeable Operation and Maintenance, Army, funding levels, as determined by the Comptroller of the Army.

(7) Training requirements, including consideration of new equipment training.

(8) Impact on the Army Force Development Plan.

6–12. Review and Approval

a. Proposed research and development projects and tasks are approved on the basis of their consonance with established objectives, as set forth in the Army Strategic Plan, the Combat Development Objectives Guide, and the Army Force Development Plan. The level of approval depends on the nature of the project, the resources that it entails, and its criticality. Basic and applied research are based on estab-

lished Department of the Army objectives, the Priority Operational Requirements from the Army Strategic Plan, Operational Capability Objectives from the Combat Development Objectives Guide, and approved Qualitative Materiel Development Objectives. The research tasks are outlined in the Army Research Plan which is prepared by the Chief of Research and Development and coordinated within the Army General Staff. Most exploratory development projects are related to a Qualitative Materiel Development Objective. Qualitative Materiel Requirements and Small Development Requirements represent definitive requirements.

b. Proposed Qualitative Materiel Requirements of major importance are reviewed in detail by the Materiel Requirements Review Committee. Review of a Qualitative Materiel Requirement by the Materiel Requirements Review Committee can be recommended by the Chief of Research and Development, the Assistant Chief of Staff for Force Development, or any other interested General Staff agency. The presentation of a Qualitative Materiel Requirement for Materiel Requirements Review Committee review includes a total feasibility evaluation which is prepared by the Assistant Chief of Staff for Force Development. The Materiel Requirements Review Committee consists of seven to eight general officers of the Department of the Army Staff. It includes three designated general officers who are voting members representing the Assistant Chief of Staff for Force Development (chairman), the Chief of Research and Development, and the Deputy Chief of Staff for Logistics; a general officer representative of the Assistant Chief of Staff for Intelligence who serves as a voting member when the Qualitative Materiel Requirement under consideration falls within his responsibility; and four nonvoting members, all general officers, representing the Deputy Chief of Staff for Personnel, the Comptroller of the Army, the Commanding General of the United States Army Materiel Command, and the Commanding General of the United States Army Combat Developments Command.

c. Major development projects (those involving research, development, test, and engineering fundir.g of more than $25 million cumulatively, or production investment of more than $100 million) require approval of the Director of Defense Research and Engineering at the Office of the Secretary of Defense level before they can be initiated. The primary vehicle for Director of Defense Research and Engineering approval is the Technical Development Plan, a comprehensive document which describes the system from beginning to end (the system concept, technical issues to be resolved during development, the management plan [management methods, organizations and so on], the financial plan, schedules, system and subsystem characteristics, plans for reliability and maintainability, configuration management, personnel, training, logistics, facilities, foreign technology, and technical documentation requirements). Upon approval, supplemented by a system of status reporting and change submission, the Technical Development Plan serves as a base line for management and control of the project. (The use of the Technical Development Plan as a control mechanism is discussed in ch 11.)

d. In addition to specific procedures for project approval, the Department of Defense programing system requires the approval of the Secretary of Defense for all new program elements or changes to existing elements above certain thresholds. Major development projects usually constitute new program elements as they move into the advanced or engineering development categories. These projects are automatically included in the review and approval procedure of the programing system, which is discussed in detail in chapter 7.

6–13. Project and Task Assignment

a. Once a proposed materiel objective or requirement has been approved, a responsive project is established in the Army's Research and Development program, and the Chief of Research and Development assigns responsibility for its prosecution to a developing agency. These assignments are governed by the general framework of responsibilities established in appendix I, AR 705–5. Depending on the field

of activity and the nature of the project, the developing agency may have either sole or prime responsibility for the project. Sole responsibility precludes any other agency from conducting research and development in that field. Prime responsibility entails the management of projects involving more than one developing agency. In this case, the associated agencies are designated as having attendant responsibility. Thus, the Chief of Engineers has sole responsibility for nuclear power reactor systems, prime responsibility for electric power generation equipment associated with nuclear reactor systems (the Commanding General, United States Army Materiel Command, has attendant responsibility in this field), and attendant responsibility to the Commanding General, United States Army Materiel Command, for mapping and surveying equipment for the field Army. Normally, of course, the developing agency or agencies involved in a project have been active in the planning and exploration that preceded the statement of the proposed materiel objective or requirement.

b. Along with the assignment of responsibility, the Chief of Research and Development establishes priorities for research and development projects. Priorities are assigned to Qualitative Materiel Development Objectives, Qualitative Materiel Requirements, and Small Development Requirements as follows:

(1) *Priority I*—items of materiel essential to the security of the nation or mandatory for the successful accomplishment of assigned missions.

(2) *Priority II*—items of materiel which will increase, substantially, the combat effectiveness of the future Army or which will provide such a marked improvement over existing items that complete or extensive replacement would be justified.

(3) *Priority III*—additional items of materiel required to complement higher priority items and improve the overall effectiveness of the future Army.

Projects in Priority I have a prior claim on funds and are usually funded before lower-priority projects are considered; they also receive intensive management attention. Project-managed items fall in this category.

6–14. Special Provisions for Nuclear Energy

a. The development and production of nuclear warheads and nuclear components of reactors are assigned by statute to the Atomic Energy Commission. As a result, the establishment of requirements for these items and the management of development projects involving nuclear components depart somewhat from the normal Army procedure.

b. Research on nuclear components is conducted by the Atomic Energy Commission, in coordination with the Department of Defense, which incorporates Department of the Army requirements in its guidance to the Commission. Qualitative Materiel Requirements for nuclear weapons are prepared by the Combat Developments Command and reviewed by the Chief of Research and Development.

c. The Army has complete responsibility within the Department of Defense for development of nuclear reactor systems, exclusive of propulsion and aerospace vehicle applications. The Atomic Energy Commission is responsible for reactor development and the Department of the Army for power conversion equipment. In projects involving nuclear reactor systems, the Combat Developments Command prepares Qualitative Materiel Development Objectives for field equipment and the Chief of Engineers prepares Qualitative Materiel Development Objectives for fixed installations, forwarding them to Headquarters, Department of the Army through the Combat Developments Command. Draft military characteristics are reviewed by the Chief of Research and Development, coordinated with the Navy and Air Force, and submitted to the Director of Defense Research and Engineering for transmission to the Atomic Energy Commission. Qualitative Materiel Requirements and final military characteristics are prepared by the Chief of Engineers and submitted through the Combat Developments Command to Headquarters, Department of the Army for transmission, via the Military Liaison Committee, to the Atomic Energy Commission.

d. To insure safety and reliability, the U.S. Army Materiel Command participates in reviews and analyses of nuclear weapons systems and, within his area of responsibility, makes determinations and certifications regarding safety and reliability before issue of nuclear weapons materiel for troop use. The Chief of Engineers has similar responsibilities for nuclear power reactor systems.

Section IV. INDUSTRY PARTICIPATION

6–15. Information-to-Industry Program

a. General

(1) Much of the creativity and inventiveness upon which the development of Army materiel depends is found in the complex of industrial firms that make up the Defense industry. These firms include both the prime contractors who deal directly with the Army and the other services, and the subcontractors who support the primes by providing subsystems, components, and parts. The relation between the Army and its Defense contractors must be, so far as possible, a cooperative one. To further this objective, the Army must clearly define its needs and problems, and industry must seek solutions to them.

(2) In order to derive the maximum value from the Defense industry's capability and ingenuity, it is important for the Army to provide as much information as possible to industry about its needs and problems, and the direction of its thinking, particularly in scientific and technical areas. At the same time, the Army must retain the greatest possible degree of freedom to test and weigh alternatives, to assess the impact of a particular course of action, and to shift readily from one alternative to another, as strategic and tactical requirements change.

(3) If industry is to respond to the Army's requirements, it must be able to make its plans in consonance with the Army's objectives. Although the Defense industry is accustomed to working within a constantly changing environment, it cannot marshal and direct its resources wisely and intelligently unless it is adequately informed in the planning stage about the Army's needs and objectives. When it is equipped with this kind of information, industry can interact creatively with the Army's planners, scientists, engineers, and managers. It can respond to the Army's thinking, and can indicate its own reaction to the feasibility of specific proposals. It can suggest alternative means of implementation and can appraise the impact of each possible approach. The Chief of Research and Development is responsible for keeping industry informed about requirements, technology, and objectives.

b. Means of Providing Information. The Army clearly recognizes the great potential of industry for providing new concepts and ideas for weapons and equipment. In support of this potential, it has established three principal means of providing research and development assistance to industry. These are conferences, technical and industrial liaison, and provision of documentation. Each of these is discussed below. This discussion is preceded by a review of the nature of industry's need for information from the Army and the basis upon which this information is provided—the "need to know."

c. Need to Know. The exact procedure for keeping industry informed varies, but in general it is governed by the security clearance of the firm and the individual, and by the "need to know." A major barrier to better military-industry relations is the variation of individual interpretation at every level of what constitutes "need to know" and what constitutes proper evidence of justification of this need. AR 380–5 states that the need to know is "a

determination made by the possessor of classified information that a prospective recipient, in the interest of national defense, has a requirement for access to, knowledge of, or possession of the classified information in order to perform tasks or services essential to the fulfillment of a classified contract or program approved by the Department of Defense." Additional statements by the Chief of Research and Development, the Assistant Chief of Staff for Force Development, and the Commanding General, Combat Developments Command, have emphasized that the need to know should be interpreted to include the following criteria:

(1) Firms which have a potential for, and an interest in, the subject matter, rather than restriction to those with current capabilities or Government contracts.

(2) Firms which provide acceptable evidence of a research and development capability in being and, in cases where the organization's area of interest exceeds it capability in being, provision of acceptable evidence of a firm and feasible intent to expand its capability.

(3) When circumstances indicate that the release of the information will tend to assist in the general progress of the Army Research and Development Program.

d. Conferences

(1) *General.* Conferences, as stated above, are one of the three ways in which research and development assistance is provided to industry. Two specific types of conferences involving policy guidance from the Department of Defense—Unclassified and Classified Advanced Planning Briefings to Industry—are particularly important. The intent of these briefings, like other information-to-industry efforts is to tell industry what the Army needs and what it has done, is doing, and intends to do to fulfill these needs. It is hoped that by providing industry with official and authoritative information of this nature, industry will avoid duplication of effort or redundancy, will plan its own in-house efforts properly, and will be completely ready to respond to competitive procurement when the Army requests responses.

(2) *Unclassified Advanced Planning Briefings.* Under the direction of the Department of Defense, the military departments and the Defense Supply Agency join with the Department of Defense to "provide information of industrial interest in Defense contracts." Unclassified Advanced Planning Briefings include speakers from each of the military departments. They afford these speakers an opportunity to discuss broad future requirements and to provide detailed information on such requirements. Among topics which these speakers have discussed at such briefings are the economic impact of the Department's long-range planning on Defense industry; the Department's Five-Year Force Structure and Financial Program; the technological challenge of the next 10 years; management trends in Defense development; and the Defense Cost Reduction Program.

(3) *Classified Advanced Planning Briefings.* These briefings are tailor-made for a specific audience, attendance is on a need-to-know basis, and classified material is authoritative, definitive, and up-to-date. Most of them are conducted by the developing agencies at the commodity command level and cosponsored by industrial associations. Others are conducted by staff agencies of the Department of the Army.

e. Technical and Industrial Liaison.

(1) In the second area of information to industry, the Technical and Industrial Liaison Offices at Headquarters, Department of the Army, and the devel-

oping agencies continually provide comprehensive assistance to industrial planners. These offices brief industry on the Army's research and development policies and procedures, orient it on the Army's needs in each particular area of interest, and inform it of the current state of fulfillment of these needs. They direct representatives of industry to the appropriate project officer with responsibility for developing the type of end item they can produce, thus saving industry and the Army much effort and time in the provision and use of research and development information. The Technical and Industrial Liaison Offices perform the function of librarian, and maintain an index file to make sure that industry knows whom it should see and what the requirement really is.

(2) A review of the procedures used by the Technical and Industrial Liaison Office, Office of the Chief of Research and Development, Department of the Army, will serve as an example. The Technical and Industrial Liaison Office attempts to satisfy industrial planners by showing portions of the Department of the Army research and development planning documents to industry on a specific case-by-case basis. As a rule, an industrial firm applies formally in writing to the Chief of Research and Development, Department of the Army, requesting that the firm be permitted to review Army research and development documents within its areas of capability. In order to make sure that the firm has the capability to satisfy Army requirements, this request or application is accompanied by documentation proving that the firm is a cleared security agency; the representatives of the firm are also cleared; the areas of capability and interest of the firm are considered; and the particular subject of concern in this visit has been incorporated.

(3) After verification of the need to know, a tentative date is given to visit the Technical and Industrial Liaison Office—usually 2 weeks from the date of written application. During this 2-weeks' time, the office reviews pertinent Army research and development planning documents and prepares a comprehensive but selective brochure for this particular industrial division. The brochure contains specific Qualitative Materiel Development Objectives, Qualitative Materiel Requirements, and Small Development Requirements that satisfy the research and development objectives falling within this firm's area of competence and interest; those projects that are programed to satisfy the selected Qualitative Materiel Development Objectives, Qualitative Materiel Requirements, and Small Development Requirements; project data sheets to describe the work being contemplated and accomplished; and, in special cases, portions of Research, Development, Test, and Evaluation Project/Task Cards that describe action of a particular project or task.

(4) This selected compilation, or bibliography, of a particular area enables industry to properly determine factual Department of the Army information upon which to base its Long-Range Research and Development Programs. The documentation furnished industry is for information and review at the Technical and Industrial Liaison Office and is retained under the control of that office. Classified notes may be taken, provided these notes are given the same classification as the materiel to which they pertain, and that they are safeguarded in accordance with current regulations.

(5) It should be emphasized that the information provided to industry by the

Technical and Industrial Liaison Office is Department of the Army information and departmental documents are used. In every case where the action or information is a responsibility or function of a field agency, the industrial firm is directed to that agency. In fact, the basic purpose of the entire effort is to let industry know which Army developing agency has a requirement to be fulfilled, as well as to describe the requirement and its scope and nomenclature.

(6) Firms normally spend one day with the Technical and Industrial Liaison Office before going to the appropriate field agency for detailed information. Most of the industrial representatives are market planners who are trying to determine where their firm should spend their in-house exploratory development money and effort during the next 5 years. The Technical and Industrial Liaison Office, as such, produces no documents, nor does it require any production of documents from other sources. It does, however, use a source Department of the Army planning documents pertaining to research and development. Similar types of actions are continuously being carried out at each level of command under the general premise that industry should deal habitually at the level of the source of information and activity being performed.

f. Documentation.

(1) In the third broad area of effort, that of furnishing documentation to industry, three examples are the Army Research Plan, the Qualitative Development Requirements Information Program, and the Research and Development Unfunded Study Program.

(2) *The Army Research Plan* is provided to industry on a need-to-know basis. This plan is guidance to insure adequate support of basic research and of those elements of the Research and Exploratory Development categories that are responsive to the long-range concepts and materiel objectives for the Army of the future. It also provides broad program direction and guidance in the various disciplines to working scientists and administrators in the Army's scientific establishment. The Army Research Plan therefore provides definitive guidance for the conduct of the basic research and early exploratory efforts of the Army.

(3) *The Qualitative Development Requirements Information Program* was approved by the Department of the Army as a measure to provide industry with Army Research and Development needs in areas which the Army has been unable to achieve significant breakthrough, and which, if properly solved by industry, would be received by the Army as unsolicited industry proposals.

(*a*) This program was instituted by the Army Materiel Command in 1965 and is currently being reviewed by the other developing agencies for participation. It is designed to present Army materiel objectives and needs to an extremely wide audience. By means of this program, the Army aids industry in formulating its research aims and maximizes the potential for response. The Qualitative Development Requirements Information Program involves the preparation, continual updating, and ultimate distribution of a series of eight volumes that deal with Army materiel needs and objectives. One volume is devoted to each of the five materiel areas of the commodity commands (for instance, the Missile Command). The next two volumes deal with the areas in which the Test and Evaluation Command and the Army Materiel Command laboratories are interested. The remaining volume is

a guide for the management of the Qualitative Development Requirements Information Program by the Army Materiel Command Qualitative Development Requirements Information Managers.

(*b*) Each volume contains individual descriptions, known as Qualitative Development Requirements Information, of particular Army needs or wants. A Qualitative Development Requirements Information covers the problem and states the objective, as well as operational and organizational concepts, when possible; it gives general background, including possible approaches, references, and activity in the field; and it identifies the project engineer concerned and the manager responsible for actions connected with the Qualitative Development Requirements Information. The material contents of a Qualitative Development Requirements Information are largely derived from the Combat Developments Objectives Guide, Army plans and guidance documents, and past activities of the developing agency. Although it does not quote or abstract Qualitative Materiel Development Objectives or Qualitative Materiel Requirements, a Qualitative Development Requirements Information covers its subject in sufficient detail to allow industry responses to be guided by true Army needs.

(*c*) Qualitative Development Requirements Information problems or subjects fall into four broad categories. A *major project requirement* concerns a system or major subsystem that is nearing the Engineering Development stage. A *task requirement* represents a part or component of a major project requirement. For example, problems connected with a target detection device might be a task requirement, while a project requirement might include the entire fire control system. *Classified problems* and *unclassified problems* are less specific; they identify problems that the Army would like solved, although particular developments or systems do not depend upon such solutions. These problems are similar in nature, but the first one does not involve security restrictions. The desire for a long-life, rough-service light bulb for vehicular use is illustrative of such problems.

(*d*) Every center or installation within the Army Materiel Command that prepares these requirements and evaluates responses to them has a designated Qualitative Development Requirements Information manager in its research and development group. It is his job to coordinate and control preparation and distribution of Qualitative Development Requirements guides or problems. He works with the procurement offices in qualifying the firms that wish to participate in the program, and handles the submissions received in response to Qualitative Development Requirements Information that has been distributed to the industrial community. The process of qualifying organizations to receive Qualitative Development Requirements Information is the first step in their distribution. Firms, organizations, and individuals who wish to participate in the Qualitative Development Requirements Information Program register with the cognizant Commodity Command Qualitative Development Requirements Information Manager, indicating on prescribed forms their fields of interest (by technol-

ogy) and spheres of interest (basic research, applied research, and so on). A determination is made as to the ability of the organization to be of service to the Army Research and Development Program. A basic consideration in making this determination is the relationship between the Army's areas of interest and the organization's facilities, resources, experience, and so forth. Once firms are qualified, they are registered in a central Army Materiel Command data bank for fields and spheres of interest. As an individual Qualitative Development Requirements Information is prepared for distribution, the Qualitative Development Requirements Information Manager may obtain from the Qualitative Development Requirements Information data bank a list of qualified firms in the areas concerned. For example, Qualitative Development Requirements Information prepared by the Army Tank and Automotive Center (of the Mobility Command) might deal with vehicular problems, and would be disseminated to qualified firms in the automotive industry. The actual distribution of the Qualitative Development Requirements Information may be made by briefings, interviews, or a written or published problem.

(*e*) Within 90 days of the Qualitative Development Requirements Information's issuance, participating firms are required to report whether they believe they can provide solutions to the problem it describes. If the answer is affirmative, the organization will furnish a technical report when it has achieved a solution to the problem. If the firm chooses to include a research and development proposal in the technical report, it will be treated as an unsolicited research and development proposal, and will be evaluated and processed accordingly. Responses to Qualitative Development Requirements Information are received by the Qualitative Development Requirements Information Manager. He is responsible for seeing that proper evaluation and disposition are undertaken, including any necessary coordination with the Combat Developments Command and Army Staff.

(4) *The Research and Development Unfunded Study Program.*

(*a*) The basic objective of this program is the same as the Qualitative Development Requirements Information Program—to maximize potential industrial contribution to Army materiel needs by furnishing industry with information concerning requirements and objectives. However, the implementation of this program is directed to specific organizations, rather than to industry in general. Under the overall cognizance of the Chief of Research and Development, developing agencies (particularly the Army Materiel Command) execute agreements with individual civilian organizations for the conduct of unfunded studies in particular materiel areas. These agreements make available pertinent Army documents and information and provide for contacts with Army personnel who can aid the civilian organization in understanding the Army needs and objectives further. Unfunded studies are carried on at no cost to the Government, and competition is not limited on any procurements that may ultimately arise from them. However, such agreements give the civilian organization extensive access to information that otherwise would not be available to it. This in-

formation may enable it to improve its own capabilities and competitive position significantly, while at the same time appreciably increasing the usefulness of civilian industry efforts to the Army.

(*b*) Developing agencies are responsible for determining the validity of civilian organizations' requests to participate in this program, and, in conjunction with other interested commands, for evaluating the potential benefits to the Army. Primary considerations in this determination and evaluation are Army materiel objectives in the proposed area and the competence of the civilian organization to pursue them. The Chief of Research and Development provides guidance and policy decisions where necessary. Copies of executed formal agreements are distributed to the Army Materiel Command, Combat Developments Command, and other interested parties within the Army. Once studies are under way, the developing agency concerned continues to be responsible for followup activities. It distributes study reports to the Army Materiel Command, the Combat Developments Command, and so forth; if appropriate, it also makes recommendations to the Combat Developments Command for new Qualitative Materiel Development Objectives, Qualitative Materiel Requirements, or other changes or additions to operations or organizational concepts.

6–16. Unsolicited Proposals

a. The Role of Industry. Most of the Army's basic and applied research activities are conducted in-house by the laboratories and centers of development agencies. However, as exploratory and advanced development efforts responsive to Qualitative Materiel Development Objectives begin, more and more research and development effort is performed under contract with industry. In fact, industry pursues the large majority of Army research and development projects in engineering development carried out in response to Qualitative Materiel Requirements and Small Development Requirements. Because of this heavy involvement in materiel development, industry and other nongovernmental sources are often in a position to propose new concepts or ideas based on prior technological efforts. Encouraging and exploiting this source of knowledge is very much in the Army's interest.

b. Army Policy. One of the ways in which industry may present its ideas to the Army is the unsolicited proposal. This is generally defined as a proposal for research and development made without prior formal or informal solicitation from a purchasing activity. Policy with respect to such proposals is quite clear. First, the Army must refrain from making known to third parties any proprietary information contained in a proposal. Second, the proposal must be handled in a manner that will encourage industry to continue disclosing ideas that may be of benefit to the Army.

c. Procedures.

(1) The Army's procedures in regard to unsolicited proposals are aimed at meeting these policy objectives. The proposals are usually received by the developing agencies or their subordinate commands, which evaluate the technical and developmental aspects involved. If a proposal is responsive to already established needs (for example, a Qualitative Materiel Development Objective, Qualitative Materiel Requirement, or Small Development Requirement), a developing agency may choose either to pursue it contractually with available funds, or to request funds for a new research, development, test, and evaluation project. If the proposals suggest new objectives or requirements, the Combat Developments Command, the Chief of

Research and Development, and the developing agency will examine the desirability of establishing new objectives or requirements. If the Army decides to pursue an unsolicited proposal, contracts are generally negotiated on a sole-source basis.

(2) Although this practice departs from the competitive method normally followed in Army procurement, it is necessary since any other approach might discourage individual contractors from submitting their ideas. Many of these ideas have substantial military value, and it is important that the Army maintain access to them.

(3) Several considerations are involved in the proper handling of unsolicited proposals. As suggested above, the first requirement is a total appraisal of the idea or concept in terms of technical merit, probability of success, cost, ultimate usefulness, and so forth. The developing agency, the Combat Developments Command, and the Chief of Research and Development may all play a role in this evaluation. If the idea or concept is endorsed, it must be determined first whether the proposal is, in fact, unsolicited. A proposal merely submitted in advance of the Army date for general solicitations, or a restatement and amplification of existing requirements, should not be considered proprietary, and normal competitive procedures should be used. If the proposal is unsolicited *and* proprietary, sole-source negotiations are both justified and desirable.

(4) Another major consideration involves the content of the proposal. Even though the ideas contained in the proposal may have been independently conceived by the contractor, they may not be sufficiently developed to justify award of a sole-source contract. In short, the proposal may warrant active pursuit of an idea, but may not be adequately developed. The situation here is analogous to a competitive procurement where a bidder suggests ideas of interest but does not develop them sufficiently to warrant serious consideration. One other important consideration in Government policy toward unsolicited proposals should be noted: if a sole-source award is made, the Government's resulting rights in data, patents, and so forth, should be clearly established to insure that future procurements will be handled on a competitive basis.

Section V. HARMONIZATION OF QUALITATIVE REQUIREMENTS

6–17. Harmonization in the Department of Defense

a. It is Department of Defense policy to cooperate with the allies of the United States in harmonizing qualitative requirements for materiel and in undertaking cooperative research and development programs for new materiel. The prime purpose of this policy is to make the best possible equipment available on a timely basis to the United States and its allies. It is aimed at making the most efficient use of available development resources and at increasing the standardization and interoperability of materiel.

b. The harmonization policy of the Department of Defense is carried out through two complementary programs: Harmonization, and Cooperative Research and Development. Both programs are conducted through the military departments under bilateral or multilateral agreements with the participating nations.

6–18. The Army Harmonization Program

a. The Army's Harmonization Program coordinates the needs of the United States with

those of its allies within the scope of the Army's mission, in order to minimize differences and thus form a basis for cooperative research and development and standardization of materiel. The program is designed to adjust differences or inconsistencies in the basic qualitative military requirements of the United States and its allies. As the general aim of this program implies, comparatively minor differences in requirements should not be permitted to serve as the basis for undertaking duplicative projects. Facilitating cooperative research and development is of major significance in this program. Equally important is the enhancement of interoperability and interchangeability of equipment between the United States and its allies. Such standardization improves the utility and effectiveness of materiel in the field; it also increases the effectiveness of international logistics. It is particularly important to effect harmonization early in the development cycle, before requirements on either side are frozen to a degree that would render it impossible.

b. The Cooperative Research and Development Program under the staff responsibility of the Chief of Research and Development with coordination of the Assistant Chief of Staff for Force Development provides for joint efforts with our allies in developing materiel to meet common needs. A significant example of this type of activity is the joint development by the United States and the Federal Republic of Germany of the new main battle tank. This project, under a United States-German program board, involves research and development efforts in both countries. Cooperative research and development projects are restricted to those that are responsive to specific needs of the Army. Exceptions may be made to this policy if Military Assistance Program funds are used. With the exception of Military Assistance Program projects, all cooperative efforts are funded by Army Research, Development, Test, and Evaluation appropriations.

c. The Assistant Chief of Staff for Force Development has primary staff responsibility for the overall Harmonization Program in the Department of the Army, with the following specific responsibilities:

(1) Assure coordination of policies and procedures.

(2) Promote harmonization of military requirements of the United States and allied armies by early discussions on rationale for tactical concepts and roles and missions, including harmonization of requirements for materiel in being.

(3) Provide the Department of the Army contact point for the Office, Secretary of Defense, the military departments, and other governmental agencies for the purpose of coordinating standardization aspects of related programs and activities.

(4) Maintain primary Department of the Army liaison with international military standardization agencies.

(5) Keep the Chief of Staff and Army Staff informed on major matters involving international military standardization programs and standardization aspects of related programs and activities.

(6) Assure fulfillment of standardization agreements to which the Department of the Army subscribes, maintain the office of record for agreements, and as required, provide support and representation in international meetings, studies, and projects.

(7) Supervise Department of the Army participation in combat development, nonmateriel, procedural, and technical aspects of the American-British-Canadian-Australian armies' standardization program, to include conducting arms conferences.

d. The Chief of Research and Development has primary staff responsibility for activities involving research and development, including the following specific responsibilities:

(1) Act as executive agent for the Army Staff for supervising and coordinating Department of the Army participation in the American-British-Canadian-

(2) Coordinate the international standardization aspects of research and development programs with the Office, Assistant Chief of Staff for Force Development.

(3) Coordinate harmonization of military requirements of the United States and allied armies for materiel to be developed.

(4) Coordinate negotiations for cooperative research and development projects and information exchanges with allies under approved international programs.

e. At the field command level, the implementation of the Army's Harmonization Program rests with the developing agencies (principally the Army Materiel Command) and the Combat Developments Command. The appropriate developing agency monitors research and development projects prosecuted by foreign countries to fulfill United States Army requirements, so that duplication with United States efforts is avoided. The Combat Developments Command maintains liaison with the combat development agencies of allied nations and monitors both their cooperative and their internal programs. This liaison makes it possible to take advantage of foreign combat developments, thereby improving harmonization with United States materiel. As part of this program, the Combat Developments Command transmits copies of proposed Army Qualitative Materiel Requirements to our allies for consideration and coordination in the formulation of their requirements. In the area of combat developments, the Command recommends the United States Army position on policy and doctrine statements of allied armies and on international standardization agreements in which the United States participates. The Combat Developments Command also acts to integrate international combat development activities into its study programs.

CHAPTER 7

PROGRAMING AND BUDGETING

Section I. THE DEPARTMENT OF DEFENSE PROGRAMING SYSTEM

7–1. Objectives of the System

a. Planning, programing, and budgeting are the three basic processes by which the Defense Establishment determines its objectives and controls the resources necessary to meet them. Programing is the intermediate step between planning and budgeting; it is the process of relating means (resources) to ends (objectives) in terms of specific military missions or activities within a given period of time.

b. The programing system instituted by the Secretary of Defense in 1961 makes it possible to determine, across service lines, the total application of resources to specific military missions, and the total resource requirements for a specific mission over a period of years. It classifies military activities in terms of their missions, rather than the service of origin, and it identifies the resources required for those activities over a 5-year period. It provides for planning and control of major programs at the highest level of the Department of Defense, including the comparison of alternative means of accomplishing a given mission, as well as analysis of the long-range implications of alternative decisions.

7–2. Program Structure

a. The Programing System structure consists of eight mission-oriented or task-oriented programs, within which related forces or activities of all three services are grouped together. The programs are related to resources over a 5-year period by means of the Five-Year Force Structure and Financial Program. The annual military budget is a 1-year segment of this program.

b. The eight major programs of the Defense Establishment are as follows:

I. Strategic Retaliatory Forces
II. Continental Air and Missile Defense Forces
III. General Purpose Forces
IV. Airlift and Sealift Forces
V. Reserve and Guard Forces
VI. Research and Development
VII. General Support
VIII. Military Assistance Program (Department of State program implemented by the Secretary of Defense)

c. These programs are subdivided into major and minor aggregations and within the aggregations into program elements. Program III, for example, includes such major aggregations as Army Forces, Europe; Army Forces, Pacific; and Army Forces, Alaska. One of the aggregations in Army Forces, Alaska, is Combatant Forces, and one of the program elements in this aggregation is Nike-Hercules battalions.

d. The program elements are the smallest units of military activity managed at the Department of Defense level. A program element may be a single weapon system—like the Nike–X missile in Program VI (Research and Development)—or it may represent an aggregation of men, equipment, and facilities—like the Nike-Hercules battalions in Alaska in Program III (General Purpose Forces).

e. In Program VI, Research and Development, the bulk of the projects and tasks are subordinate parts of the program elements. For example, in the first major aggregation of

Program VI—Research—the Army and the other services have only two program elements (In-House Laboratory Independent Research and Defense Research Sciences) that embrace all research projects and tasks. On the other hand, most major development projects are identified as separate program elements, particularly in the engineering development phase. The Army's Engineering Development Program includes more than forty program elements ranging from broad categories such as Tactical Communications and Wheeled Vehicles to individual systems such as the Advanced Fire Support System.

7–3. Program Change Control

a. In order to keep the defense program responsive to current needs and, at the same time, to maintain control over significant changes in the program, the Department of Defense Programing System includes a rigorous procedure for introducing changes. This procedure specifies limits, or thresholds, beyond which changes may not be made without prior approval at a designated level of authority.

b. The mechanism for introducing major changes in the Five-Year Force Structure and Financial Program is the Program Change Proposal. The thresholds for submission of Program Change Proposals vary with the type of activity. For example, any new program element in Program VI, regardless of cost must be approved by the Secretary of Defense. Approval also must be obtained for any change (increase or decrease) in an existing program element involving more than $10 million in the first program year or $25 million in total program cost. In addition, a Program Change Proposal must be submitted on any Research and Development program element, regardless of cost, when the issue is of such importance that the Director of Defense Research and Engineering directs use of the program change procedure.

c. In addition to changes in the Five-Year Force Structure and Financial Program, it is possible to reprogram funds and manpower within the resources approved by Congress for the current year. There are, however, limitations on reprograming authority. For Research, Development, Test, and Evaluation, prior approval of the Office of the Secretary of Defense (and in some cases Congress) is required for—

(1) Any increase of $2 million or more to a program element.

(2) Initiation of an element which will cost $10 million or more over a 3-year period.

(3) Increasing funding on an element specifically ordered by Congressional action.

(4) Increased funding on a program element in which any Congressional Committee has expressed "special interest."

The above limitations effectively limit Department of the Army to increases of less than $2 million in a single program element. To the maximum extent possible this authority is delegated by Department of the Army to the developing agencies.

7–4. The Relation of Planning, Programing, and Budgeting

The relation that exists among the planning, programing, and budgeting processes can be visualized as a three-dimensional matrix, made up of inputs, outputs, and time periods (fig. 7–1). The basic "output" of the Defense Establishment is the force structure, which is determined by the planning process described in chapter 5. The resources required to support it are the "inputs" provided by Congress through the appropriation of funds. These funds are provided annually in appropriation categories such as Procurement of Equipment and Missiles, Army, and Military Construction, Army. The Five-Year Force Structure and Financial Program integrates the inputs and outputs by relating resources to the force structure over a 5-year period. By this means, discrete program elements can be matched with discrete blocks of programed funds, and the full cost implications of various

plans can be derived. This system provides for effective forecasting and control of Department of Defense activities. It also permits precise evaluation of the effects of proposed changes to Department of Defense plans.

THE PLANNING, PROGRAMING, AND BUDGETING MATRIX

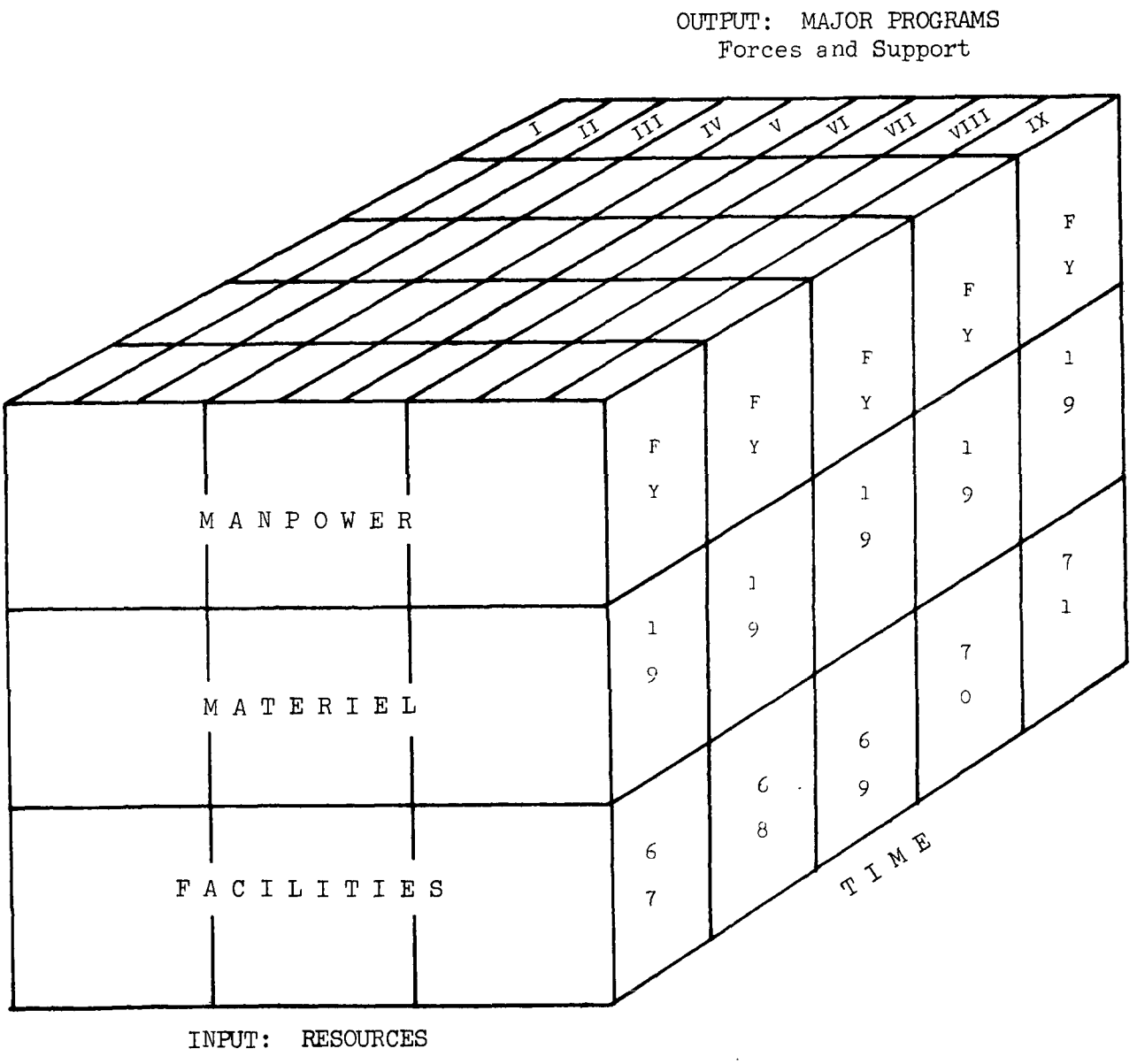


Figure 7–1. The Planning, Programing, and Budgeting Matrix.

Section II. THE RESEARCH AND DEVELOPMENT PROGRAM STRUCTURE

7–5. General

a. As noted above, Program VI, Research and Development, is the major program under which the Army's materiel development effort is conducted. All activity in Program VI is included in six major Research and Development categories as follows:

6.11 Research
6.21 Exploratory Development
6.31 Advanced Development
6.41 Engineering Development
6.51 Management and Support
6.71 Operational Systems Development

The numerical coding system is described in *c* below. In general, these groupings represent a chronological progression from very early research up to the point at which an item of materiel is approved for production and deployment. Once an item is designated for production and deployment, it becomes identified with another major program of the Five-Year Force Structure and Financial Program and is no longer included in Program VI.

b. The major Research and Development categories are further divided into minor aggregations (usually representing some broad functional application of the materiel or the research effort) and then into program elements. In the latter phases of development, program elements may be identifiable systems, such as a missile system or a tank system. Because the major categories are all arranged chronologically, the titles of their minor categories and program elements tend to resemble one another. For example, "Aircraft Suppressive Fire" appears as a program element in Exploratory Development, Advanced Development, and Engineering Development; in the last category, it is one of several program elements in the minor category of "Air Mobility."

c. The numerical coding system for identification of program elements is based on an eight-digit structure. The Program Element Code is arranged in five levels, as shown in figure 7–2. In Program VI, Research and Development, the second digit of Level 2 identifies the Department of Defense component responsible for the program element. In Program 6.41, Engineering Development, Army, one of the aggregations is 6.41.30, Surface Mobility. The program elements in this category include the following:

6.41.30.03.1 Power Systems and Converters
6.41.30.06.1 Wheeled Vehicles
6.41.30.09.1 Track and Special Vehicles
6.41.30.12.1 Marine Craft

7–6. Program Categories

The Research and Development Program categories are defined as follows:

a. Research. This category includes all effort directed toward increased knowledge of natural phenomena and environment, and efforts directed toward the solution of problems in the physical, behavioral, and social sciences that have no clear direct military application. By definition, therefore, it would include all basic research and any applied research that is directed toward the expansion of knowledge in various scientific areas. It would not include efforts to prove the feasibility of solutions to problems of immediate military importance or time-oriented investigations and developments. Work in this category is most frequently done either in Government laboratories, under grants to universities, or under cost-reimbursement contracts. The practice is to manage this work on a level-of-effort basis, by scientific area, and to encourage latitude by delegating the selection of projects to the lowest appropriate management echelon.

b. Exploratory Development. Exploratory Development includes all effort directed toward the solution of specific military problems, short of major development projects. This type of effort may vary from fairly fundamental applied research to relatively sophisticated breadboard hardware, study, programing, and planning efforts. It therefore includes studies, investigations, and minor development effort. The dominant characteristic of this category

PROGRAM ELEMENT CODE STRUCTURE

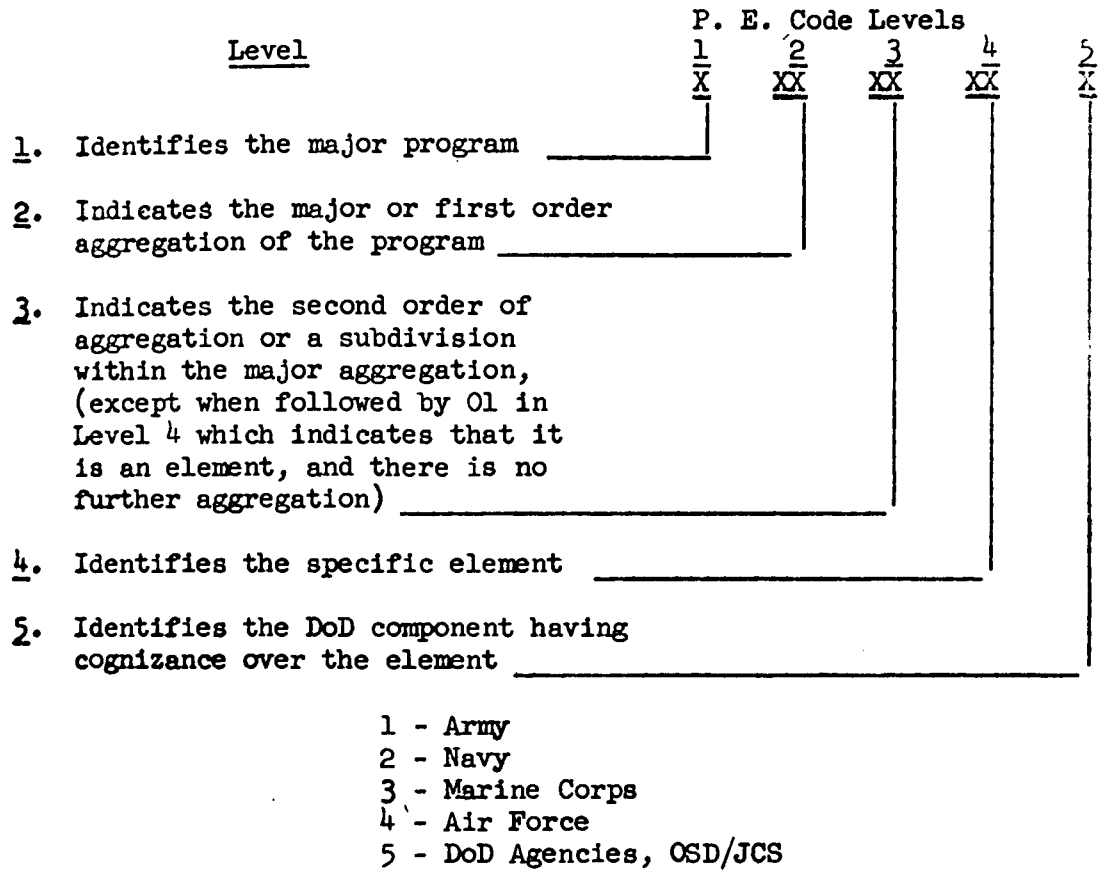


Figure 7–2. Program Element Code Structure.

is that it is focused on specific military problem areas with a view toward developing and evaluating the feasibility and practicability of proposed solutions, and determining their parameters. This exploration may include, in selected cases of low technical risk, the study work necessary to provide the precise definition required for possible direct entry into Engineering Development. As in Research, the practice is to manage on a level-of-effort basis by technological area, and to encourage latitude by delegating selection of individual projects. Contracts normally are performed on a cost plus fixed fee basis.

c. Advanced Development. This category includes all projects that have moved into the development of hardware for experimental or operational test. This phase is characterized by the development of specific hardware for suitability test and evaluation, but not for procurement and service inventory. Effort within a project in this category may include resources to advance technology as demanded by the particular system. This category continues the study to provide the definition required for Engineering Development. Efforts within Advanced Development are managed project by project. Contractual effort is ordinarily covered by incentive contracts.

d. Engineering Development. The primary objective of this category is design engineering for service test and for possible service inventory. The category includes Engineering Development on systems and equipment; it also includes subsystems that are governed by one or more system end uses. For instance, a new avionics system for an aircraft in operational use could be identified as a separate Engineering Development. Effort is managed project by project, and contracts for engineering development work are usually awarded on a fixed price or incentive basis.

e. Management and Support. This category includes research and development effort directed toward support of the installations or operations required for general research and development use. It includes test ranges, certain military construction, maintenance support of laboratories, and operations and maintenance of test aircraft and ships. Costs of laboratory personnel, either in-house or contract-operated, are assigned to appropriate projects or as a line item in the Research, Exploratory Development, or Advanced Development categories, as appropriate. Military construction costs directly related to a major development program are included in the appropriate element for that program.

f. Operational System Developments. Included in this category are research and development efforts directed toward development, engineering, and test of systems, support programs, vehicles, and weapons that have been approved for production and service deployments. It includes that effort needed to convert the design engineering products of Engineering Development into fully "productionized" systems and equipment. This category is primarily a memorandum account covering research, development, test, and evaluation funds that are actually expended in other major programs, and is included in Program VI for convenience of program control. Research, development, test, and evaluation costs of these operational systems are distributed in many program elements in Programs II, III, and VII. Only through a grouping of funds in this category could any semblance of control be exercised.

7–7. Relationship of the Categories

a. Research and Exploratory Development. In the phases represented by these two program categories, no constraints are placed on the extent of scientific and technological advancement to be achieved. The high level of advancement desired, and the requisite high level of creativity, causes high inherent technical risks with an expected high potential for failure. This work frequently requires long-term continuity without deadlines. A high level of activity is essential in these fields, and duplicate efforts are frequently desirable. A good deal of work in Exploratory Development is responsive to Qualitative Materiel Development Objectives which may suggest both general performance objectives and desired timing. In many instances, exploratory development work in response to a Qualitative Materiel Development Objective is duplicative, with two or more parallel efforts directed at the same objective.

b. Advanced Development. This is also considered a high-risk area because it is impossible to predict the degree of success in technological advancement or operational and technical suitability at this stage. Hence there is frequently need for multiple developments, accompanied by a high rate of attrition, until the approach or approaches most suitable to enter future engineering development are selected.

c. Engineering and Operational Systems Development. During these stages, technological advance is expected to be limited to that which has been demonstrated, either in the laboratory or in other experimental form. Although the technical risk is reduced, some risk is inherent in the assumption that quantitative laboratory results can be engineered into final equipment.

d. Summary. In terms of purpose and progression, Research represents basic knowledge; Exploratory Development and Advanced Development are building-block categories; and Engineering Development and Operational Systems Development are concerned with new sys-

tems or new hardware for field usage. Although all work should in some way be oriented toward a useful military application, the ideas or natural phenomena being explored during Research may not be clearly identifiable with a Qualitative Materiel Development Objective until the Advanced Development stage. The usefulness of these categories as a means of identifying status and effort is obvious. However, it must be recognized that this is merely one form of Department of Defense program control, and that congressional appropriations for research and development continue to be made on the basis of the conventional commodity programs of the Research, Development, Test, and Evaluation budget. The interrelationship of the budget activities and the six Research and Development categories is described in the AR 37–100-series, the Army Management Structure (Fiscal Code), chapter 7, Research, Development, Test, and Evaluation, Army.

Section III. THE ARMY PROGRAM SYSTEM

7–8. Army Five-Year Force Structure and Financial Program

a. The structure of the Army's Five-Year Force Structure and Financial Program parallels the Department of Defense program structure. It includes approximately three hundred program elements in six of the major programs:

II. Continental Air and Missile Defense Forces
III. General Purpose Forces
IV. Airlift and Sealift Forces
V. Reserve and Guard Forces
VI. Research and Development
VII. General Support

The Army has no forces or activities in Program I (Strategic Retaliatory Forces). Program VIII (Military Assistance) is centrally controlled through the Secretary of Defense.

b. The initiation of changes in the Army program is closely coordinated with the Army Force Development Plan, discussed in chapter 5. This plan provides essential guidance on capabilities and objectives.

c. Like the Department of Defense program, the Army Five-Year Force Structure and Financial Program includes annexes that contain detailed information on certain aspects of the program. The Materiel Annex is the most significant of these annexes for the management of materiel development. In addition to detailed information on items in production and development, the Materiel Annex includes data on requirements, costs, and other aspects of selected major research and development projects.

7–9. Progress Reporting

a. The Secretary of Defense has designated certain major projects and systems in the Department of Defense program for special reporting. Monthly progress reports are required for these items, indicating their status in relation to milestones agreed to by the Army and the Office of the Secretary of Defense. The monthly progress reports cover the current month and the 3 months following. These reports are related to the project plan, on the basis of which the initiation of the project was approved. For major projects, this is a Technical Development Plan; for others, it is the Research and Technology Resume (DD Form 1498).

b. As a part of the program reporting system, the Army has designated a Department of the Army System Staff Officer for each selected item. For most projects, this officer is a member of the staff of the Assistant Chief of Staff for Force Development. He develops and maintains milestone schedules and progress reports for his assigned item. He also serves as a source of information on the item for the Chief of Staff, the Secretary of the Army, other members of the Army Staff, and representatives of the Office of the Secretary of Defense. He complements and supplements the project manager

by coordinating and integrating information on the materiel development effort and related work, such as the development of doctrine and the training of personnel.

Section IV. BUDGET FORMULATION AND EXECUTION

7–10. The Budget Cycle

a. The annual budget is the instrument by which Congress reviews the programs of the Army and other elements of the executive branch of the Government, and appropriates necessary funds. Congressional action on each annual budget is preceded by a 12-month period of budget formulation, and is followed by the period of budget execution specified in the appropriation legislation. Certain appropriations, such as "Research, Development, Test, and Evaluation, Army," "Procurement of Equipment and Missiles, Army, and Military Construction, Army" are no-year appropriations, which are established for the duration of the projects or work programs for which the funding is made available. Other appropriations, such as "Operations and Maintenance, Army" are 1-year appropriations, and as such the budget obligation period is limited to the single fiscal year for which the funds are made available.

b. Budget formulation begins with the issuance of guidance by the Secretary of Defense, which is based on the approved Five-Year Force Structure and Financial Program and on guidance from the President (through the Bureau of the Budget). The guidance from the Secretary is issued approximately 18 months before the budget year in question; thus, budget formulation for Fiscal Year 1970 would begin in January 1968. This guidance is further elaborated at the Army and major command levels. The major commands draw information from subordinate levels and prepare and submit budget estimates to Headquarters, where they are reviewed and integrated into a single Army budget estimate under the direction of the Comptroller of the Army. This departmental estimate is submitted, through the Chief of Staff and the Secretary of the Army, to the Secretary of Defense, who submits it to the President. The President presents the national budget to Congress in January. Congress reviews the budget at appropriation hearings during winter and spring, with the objective of completing the appropriation process before the beginning of the fiscal year in July.

c. During the latter stages of budget formulation, the Bureau of the Budget plays an active role in adjusting and reconciling the estimates of the many agencies and departments of the executive branch. Throughout the formulation period, adjustments and reestimates must be made, as successively higher levels of authority integrate the estimates of subordinate elements to conform with the guidance provided at intervals by the Bureau of the Budget, the Office of the Secretary of Defense, and the Department of the Army.

d. During congressional review, Department of Defense and Department of the Army representatives furnish information and justification on the program and budget to the Armed Services and Appropriations Committees of both the House of Representatives and the Senate.

e. Budget execution phase begins with the submission of the President's budget to Congress. This phase is concerned with obtaining appropriations from Congress and obligation authority from the Department of Defense and the Bureau of the Budget, and with the control of funds to meet the approved objectives. In recent years execution has begun using a Congressional joint resolution authorizing obligational authority. Following congressional appropriation of funds, the Bureau of the Budget and the Office of the Secretary of Defense hold joint apportionment hearings. Apportionment—the first level of the funds distribution process—is made after these hearings. The services, in turn, distribute the apportioned funds by allocating them to subordinate commands and agencies. Their subordinate com-

mands allot and suballot funds to lower level commands, installations, and agencies.

f. The process of developing the Fiscal Year 1970 budget and carrying it to the point where the agencies charged with materiel development have funds to carry out their responsibilities is shown in figure 7–3. This summary indicates why the period of budget formulation is a relatively long one. In order to have the President's budget ready for presentation to Congress in January, department and agency budgets must be integrated in a single coherent document. Therefore the Defense budget, along with those of the other departments, must be completed by late fall of each year. To allow time for internal integration of the Defense budget submission, the services' estimates must be ready by late summer or early fall. During the internal integration process, the activities and requirements of the subordinate commands and agencies must be analyzed and coordinated in minute detail. The complexity of the whole process, involving repeated adjustments and reestimates at successively higher levels that embrace larger and larger aggregations of activity, makes the entire period of budget formulation (especially the last few months) one of exacting, intensive activity.

7–11. The Budget Structure

a. The Army budget comprises eleven appropriation categories, to which the related accounting and control system is keyed. These categories identify functional areas of expenditure, such as research and development, procurement of materiel, and construction. The four categories most significantly related to the materiel development process are the following:

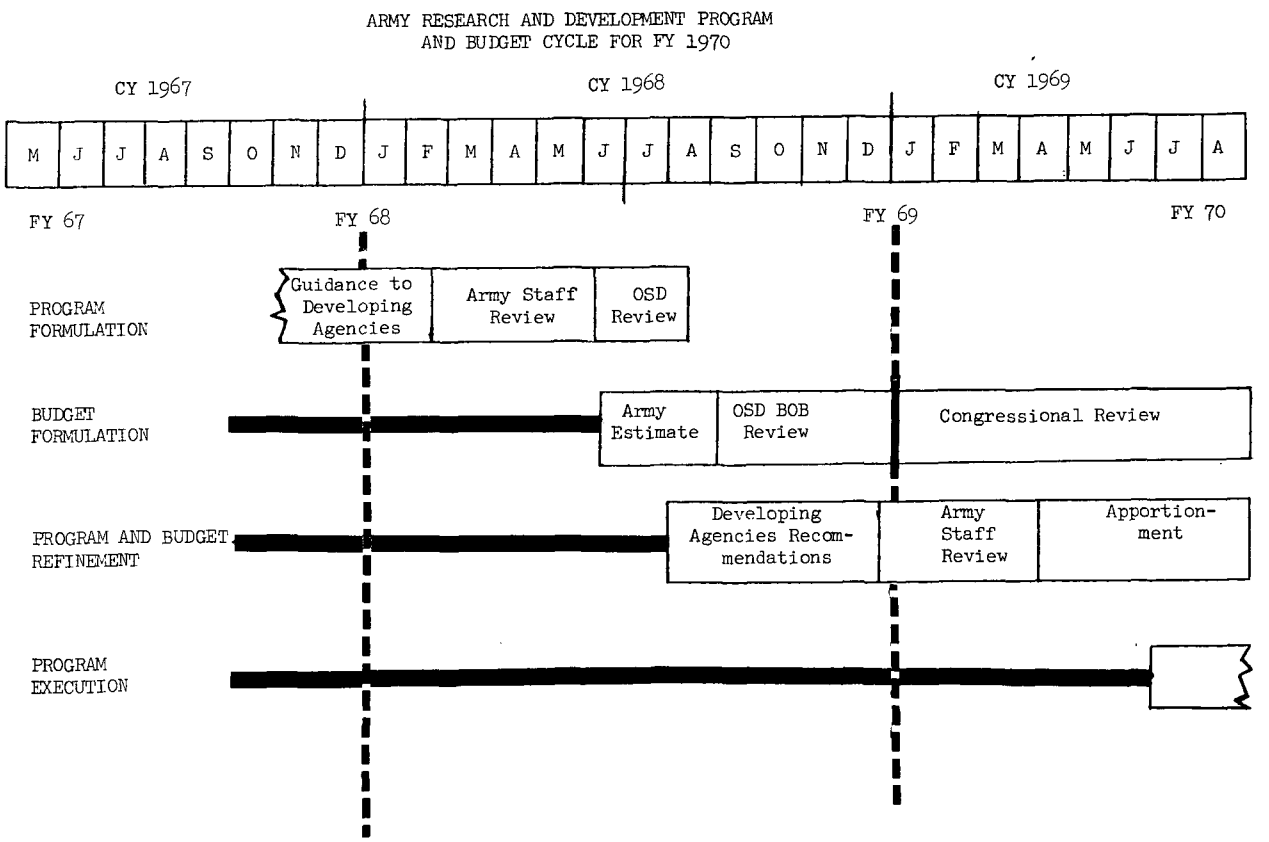


Figure 7–3. Army Research and Development Program and Budget Cycle for FY 1970.

(1) Research, Development, Test, and Evaluation, Army.

(2) Procurement of Equipment and Missiles, Army.

(3) Operations and Maintenance, Army.

(4) Military Construction, Army.

b. The distinction between the Research, Development, Test, and Evaluation appropriation and the Procurement of Equipment and Missiles appropriation marks the transition from development on the one hand to production of operational equipment on the other. The Operations and Maintenance appropriation supports certain activities (such as the operation of installations) that apply to research and development, as well as to other Army activities. Similarly, the Military Construction appropriation may also support the construction of research and development facilities, as well as other military construction.

c. The Research, Development, Test, and Evaluation appropriation is primarily subdivided along such commodity lines as missiles, aircraft, ordnance, and combat vehicles. Within each classification, research and development activities are grouped according to the six categories of the Research and Development Program described in paragraphs 7–5 through 7–7—Research, Exploratory Development, Advanced Development, Engineering Development, Management and Support, and Operational Systems Development. In some instances, the budget line items in these categories correspond to program elements in the Research and Development Program — for example, the Nike–X missile in the category of Missiles and Related Equipment. The system of identification and accounting for budget activities is part of the Army Management Structure set forth in AR 37–100. This system includes a conversion table that makes it possible to relate the items and categories of the Army budget to the elements of the Department of Defense program that they support.

d. Research, Development, Test, and Evaluation funds are, for the most part, controlled by Headquarters, Department of the Army, at the level of projects and major items. Thresholds for reprograming of funds are established for the budget structure, as well as for the program structure. Major commands and agencies are authorized to reprogram Research, Development, Test, and Evaluation funds in the current year within specified limits without Department of the Army approval.

e. Army Program and Budget Guidance, published annually, includes information on research and development plans and resources. The research, development, test, and evaluation portion of this document is prepared by the Office of the Chief of Research and Development for the research, development, test, and evaluation activities of major commands. It includes extracts from the Basic Army Strategic Estimate on concepts, and Priority Operational Requirements developed in the Army Strategic Plan and set forth in the Combat Development Objectives Guide. It also contains a summary of funding by budget programs, as well as manpower authorizations by command. Most of this guidance, which is informational in nature, appears in other documents in as much or more detail. However, since manpower authorizations and research, development, test, and evaluation funds approval are achieved through separate procedures, this guidance is particularly useful in correlating for the commands the funding and manpower available for pursuing research, development, test, and evaluation tasks.

Section V. PROCEDURE FOR ESTABLISHING A NEW MATERIEL REQUIREMENT

7–12. Systems Interrelation

The systems described in this and the preceding chapters—for planning, establishing requirements, programing, and budgeting—are in constant operation throughout the year. Each system provides for annual outputs, and each is geared to a series of 5-year cycles extending well into the future. At key points, the systems interlock, either for the exchange of

information or for the validation of a decision (such as initiating a development project or determining the amount of money to be requested for Army research and development for the coming year). The interrelation of these systems in originating and controlling the development of Army materiel is summarized in the following paragraphs, by means of a hypothetical example. This example traces the evolution of a hypothetical combat vehicle from the early stages of planning and basic research.

7–13. Case Example

a. At an Army laboratory, a research project is initiated to investigate the molecular properties of certain metals under certain conditions. The project is a part of the broad Army objective of developing stronger, lighter metals for use in combat conditions. This objective is reflected in the Army Long-Range Technological Forecast and the Combat Development Objectives Guide. The project is identified specifically in the Army Research Plan and in the project listings issued by the Chief of Research and Development. The project is initiated as a part of Program 6.11, Research-Army, in the Five-Year Force Structure and Financial Program. It is one of many such projects in the program element, Defense Research Sciences. The project is described in a Research and Technology Resume (DD Form 1498), which is forwarded through channels to the Director of Defense Research and Engineering, in the Office of the Secretary of Defense.

b. At the Combat Developments Command, work is proceeding on the Army Concept Programs. The concept study for one of these programs has indicated the desirability of an air-droppable battle tank. The feasibility of developing such a vehicle is uncertain. Among other things, the vehicle will require lighter, stronger armor plate than any available at present in order to perform under the operating conditions envisaged at the time of its deployment. The concept study, which both contributes and responds to the current content of the Army plans, is approved, and the preparation of a Qualitative Materiel Development Objective for the tank begins. This may occur before or after the laboratory research project is initiated, or the two events may occur at the same time.

c. At the laboratory, the research project is completed successfully, and a follow-on project is initiated to develop concepts and techniques for manufacturing, machining, and joining metals. This project is undertaken as a part of Program 6.21, Exploratory Development-Army, under the program element entitled Materials. The project is responsive to the objectives of the Army Research Plan; it may also be related to the Qualitative Materiel Development Objective for the air-droppable battle tank, which has been approved by Headquarters, Department of the Army, as an objective whose feasibility has not yet been determined. As the metallurgical research proceeds to the point of feasibility studies and testing (along with other work that may ultimately contribute to the development of the tank), it generates information that will become part of a Qualitative Materiel Approach. This Qualitative Materiel Approach is the statement by the developing agency that the feasibility of the tank development has been established.

d. At this point the results of the metallurgical research projects have clearly merged with other research and development work to become a part of the proposed air-droppable battle tank development. However, further work may be necessary to demonstrate conclusively the technical feasibility of the project; for example, a prototype may have to be built to test the strength of the metal under simulated operating conditions. This effort would be identified in Category 6.31, Advanced Development-Army.

e. If the tank requires no further exploration of technical feasibility or methodology, it advances from Exploratory Development to Program 6.41, Engineering Development-Army. The transition from exploratory or advanced development to engineering development is a major step, representing the commitment of the Army and the Department of Defense to a major investment of time and money and to a major new item of materiel. The Qualitative Materiel Approach when formalized in the Re-

search, Development, Test, and Evaluation process will facilitate the development of a Qualitative Materiel Requirement by the Combat Developments Command. The Qualitative Materiel Requirement, backed up by cost/effectiveness studies, a concept selection study (necessary for a major development such as this), and a total feasibility study, is approved by the Department of the Army. The Qualitative Materiel Requirement is circulated widely in draft form. It provides the basis for a Technical Development Plan, which in turn supports a Program Change Proposal. The last document is subjected to intensive review in the Office of the Secretary of Defense. Upon approval, the tank project is advanced to the Engineering Development category in the Five-Year Force Structure and Financial Program. For a project of this size, the engineering development phase would include a Contract Definition period to develop detailed specifications and to select a contractor for the detailed design and development process.

f. As the tank progresses toward type classification, increasingly detailed plans are developed for its production, deployment, and operation. These plans are incorporated in the Army Family of Plans, the Army Concept Program, and the Army Five-Year Force Structure and Financial Program, where they comprise parts of other programs, such as General Purpose Forces (Program III), as well as Research and Development. If further development is required after type classification, it is noted in the Research and Development Program under Operational Systems Development-Army, Program 6.71, and carried concurrently as a part of the program to which the tank is assigned.

g. During the research and development cycle, the activities described above are funded through the Research, Development, Test, and Evaluation appropriation of the Army budget. The metallurgical research projects would be funded through the Military Sciences portion of this appropriation. During exploratory development, this and other work related to the tank would be funded in the Ordnance, Combat Vehicles, and Related Equipment portion of the appropriation.

PART FOUR

MATERIEL DEVELOPMENT

CHAPTER 8

MANAGEMENT PLANNING

Section I. FACTORS AFFECTING THE MANAGEMENT APPROACH

8-1. General

a. Initial Steps. Once a Research and Development project is approved, it must be planned and managed in the way that best assures its successful completion. AR 705-5 specifies a number of steps to be taken by the developing agency at the outset of a project. They included the preparation of technical characteristics, programing of funds, initiation of contracts, provision of guidance on the use of specifications, and definition of requirements in such areas a prototype fabrication, testing, packaging, calibration, security, and the use of radio frequencies. For many projects, particularly major ones, a number of planning and control procedures are more or less automatically dictated by policy or regulation; these range from the organization of the project management office to the use of PERT/Cost or Configuration Management.

b. Specific Requirements. Within the general guidance provided by policies and regulations, each project must be managed in accordance with its own particular requirements. These requirements vary widely; a research project must be managed in a very different way from a system development project. Paragraphs 8-2 and 8-3 discuss the factors that influence the management approach—that is, the organization and control structure—of Army Research and Development projects. Paragraphs 8-4 through 8-8 describe the organizational approaches that may be applied to projects of various types. Paragraphs 8-9 through 8-11 discuss the process of establishing initial control over project objectives. This process is presented in terms of the Contract Definition procedure for Engineering Development Projects, a procedure that is exhaustive and definitive in its detail and elaborates in the fullest possible form a planning process that is present in all development efforts.

c. Primary Factors in the Management Approach. The extent and intensity of the management effort applied to a given project depend on a number of factors. Perhaps the most influential in determining the management approach are three: the complexity of the end product, the urgency of the requirement, and the degree of uncertainty that attends the achievement of the objective. Clearly, a scientific report is less complex than a missile system. The outcome of a basic scientific study is rarely an urgent matter, but the completion of an Exploratory Development project within a specified time may be important and even critical to the Army's midterm objectives, and the completion of a missile development project may be a matter of the highest national priority. The ultimate content of a scientific report is usually highly uncertain; it cannot be predicted with any precision at the outset of the effort. A missile system, on the other hand, although far more complicated, can be described in great detail before its development is begun.

d. Other Factors. These primary factors—complexity, urgency, and uncertainty—determine to a considerable extent the other factors that affect the management approach. The complexity of a project, for example, has a good deal to do with the number of people who will be involved; whether they will all be Army personnel or will include contractors as well; the number of Army organizational elements that will participate; and the amount of time and money that it will take to complete it. The number of people and organizational elements, in turn, determine the degree of coordination that will be required, and thus the extent of formal communication and control that will be necessary to keep the project in phase and in balance. In the same way, the urgency of a project affects the management approach—the number of people to be involved, the amount of money that will be required, and so on. Finally, the uncertainty of the outcome affects the management approach—the degree of supervision and direction that is possible and the extent to which schedules and budgets can be established.

e. Applicability. The applicability of these factors varies roughly with the phases of the Research and Development cycle. Management organization and control are generally least intensive and least project-oriented in the research phase, and most intensive and most project-oriented in Engineering and Operational Systems Development. Paragraphs 8–2 and 8–3 discuss the factors that influence the management approach in each of these phases.

8–2. Research and Exploratory Development

a. Research. Basic research projects, although shaped and guided by the Army Family of Plans and Operational Capability Objectives, may not in their entirety be directed toward specific military objectives. Dependent for their success on the competence and curiosity of individual scientists, they are often identified and proposed by the scientists themselves. Typically, they involve a small number of people, often one man supported by technicians and laboratory staff personnel. They involve a relatively small investment, and are funded on a level-of-effort basis. Supervision and direction are minimal; the primary role of management is to review proposals, provide, support, and evaluate results—usually in the form of scientific and technical reports. For the most part, research projects and tasks are performed in-house, although they may be pursued under contract at universities, scientific foundations, or industrial firms; also, grants for basic research may be awarded to nonprofit organizations. In any case, they rarely involve more than one organizational element of the developing agency.

b. Exploratory Development. Projects and tasks in Exploratory Development include both applied research and component or subsystem development to explore concepts and establish the feasibility of specific military applications. They are usually related to a specific objective or Qualitative Materiel Development Objective, and they involve not only the developing agency but also the Assistant Chief of Staff for Force Development and the Combat Developments Command. Applied research activities typically are carried on under continuous projects, such as the development of electrical power sources, with subordinate tasks established, pursued, and completed as new objectives are defined and old ones are met. Component development activities are usually directed toward specific hardware objectives, such as the development of power drives for the Heavy Lift Aircraft. Projects in this category may involve substantial numbers of people, both in-house and contractor, and they may draw on a variety of technical disciplines. They also involve a relatively high degree of uncertainty. For this reason, they are funded on a level-of-effort basis.

8–3. Advanced, Engineering, and Operational System Development

a. Advanced Development. Projects in Advanced Development entail much of the complexity of projects in the Engineering Development phase. At the same time, they are constrained by state-of-the-art limitations, with the attendant uncertainty of the result. Gener-

ally, however, they are planned in considerable detail—in many instances, a preliminary Technical Development Plan is required—and they are controlled on a project basis.

b. Engineering and Operational Systems Development. In Engineering and Operational Systems Development, the degree of uncertainty is reduced, the complexity of the end product is often comparatively high, and the date of completion is relatively important—often critical. These projects almost always involve large numbers of Army and contractor personnel, and they draw upon many technical disciplines and functional specialties—procurement, production, and support. They are clearly and precisely defined—for major projects, the Contract Definition procedure is mandatory. They often involve a major financial investment and they represent a commitment to operational use that may have major implications for the Army's organization and operations. In some instances, the development process continues after type classification. For these reasons, projects in this category receive the most intensive possible management planning and control. A limited number are designated for project management, with command authority and substantial staffs; most others are managed on an item- or commodity-oriented basis that assures a well-defined focal point of management attention.

Section II. ORGANIZATIONAL APPROACHES

8–4. Introduction

a. Activities in Materiel Development. Certain activities are common to all materiel development projects. The technical objective must be established and the technical approach defined. Organization structure and staffing requirements must be determined. Tasks must be defined and scheduled and the necessary resources estimated and acquired. As the project proceeds, review and analysis are necessary to see that its objectives are being met and appropriate decisions are being made. Throughout this process, the cognizant agency must coordinate its efforts with those of other commands and agencies. It must see that necessary studies and tests are made and their results reviewed, that specifications are prepared and that they are mutually consistent, that designs are completed, prototypes fabricated, and so on. The extent and complexity of this activity varies from project to project, and the organizational approach must vary accordingly.

b. Organization for Materiel Development. The Army has three organizational approaches to the management of materiel development—functional management, project management, and commodity management. They are complementary rather than mutually exclusive. Functional management is the Army's basic approach to materiel development. The functional organization—research and development, test and evaluation, procurement and production, supply and maintenance—is the "doing" organization, and for most of the Army's materiel development activities it is the managing organization as well. Project management and commodity management are techniques for overlaying the functional organization with a structure that is oriented to the item of materiel itself, rather than to the kind of activity applied to the item. They emerge as the management requirements for a development project become more complex and demanding, but they do not supersede the functional organization.

8–5. Functional Management

a. Definition. Functional management is oriented to specialized services rather than to the items of materiel to which those services are applied. The management responsibility for a particular item is divided among the specialized elements of the organization, and no single element has exclusive, comprehensive responsibility for the development, production, and support of the item.

b. Approaches. In Army materiel management, the principal functional activities represent sequential stages in the life cycle of an

item—research and development, procurement and production, and supply and maintenance. Other functional activities, such as financial management and personnel administration, cut across these groups, providing them with support and helping top management to integrate and control their efforts. The same functional activities appear in the organization structure at each major echelon of command. Research and Development, for example, is represented at Headquarters, Department of the Army, by the Office of the Chief of Research and Development; at Headquarters, Army Materiel Command; and at Headquarters, Army Missile Command, by that Command's Directorate of Research and Development. In the Office of the Surgeon General, Research and Development is a subordinate command.

c. Variations. The functional structure at each level of command is not rigidly fixed; it varies somewhat from place to place in response to local requirements. In the same way, variations occur within the research and development activity of the various commands. At the Army Electronics Command, for example, the Directorate of Research and Development is primarily a planning and coordinating activity, with the Command's seven laboratories and two detached research and development activities reporting directly to the Commanding General. At the Army Missile Command, in contrast, the Directorate of Research and Development includes, in addition to its staff elements, three divisions that are primarily concerned with the planning and direction of development projects, and eight laboratories that are oriented to scientific and technical disciplines, such as physical sciences, propulsion, electromagnetics, and so forth. The divisions are subdivided along end-item lines—for example, small rockets and antiaircraft or target missiles. The laboratories are subdivided according to scientific and technical specialties—for instance, plasma physics, solid propellant chemistry, or aerodynamics.

d. Authority and Responsibility. In the functional structure, authority derives from the commander of the activity and is delegated to the heads of the functional elements. Their authority normally is limited to the personnel and activities falling within their sphere of operation. Thus, although the Procurement organization may be engaged in activities of major importance to a development project, Research and Development managers cannot exercise directive authority over them. The attainment of common objectives is achieved by cooperation between functions and by adherence to procedures, regulations, and agreed-to plans, rather than by centralization of authority. The responsibilities of functional elements are, in general, clearly defined, and many of them are carried out independently. For example, a feasibility study for an item in Exploratory Development is likely to involve only Research and Development personnel. Responsibilities often tend to interlock, however. In the structuring of a development contract, for example, Procurement will be responsible for the administrative aspects, and Research and Development will be responsible for technical specifications. Finally, the major responsibility for an item of materiel shifts from one function to another as the item moves from development into production and finally to service use.

e. Advantages and Limitations. The functional approach has several advantages. It provides great flexibility in handling a wide range of technical tasks. It concentrates skills—engineering, procurement, logistics, and so on—and thus fosters a professional environment for the cultivation of high competence in a specialized field. This is particularly important in research and development, where an immense body of highly specialized knowledge must be applied to the creation of new concepts and techniques. The functional approach also has several limitations. Because a wide variety of specialized activities is dispersed through several organizational elements, it is difficult to see clearly the total status of any single project. The separate areas of responsibility come into focus only at the highest level of the organization—in a commodity command, for example, only at the level of the Commanding General. Thus it is difficult, in a functional organization pursuing a large number of projects, to identify prob-

lems and to get timely, decisive action, particularly in a complex effort like the engineering development of a major system. This limitation is the primary reason for the Army's introduction of project management and commodity management—to provide a single focal point below the command level for the management of development projects that are being supported in various specialized ways by a great number of functional elements.

8–6. Department of the Army System Staff Officer System

a. The Department of the Army System Staff Officer performs a management function at Headquarters, Department of the Army by monitoring selected items or systems to assure the interrelationship and timely coordination of materiel development, doctrine, personnel, organization and training as well as other facets integral to the fielding, operation, maintenance, and ultimate disposition.

b. The Department of the Army System Staff Officer System is not limited to only materiel items or systems, but may be used to facilitate the monitorship of any major Army endeavor that meets the following criteria:

(1) Criticality of the project, item or system in relation to the Army's operational requirements or materiel modernization objectives.

(2) Significant impact on Army doctrine, force structure, training programs, personnel requirements, or facilities.

(3) Unusual management interest by the President, the Congress, the Secretary of Defense, or the Secretary of the Army.

(4) Item or system program complexity.

(5) High dollar cost.

c. The Department of the Army System Staff Officer System, as established, is a Chief of Staff directed responsibility of the Assistant Chief of Staff for Force Development, and allows Headquarters, Department of the Army to maintain overall surveillance and, through monthly progress reporting, cognizance of current program status.

d. When a system or item is assigned under the Department of the Army System Staff Officer System, a draft DA Master Schedule is prepared by the assigned Department of the Army System Staff Officer and circulated throughout the DA Staff and major field commands. After review and/or concurrence by the staff, the schedule is approved by the Assistant Chief of Staff for Force Development, reproduced and distributed to the staff and major commands for reporting purposes. The schedule contains data on funding, requirements, and a list of life-cycle milestones. Each milestone listed also indicates that agency responsible for completing the action. The agency so indicated on the schedule is required to notify the Assistant Chief of Staff for Force Development Department of the Army System Staff Officer, by a monthly feeder report, of the status of its assigned milestones, including reasons for milestone rescheduling or noncompletion. The Department of the Army System Staff Officer compiles and assembles all pertinent data from his feeder reports and prepares, by the tenth working day of each month, a progress report for the Chief of Staff indicating current status and noting any change in program scheduling. These reports are reproduced and circulated throughout the Army staff and to the major field commands for information and any indicated action.

e. Recommendations for items or systems to be added to—or deleted from—the Department of the Army System Staff Officer System are forwarded to the Assistant Chief of Staff for Force Development for staff consideration, coordination, and forwarding to the Chief of Staff for approval.

f. The Department of the Army System Staff Officer is required to establish and maintain close relationship with any assigned Project Officer and other staff agency contacts.

8–7. Project Management

a. Definition. The term "project management" refers to a concept for the technical and

business management of particular projects based on the use of a designated, centralized management authority who is responsible for planning, directing, and controlling the definition, development, production, and initial logistical support of a project; and for assuring that planning is accomplished by the organizations responsible for the complementary functions of logistic and maintenance support, personnel training, operational testing, activation, or deployment. The centralized management authority is supported by functional organizations, which are responsible to the centralized management authority for the execution of specifically assigned project tasks. The Army uses this management approach selectively, in conjunction with existing organizations. The Army Materiel Command has designated approximately forty-five project managers for this exceptional form of management. The other developing agencies of the Army also employ project management in varying degrees.

b. Objectives. The exceptional management policies established for project management by AR 70–17 are intended to accomplish two objectives—

(1) Give particular attention to the management of an allocation of resources to those projects that are most critical to the Nation's defense posture or costly to the Department of the Army, and

(2) Strengthen management authority and effectiveness, particularly at project manager level, so that the Department of the Army can acquire, deploy, operate, and support projects possessing required performance capabilities within the approved schedule and within available resources.

c. Application. The project management system set forth in AR 70–17 is to be applied according to the following guidelines. It is mandatory for all those new (or major modifications of existing) production projects, or new Engineering and Operational Systems Developments, as defined in AR 705–5, and having one or both of the following characteristics: are rated in the BRICK-BAT category of national and military urgency requirements; and/or estimated to require total cumulative research, development, test, and evaluation financing in excess of $25 million, or are estimated to require total production investment in excess of $100 million. It may also be applied to other projects under the following conditions:

(1) Other projects may be designated for this exceptional management by the Secretary of the Army when they possess one or more of the following characteristics:

(*a*) Have a significant effect on the United States military posture.

(*b*) Are closely related, and when taken collectively, would qualify for this exceptional management under the threshold established in *b*(2), above.

(*c*) Are conducted on a substantially concurrent basis, particularly when significant technical problems are anticipated.

(*d*) Involve unusual organizational complexity or technological advancement.

(*e*) Require extensive interdepartmental, national, or international coordination or support.

(*f*) Present unusual difficulties, which need expeditious handling to satisfy an urgent requirement.

(2) As an internal management and control device heads of developing or procuring agencies may, within existing resources, designate for management by these exceptional management techniques other projects when the interfaces involved are primarily within the developing or procuring agency and when the project has not been designated by the Secretary of the Army.

(3) Projects satisfying one or more of the above criteria may be selected for project management at any stage in the life cycle. The Medium Anti-

Tank/Assault Weapon was designated for project management in the Exploratory Development stage, while two alternative control concepts were being studied. On the other hand, General Purpose Vehicles are operational, but the very substantial annual investment in these vehicles justified their designation for project management. However, projects most often meet the selection criteria shortly before Engineering Development begins.

d. Initiation, Termination and Notification.

(1) *Initiation.* A charter is issued for each new project designated for exceptional management. The charter explicitly sets forth the following:

(*a*) The name of the individual assigned as the project manager, his mission, reporting channel, and special reporting requirements.

(*b*) The program elements, or parts thereof, for which the project manager will be responsible.

(*c*) The interface relationship and direct communication channels between the project manager and the participating organizations identified, including the logistics organizations that will identify or provide project support needs and follow-on logistics support and the other organizations that will identify or accomplish complementary support such as operational testing, personnel training, activation, or deployment.

(*d*) Provisions for control by the project manager of the allocation and utilization of all resources identified and approved in the Five-Year Force Structure and Financial Program and authorized for obligation for the execution of the approved project.

(*e*) The primary location of the Project Management Office and the organizations that will provide the administrative support specified.

(*f*) Any special delegations of authority or exemptions from regulations that are considered necessary for the project manager.

(2) *Termination.* Projects designated for exceptional management are reviewed periodically. The use of this management technique may be terminated by the chartering authority (the Secretary of the Army or the head of the developing or procuring agency) when a project has achieved its principal objectives and at least one of the following criteria has been met:

(*a*) The project has been delivered to all or a substantial number of operating units and is considered fully operational.

(*b*) Support of the project can be assigned to normal supply channels subsequent to distribution to the field.

(*c*) Operational experience indicates no extraordinary problems associated with technical performance or follow-up support.

(*d*) The principal criteria governing selection for project management are no longer applicable.

(*e*) Another system of management supersedes the project manager assignment.

(3) *Notification.* At least 6 months before a charter approved by the Secretary of the Army is to be withdrawn, the project manager must notify the Secretary of the Army of completion of transition plans, for relinquishing management direction and control over specified functions to supporting or operating organizations.

e. Logistic Support Planning. Logistic support planning for the period following project management must be accomplished concurrently with other project effort. Logistics organizations identified in the Project Manager Charter

and/or in the approved, negotiated Project Master Plan will assist the project manager in support planning and in developing transition agreements.

f. Staffing for Project Management.

(1) *General.* The Project Management Office is established and staffed within the resources of the command with the minimum necessary cadre of technical and business management personnel as early as practicable, preferably at least 90 days prior to submission of the Technical Development Plan and the initial Program Change Proposal for the project. When a project is approved for inclusion in the Five-Year Force Structure and Financial Program, a full-time staff is provided. The size, scope, functions, and relationships of a Project Management Office, including representation from participating organizations, are tailored to meet the needs of the particular project. A major project in Engineering Development, with heavy funding and complex tasks, may have a project office of 250 authorized personnel. A smaller project, with considerably less funding, the materiel well into the operational phase, and technical problems largely resolved, may have 40 or fewer. Figure 8–1 shows the structure and staffing of a project office in the Army Materiel Command.

(2) *Selection of the Project Manager and Staff.* The project manager and his

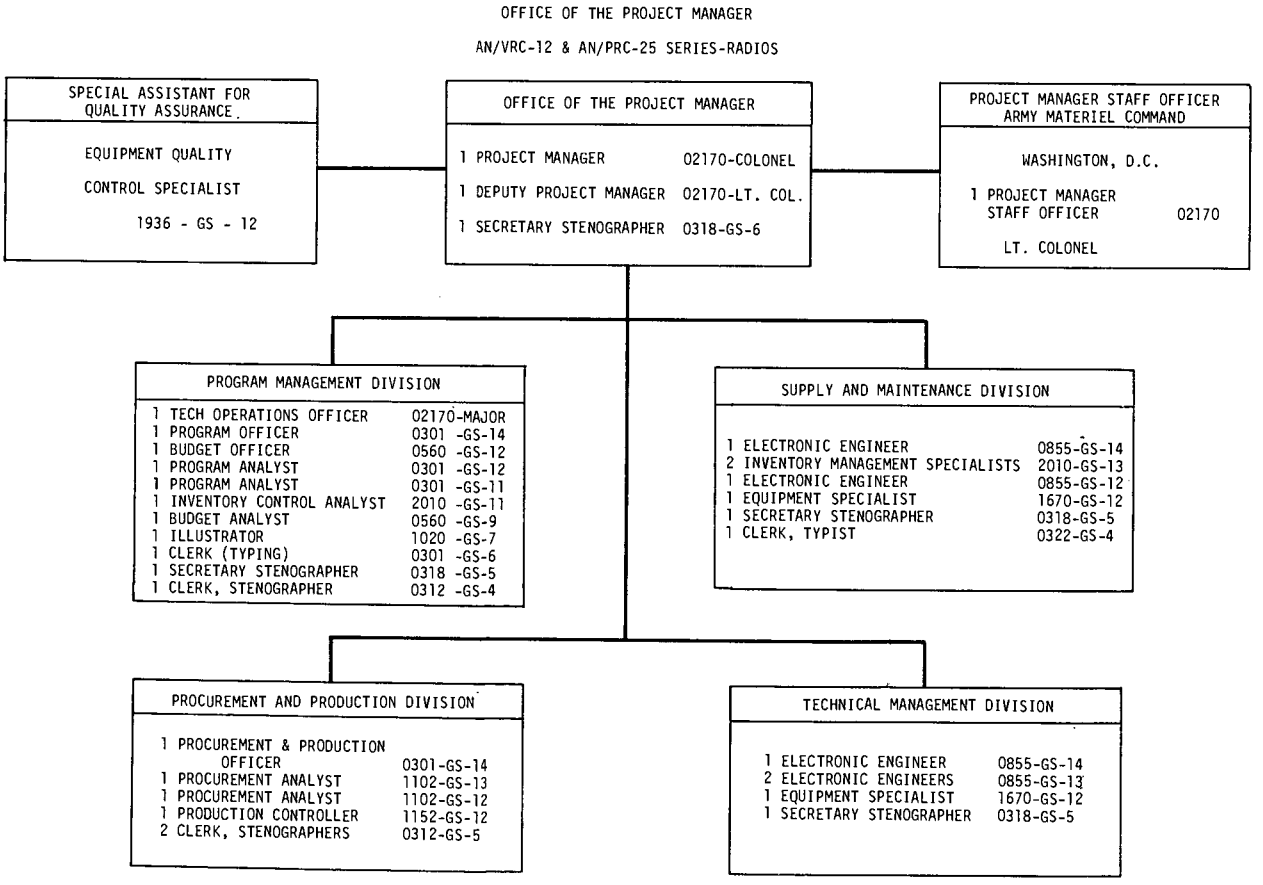


Figure 8–1. Office of the Project Manager.

staff should have sufficient rank or grade and organizational stature to deal effectively with staff, field, and functional personnel who must support the project; and enable the manager independently to make substantive decisions regarding the direction and control of project efforts by in-house and contractor organizations. As a general rule it is expected that, for projects meeting the criteria of *c*(1), above, the project manager will hold the rank of colonel, or an equivalent civilian grade. However, the most critical projects may be managed by general officers, or equivalent civilian grades. It is mandatory that the project manager and his staff have a high degree of technical and business managerial competence, supplemented whenever possible by recent experience in project management, and by training in the special requirements of such management. Personnel considered for assignment should be expected to be available for at least 3 years. Whenever possible, tours of military project managers will be extended to the duration of the project unless terminated by the chartering authority.

g. Role and Authority of the Project Manager.

(1) *Responsibility and Authority.* The project manager is responsible for successful accomplishment of his project. He exercises executive authority, as defined in the Project Manager Charter, over the planning, direction, and control of the approved project, and over the allocation and utilization of all resources identified and approved in the Five-Year Force Structure and Financial Program and authorized for obligation for the execution of the approved project. Specifically he—

(*a*) Is responsible for preparing, securing approval of, and maintaining the Project Master Plan.

(*b*) Has authority to make technical and business management decisions required by the approved project and authorized by his charter.

(*c*) Approves, consistent with the Armed Services Procurement Regulation, all contractual actions required for the accomplishment of the project.

(*d*) Approves the scope and schedule of project effort proposed for accomplishment by in-house activities and the costs of such effort to be defrayed by project funds.

(*e*) Reports on the progress of his project in accordance with reporting instructions prescribed in his charter or by other authority.

(2) *Reporting Channel.* For projects chartered by the Secretary of the Army, the project manager reports to the head of the developing or procuring agency during the life of the project, or, if prescribed in the charter, through the next lower organizational level to the head of the agency. As pertains to these projects, unless specifically excepted in the charter, the established reporting channels, responsibilities, and requirements of major developing/procuring agencies to Headquarters, Department of the Army, remain in effect.

(3) *Direct Communication.* Direct two-way communication may be established between the project manager, the Department of the Army System Staff Officer, if applicable, and all other participants and participating organizations involved in implementation of the approved project, to assure timely and effective direction and interchange of information between all levels.

(4) *Extra-Office Assistance.* Participating organizations furnish resources and

other assistance to support the requirements of the project manager, as specified and identified in the Project Manager Charter and/or in the approved, negotiated Project Master Plan. When execution of functions for a project is divided among commands, the responsible authorities of those organizations designate, by organizational title, the officials responsible for supporting the project manager. Such support includes development of transition agreements between commands, as necessary. The support required is considered a principal responsibility of the participating organization.

(5) *Resources Assessment.* The project manager assesses and documents the effect of proposals to increase or decrease authorized resources for accomplishment of the objectives of the Master Plan. This assessment is considered by the individual within the Army having final decision authority for the change proposed.

h. Responsibilities.

(1) The Chief of Research and Development has Army General Staff responsibility for coordinating within the Army Staff those Project Manager Charters pertaining to Engineering and Operational Systems Development projects that are referred to Headquarters, Department of the Army, for approval. The Deputy Chief of Staff for Logistics has Army General Staff responsibility for coordinating within the Army Staff those Project Manager Charters pertaining to production projects which are referred to Headquarters, Department of the Army, for approval. Heads of developing or procuring agencies shall have responsibility for—

(*a*) Supervision of project managers in the development of proposed Project Manager Charters and in the preparation of the Project Master Plans to include coordination of interfaces, operational procedures, and support responsibilities with appropriate participating organizations in order to assure successful accomplishment of the project.

(*b*) Submission of Project Manager Charters to Headquarters, Department of the Army.

(*c*) Initiation, operation, and termination of project management activities assigned to their agency.

(*d*) Approval of appropriate elements of the Project Master Plan not requiring approval by higher headquarters, to include obtaining concurrence of participating organizations.

(*e*) Submission to Headquarters, Department of the Army, of applicable budget data related to project management.

(2) Field commands and agencies designated as participating organizations shall be responsible for—

(*a*) Assisting in the preparation of the Project Manager Charter and of the Project Master Plan to assure that necessary interfaces, operational procedures, and support responsibilities are established for successful accomplishment of the project.

(*b*) Supporting the project manager within the scope of the approved Project Manager Charter and the approved, negotiated Project Master Plan.

8–8. Commodity Management

a. Definition. For items that require special management attention but do not justify the exceptional techniques of project management, the Army Materiel Command employs another form of item-oriented management. Commodity management, unlike project management, does not involve full-line authority, but it does serve to coordinate various functional activi-

ties and provide an item or system focus. Where it is employed, a commodity manager is designated by the commander of the commodity command. This manager may be responsible for a single item or a group of items.

b. Objectives and Criteria for Designation. The objectives of commodity management are to provide a degree of integrated life cycle management for major items not project-managed; to coordinate the diverse functional efforts relating to particular items or systems; and to provide the commodity commander with a management focal point and an overview of all activities relating to particular items or systems. The basis for selection of items for commodity management varies somewhat among commands. Frequently, there is some degree of significance as measured by dollar cost, urgency, or particular interest. Items that are not project-managed but are approaching project management criteria, such as the Electronics Command's Side-Looking Airborne Radar, are often selected for commodity management. Like project management, commodity management is applied at various stages in the life cycle. The need for appointment of a commodity manager should be considered as early as the feasibility study phase and should not be delayed beyond the preparation of a Technical Development Plan or equivalent. Under normal circumstances, commodity management continues beyond type classification until the materiel is fully fielded.

c. Authority and Responsibility. The major activities of the commodity manager are to plan or see that planning is done, review results, suggest necessary actions, and coordinate the activities of various functions and groups. As a minimum, commodity managers should have authority and responsibility for—

(1) The initiation and issuance of a life cycle Commodity Master Plan.

(2) The maintenance of pertinent information on all aspects of the current status of the commodity or commodities assigned to him.

(3) The initiation of coordinated corrective action in the event of deviations from the plan.

(4) Acting as the focal point within the commodity center or command on major actions pertaining to his assigned commodity or commodities. This includes contacts with other elements of the Army Materiel Command, with Department of the Army elements, with the Combat Developments Command, and with field or user commands. It also includes cognizance of complaints about the performance or support of the item.

d. Organization and Reporting Relationships. If the command is not decentralized into major subcommands, the commodity manager typically reports to the commodity commander either directly or through the chief of a commodity management office. When the commodity command operates major subcommands or centers as in the Mobility Command and the Munitions Command, the commodity manager is usually located at the center and reports to its commander. The size and structure of commodity offices vary considerably. At the Electronics Command the six commodity offices are organized by items or classes of items. Each item is the responsibility of an individual in the office. The commodity groups range in size from 15 to 25 people, and they have their own technical and administrative support. At the Missile Command, the commodity offices are much smaller. However, the commodity managers are supported by a permanent team of functional people designated by the functional directors, including the Controller-Director of Programs. Although the team members are not a part of the commodity office and are not under his direct authority, the commodity manager is the designated and accepted chairman of the group and, as such, exerts considerable influence. The ranks and grades of commodity managers vary, but as a rule the heads of commodity offices are not below the rank of major or above the rank of colonel. Equivalent grade civil service personnel may also occupy this position.

e. Commodity Master Plans and Reports. The Commodity Master Plan is the primary instrument used by the commodity manager for plan-

ning, coordinating, and controlling assigned commodity effort. The objective of Commodity Master Plans is to—

(1) Assure that all organizational elements concerned with a commodity view their participation as a part of a single integrated effort.

(2) Provide the basis for interface coordination and control of all participating organizations in the commodity effort.

(3) Provide necessary summarized information for the commodity including project description, technical requirements, plans, programs, and forecast in terms of time, cost, and operational effectiveness.

(4) Provide the means by which a commodity manager informs his commander, participating organizations, and higher authority of the status of the commodity effort.

(5) Provide historical documentation of the sequential events of the commodity throughout the life cycle.

Section III. CONCEPT FORMULATION AND CONTRACT DEFINITION

8–9. Purpose

a. General. Management planning for research and development projects is addressed to the definition of project objectives and requirements, including the activities that must be performed and the resources that must be applied. The degree of planning that is possible and desirable varies with the nature of the project. For projects in Engineering and Operational Systems Development, a high degree of planning is both possible and necessary, not only for the development effort itself but also for the production and support activities that follow it.

b. The Planning and Definition Process. The process of planning and defining a major development project takes place over an extended period. Although it is not practicable to complete at the outset all the detailed planning and definition that will ultimately be necessary, it is possible to complete the basic process before full-scale development begins. On this basis, a high level of confidence that the project will be successful can be established before a major commitment of resources is made. The concept of the planning and definition process set forth in AR 705–5 identifies two phases of activity. The first is Concept Formulation, which is concerned with establishing the concept of employment and the technical and economic aspects to be pursued. The second is Contract Definition, which is directed at the refinement of the technical, cost, schedule, and management aspects of the project and their incorporation in a definitive contract. The result of Concept Formulation is a conditional decision on whether to proceed with Engineering Development, the first phase of which is Contract Definition. The result of Contract Definition is a final decision on whether to proceed with the development as planned.

c. Objectives. The objective of Concept Formulation is to provide the technical, economic, and military bases for a conditional decision to initiate Engineering Development. It is accomplished through comprehensive system studies and experimental hardware efforts in Exploratory and Advanced Development. The objective of Contract Definition is to determine whether the conditional decision to proceed with Engineering Development should be ratified. Its ultimate goal, when the development is to be performed by a contractor, is achievable performance specifications, backed by a firm fixed price or fully structured incentive proposal for Engineering Development. In addition, it embraces the following subsidiary objectives:

(1) Provide a basis for a firm fixed price or fully structured incentive contract for Engineering Development.

(2) Establish firm and realistic performance specifications.

(3) Precisely define interfaces and responsibilities.
(4) Identify high risk areas.
(5) Verify technical approaches.
(6) Establish firm, realistic schedules and cost estimates for Engineering Development, including production engineering, facilities, construction, and production hardware that will be funded during Engineering Development because of concurrency considerations.
(7) Establish schedules and cost estimates for planning purposes for the total project, including production, operation, and maintenance.

8–10. Key Policies

a. Application. The Contract Definition procedure is mandatory for all new Engineering Developments or Operational Systems Developments (or major modifications of existing ones) that are estimated to require total cumulative research, development, test, and evaluation financing in excess of $25 million, or a total production investment in excess of $100 million. Other projects may be designated for Contract Definition by the Department of the Army or the Director of Defense Research and Engineering.

b. Technology Advancement. The degree of technology advancement to be accomplished by the development is limited to that which can be demonstrated quantitatively, by either laboratory or experimental devices, to have a high probability of achievement. If it is necessary to make a projection of anticipated developmental achievement, the projection will assume the probability of matching but not exceeding the laboratory results. This policy is not intended to limit a system development to assembly of off-the-shelf components, but rather to assure a high level of confidence that every technical requirement can be met.

c. Approval and Conduct. Conditional approval to proceed with Engineering Development—that is, to proceed with Contract Definition—is given by the Secretary of Defense, on the basis of an up-to-date Technical Development Plan. Contract Definition normally is performed by two or more contractors in competition under the technical direction of the Army. It may, however, be performed by a sole-source contractor if necessary, or by Army laboratories if they are to perform the Engineering Development. Contract Definition is conducted on a fixed price basis, with the intention of compensating each contractor fully for his work. This compensation includes reimbursement for key personnel between the submission of a development proposal and the award of a definitive Engineering Development contract.

d. Studies and Specifications. The trade-off studies that are conducted during Contract Definition should be directed toward achieving an optimum balance between total cost, schedule, and operational effectiveness for the system. "Total cost" includes the cost of development, production, deployment, operation, and maintenance. "Operational effectiveness" includes all the factors that influence effectiveness in operational use, such as reliability and maintainability, as well as inherent or "pure" performance characteristics. The "system" includes not only the hardware but also all other required items, such as facilities, data, and training equipment, and the operational and support personnel who will be required. The specifications developed during Contract Definition should be for performance rather than detailed design. Performance specifications are preferred at this stage in order to avoid limiting the latitude of design, to minimize the incidence of contract changes during development, and to prevent excessive precontract negotiation.

8–11. Procedure

a. Concept Formulation.

(1) The process of Concept Formulation is carried on in Exploratory and Advanced Development by means of experimental tests, engineering, and analytical studies. This work constitutes the necessary preliminary effort-threat and operational analyses,

trade-off and cost/effectiveness studies, and development of components and technology—to assure a firm foundation for Engineering Development. The evidence required for a conditional decision to proceed with Engineering Development includes the following prerequisites:

(*a*) Primarily engineering rather than experimental effort is required, and the technology needed is sufficiently in hand.

(*b*) The mission and performance envelopes are defined.

(*c*) The best technical approaches have been selected.

(*d*) A thorough trade-off analysis has been made.

(*e*) The cost/effectiveness of the proposed item is favorable in relation to that of competing items on a Defense-wide basis.

(*f*) Cost and schedule estimates are credible and acceptable.

(2) On the basis of this information, the Army requests approval to initiate Engineering Development. The request is made either by memorandum to the Director of Defense Research and Engineering or, if required, by a Program Change Proposal. It is accompanied by a Technical Development Plan, specifically addressed to the six points cited above, which summarizes pertinent studies or developments and provides whatever information may be required to substantiate the achievement of these prerequisites.

b. Request for Proposal. If the initiation of Engineering Development receives conditional approval, the Contract Definition phase begins. If it is to be performed by contractors, the first step in this phase is the issuance of a Request for Proposal, soliciting a firm proposal for the contractor's effort during Contract Definition and a planning proposal for Engineering Development. The Request for Proposal should give prospective contractors the fullest possible information and guidance. It should include such information as mandatory requirements; results of prior studies; criteria for evaluation of proposals; the Army's plan for project management and requirements for contractor project management; a network of activities during Contract Definition and Engineering Development; a work statement for the Contract Definition, and a specimen work statement for the Engineering Development; the requirement for documentation during Contract Definition and Engineering Development; the format and content of the proposal package for Engineering Development, including desired incentive features and specifications; quantitative reliability and maintainability goals; concurrency considerations and production quantities; a mandatory subsystem breakdown; and a list of Government-furnished equipment. Following review of the bidders' proposals, contractors are selected to perform the Contract Definition, and fixed price contracts are negotiated.

c. Performance of Contract Definition. During the Contract Definition phase (normally 3 to 4 months), the contractors conduct studies and develop performance specifications. The end product of this effort is a complete technical, management, and cost proposal package for the Engineering Development. The contractor's proposal package should include such information as a list of the end items required; performance specifications for each item; a work breakdown structure and a PERT network plan; the principal objectives and features of the overall system design, including recommendations for its operational use; a recommended maintenance plan; detailed cost estimates and milestone schedules for Engineering Development, and planning estimates and schedules for 5 years beyond it; quantitative reliability and maintainability specifications and test plans; time/cost/performance trade-off decisions on major alternatives; required new designs and technology; foreseeable technical problems and proposed solutions; technical specifications and performance specifications for support items (facilities, training devices, and so on) for which early Engineering

Development is required; delivery schedules and requirements for data and documentation; and a proposed schedule of production engineering and production tooling in relation to Engineering Development, if appropriate.

d. Resulting Actions. After a review of the contractors' Contract Definition proposals, the Army recommends one of the following actions: to contract for Engineering Development on the basis of the proposals received; to contract with an alternative source; to continue further Contract Definition effort; to defer or abandon the Engineering Development effort; or to undertake further Exploratory or Advanced Development of key components and/or system studies. The Army's recommendation is submitted by memorandum or Program Change Proposal via the Director of Defense Research and Engineering to the Secretary of Defense. If it is decided to proceed with Engineering Development, a contractor is selected and a definitive contract is negotiated. The contract type may be firm fixed price, fixed price incentive, or cost plus incentive fee. The Contract for Engineering Development should be executed within 18 weeks after the contractors have submitted their reports and proposals.

CHAPTER 9

CHARACTERISTICS INFLUENCING DEVELOPMENT

Section I. INTRODUCTION

9–1. General

a. With the establishment of an approved military requirement and the completion of a management plan, the development process begins. Whether conducted in-house or on contract, the management of this process is essentially the same—the determination of technical characteristics, the monitoring of progress toward the achievement of those characteristics, and the exercise of judgment in maintaining a proper balance among the three primary objectives of schedule, cost, and technical performance.

b. This chapter considers the management of the development process, in and of itself. Paragraphs 9–4 through 9–9 deal with the determination of technical characteristics, and paragraphs 9–10 through 9–14 deal with the control of technical performance, schedule, and cost. Subsequent chapters cover the evaluation and selection of sources to perform the development; the use of formal management information and control systems to assist the development managers in following progress and controlling the resources at his command; and the testing of new items of materiel to evaluate technical progress and to determine their acceptability to the Army.

9–2. The Relation of Schedule, Cost, and Technical Performance

a. The management of materiel development is predominantly a process of integrating and balancing a variety of dynamic forces. The process is characterized throughout by uncertainty; no matter how well-defined the end objective may be, changes will occur in the course of development—the specified weight cannot be achieved without a sacrifice in range, or the specified speed cannot be achieved without a reduction in payload, and so on.

b. In this atmosphere, the manager must be continually alert to the objectives he is striving to achive. He must know the consequences of the problems that arise, and the relative importance of the objectives that are affected. Most problems in materiel development are rooted in the technical effort, but they almost always have an impact on schedule, cost, or both. For one project, delivery of the equipment on schedule may be of primary importance; for another, cost may be predominant; for a third, the achievement of the required performance may override all other considerations. Some technical requirements are more important than others—high reliability may be more important than extreme range; light weight may be more important than durability. Moreover, any or all of these considerations may change in the course of the development effort—a new tactical requirement, a technical breakthrough, or a change in the Defense budget may shift the balance among the schedule, cost, and technical performance objectives of a project.

c. System considerations often impose additional demands on the development manager. Most items of Army materiel affect other items. The tactical radio must fit into the truck or tank; the ordnance must be transportable by Army aircraft. Considerations of this kind not only arise within the confines of an organization, but often spread across organizational lines. The development of a new Army aircraft, for example, may involve elements of the Mobil-

ity Command, the Electronics Command, the Munitions Command, and the Weapons Command in the Army Materiel Command, as well as the Corps of Engineers and The Surgeon General. In these circumstances, the need for an accurate grasp of objectives and interrelationships is doubly important.

9–3. Technical Characteristics

a. Establishment. The establishment of technical characteristics is the first step in the development process. These characteristics are derived from the information set forth in section IV of the Qualitative Materiel Requirement or in paragraph 2 of the Small Development Requirement. They include the following categories, each of which is discussed in the following paragraphs:

(1) Performance characteristics.
(2) Physical characteristics.
(3) Maintenance characteristics.
(4) Human engineering characteristics.

b. Derivation from Requirement Document. The characteristics set forth in the requirement document describe the desired equipment performance, the operating conditions to which it will be subjected, and any special limitations as to weight, cubage, and so on. They are "translated" into technical characteristics, which describe the equipment in terms of materials, components, assemblies, and physical processes.

c. Preparation. Technical characteristics are prepared by the developing agency, usually at the same time that the requirement document is being staffed at the Department of the Army. For items covered by a Qualitative Materiel Requirement, these characteristics are reviewed by representatives from the developing agency, the General staff, the Combat Developments Command, the Continental Army Command (for training devices), and using and supporting agencies, as appropriate. This is the first of several in-process reviews to which most development projects are subjected; these are discussed further in paragraphs 9–10 through 9–14. The purpose of the Technical Characteristics Review is to make sure that the developer understands the requirements and has properly stated them in terms of technical characteristics.

d. Guidelines. AR 705–5 sets forth the following guidelines for the preparation of technical characteristics:

(1) They should insure development and integration of essential features and preclude unnecessary, complex, or costly "nice-to-have" features.
(2) They should reflect adequate consideration of the specific environment in which the end item will operate.
(3) They should assure integration of established standards and specifications (Federal, military, and industry) and minimal use of nonstandard specifications.
(4) They should include a quantitative reliability and maintainability objective that can be achieved within acceptable time and cost limits.
(5) They should insure that communications security and electronic security have received full consideration.
(6) They should insure that deficiencies of materiel in the Army inventory are considered, to preclude similar deficiencies from occurring in the new materiel.

Section II. PERFORMANCE CHARACTERISTICS

9–4. General

The performance characteristics set forth in the requirement document form the basis for technical characteristics and preliminary engineering design. They influence the development of the materiel more than any other portion of the Qualitative Materiel Requirement. These characteristics describe what the equipment should do, specifying both upper and lower performance limits. They should distinguish between performance features that are essential to the acceptability of the equipment and those that are desirable, if they can be achieved with-

out a disproportionate increase in cost, complexity, and lead time while maintaining the required standards of reliability and maintainability. They should include the following considerations, when applicable:

a. Environmental considerations, including operating and storage conditions in the areas (subarctic, tropics, mountains, desert) where the equipment will be used. This subject is discussed more fully below.

b. Dynamic actions or changes that occur in the equipment, such as rates, velocities, movements, and noise levels. These required characteristics would include, for example, the speed of a vehicle, the quadrant elevation of a missile launcher, or the peak power of a radio transmitter.

c. Improvements expected in the efficiency of the individual or unit, as related to physical efforts necessary for operating and maintaining the equipment. For example, an equipment setup time of 30 minutes (in contrast to 2 hours for present equipment) might be specified.

d. Quantitative criteria covering the endurance capabilities required to meet user needs under stipulated operating conditions, including minimum total life expectancy, required mission duration, and planned utilization rate. For instance, the life expectancy under given operating conditions of a new radio might be specified.

e. Reliability criteria to indicate that the item will perform its mission adequately for the period intended and under the expected operating conditions. This subject is discussed more fully in paragraph 9–6.

f. Period and conditions of storage before use, and reliability after storage. These considerations might lead to a specification, for example, that the equipment should suffer no more than 2 percent degradation of reliability after twelve months' storage in a forward area.

9–5. Environmental Considerations

a. Policy. The environment in which the equipment is to operate is an important consideration. It affects almost every aspect of the equipment design, from the moisture resistance of an electronic circuit to the mobility of a vehicle. Army policy requires careful consideration of environmental conditions in order to provide a capability for safe and effective use of equipment in the areas of intended use. Normally, the attainment of operational capabilities for the cold regions necessitates that materiel and equipment be specially designed and developed for that environment. This may include standard equipment developed for intermediate climatic conditions for which modification in production for cold regions is determined as most practicable and economical. Considerable emphasis is placed on environmental testing to provide the maximum assurance that the equipment will operate effectively under expected conditions.

b. Major Responsibilities. The Chief of Research and Development has primary Army Staff responsibility for insuring that research and development programs and projects take adequate account of environmental requirements. The Commanding General, Army Materiel Command, is responsible for implementing Army policy on environmental considerations in research and development. The Commanding General, Combat Developments Command, is responsible for stating environmental requirements for new materiel, for monitoring tests to insure that the materiel will satisfy operational needs, and for determining necessary modifications to organizations, doctrine, tactics, or procedures. The Deputy Chief of Staff for Logistics is responsible for insuring that materiel meets the required environmental conditions in the post-development phase.

c. Design Criteria.

(1) Design requirements for meeting environmental conditions are based on the geographic areas where the equipment is to be used. AR 705–15 identifies five such areas in terms of the interactions between temperature and moisture that prevail. They are—

(*a*) Hot-dry climatic conditions (desert areas).

(*b*) Warm-wet conditions (tropical and jungle areas).

(*c*) Intermediate conditions (prevailing in most populated parts of the world).

(*d*) Cold conditions (far northerly and subarctic areas).

(*e*) Extreme cold (a few areas in North America, Greenland, and Siberia, and Antarctica).

(2) All combat and combat support equipment is to be designed to operate under intermediate conditions. If the environment inhibits equipment usage, modification kits will be developed to permit operation under extreme climatic conditions.

9–6. Reliability

a. Policy. Reliability is defined as the probability that materiel will perform its intended function for a specified period under stated conditions. With the increasing complexity and technical sophistication of Army materiel, reliability has become an increasingly critical factor in equipment performance. Accordingly, Army policy lays great stress on achieving reliability during development and precluding the degradation of inherent reliability of materiel during production, storage, distribution, operation, and maintenance. AR 705–25 sets forth Army policy in this area. Reliability terms are defined in MIL–STD–721A, "Definition of Terms for Reliability Engineering."

b. Major Responsibilities. The Chief of Research and Development has Army General Staff responsibility for the formulation of policy and supervision of the overall reliability program pertaining to materiel and equipment. The Deputy Chief of Staff for Logistics and the Assistant Chief of Staff for Force Development are responsible for assuring implementation of reliability policies in their respective areas. Field commands and agencies involved in materiel development are required to establish and maintain reliability controls at appropriate levels to assure both the effective coordination of reliability functions and the implementation of reliability policies.

c. Reliability Information.

(1) *General.* Data of various kinds are required for reliability planning and control during the design, development, test, and evaluation process, as well as the phases of materiel management that follow type classification. These data are required in Qualitative Materiel Requirements, Small Development Requirements, Technical Development Plans, and feasibility studies associated with total feasibility evaluations. The information that is required is of two kinds: operational information and planning information.

(2) *Operational information.* This category affects inherent reliability; that is, "built-in" reliability, as determined by the type of components and subsystems that are required. It includes the following types of information:

(*a*) Planned deployment—the type of organizational units involved, quantity per unit, and mission assigned. For example, a unit antitank weapon to be used by rifle squads of infantry and airborne divisions.

(*b*) Turnaround time required. Assuming that no repairs are required, this is the time needed to service or check the materiel for recommitment or dispatch. For example, the minimum elapsed time from aircraft landing to takeoff, or the maximum time for preventive maintenance and servicing of a vehicle following a 24-hour battlefield day.

(*c*) Reaction time required; that is, the time between the order for an action and the onset of the desired action. For example, the time required for a propulsion system to generate full power after the power-on switch is activated.

(*d*) Mission reliability, or the probability that the system or equipment will perform its intended mission for the specified period under stated condi-

tions. For example, a mission reliability of 98 percent for an estimated mission time of 2 hours during which a transmitter will be operated at peak power.

(*e*) Availability or combat-ready rate; that is, the percentage or quantity of an item capable of performing the designed mission or function versus the total number of items assigned. For example, a minimum availability rate of 70 percent of the trucks assigned to a battalion-sized unit.

(*f*) Operational and maintenance environmental conditions—climatic conditions, maintenance facilities to be available, and so forth. For example, a radar to be operated wherever Army aircraft fly, with normal maintenance and support facilities for organizational and direct support levels of maintenance.

(*g*) Required mission duration, or the time required to complete each type of applicable mission. For example, a helicopter with an endurance of 300 nautical miles or 4 hours of flight while transporting maximum design load.

(*h*) Planned utilization rate; that is, the number of hours, miles, firings, flights, and so forth, per unit of time. For example, the maximum rate of fire for a weapon or the normal peacetime utilization rate of an aircraft, in hours per month.

(3) *Planning information.* The kinds of planning information that affect reliability design include the following:

(*a*) Mean time to repair—the allowable time period during which an item is inoperative so that corrective and scheduled maintenance can be carried out. This information might include, say, the allowable downtime for unscheduled maintenance operations at the various levels of maintenance.

(*b*) Reliability after storage; that is, the goal necessary to comply with intended employment of the item after a specified period of storage. For example, a reliability goal of 98 percent after 3-year field storage or 5-year depot storage.

(*c*) Minimum allowable time between scheduled maintenance functions for each applicable level. This information is dependent on the operational mission for which the materiel is being developed. For example, a period of 18 months between scheduled surveillance inspection for a missile.

(*d*) Test and checkout methodology; that is, extent of automation, complexity of test, degree of fault isolation at various maintenance categories, and special system-peculiar versus multipurpose test equipment. For example, a statement of the extent of new test equipment to be developed, its general characteristics, and the type of test to be performed at each level.

(*e*) Categories of maintenance — the maintenance concept, including specific responsibilities at each level of maintenance. For example, a statement of the maintenance operations to be performed at each level.

(*f*) Maintenance personnel—the number of people and skills and the training allocated for support of the materiel for each category of maintenance. For example, a statement of the Military Occupational Specialties involved, the types of maintenance to be performed (such as special electrical devices repair), and the hours of special training required at each level.

d. Reliability Plan. Based on the information described above, a reliability plan must be prepared to explain how the reliability requirement will be achieved. Projects and tasks for which a Technical Development Plan is required will include the plan in section III

of the Technical Development Plan, as required by AR 705–12. The plan should refer to applicable specifications, and it should include the following information:

(1) Determination of environmental conditions, including heat, pressure, vibration, radiation, and magnetic field intensity for each system, subsystem, and component.

(2) Statement of the system reliability requirements and goals, including the apportionment of numerical reliability values to components, assemblies, and subsystems.

(3) Test specifications, ground rules, and statistical methods of reliability demonstration.

(4) Test plans and schedules for all materiel and equipment.

(5) Objectives of the tests described in (4) above, including a description of sample sizes and the state of development of the materiel to be tested.

(6) The reliability goals to be demonstrated and the circumstances of demonstration.

(7) Reliability activities for evaluation, analysis, and product improvement.

(8) A plan for specification reviews.

(9) A plan for reliability design reviews.

(10) Special procedures for reporting and analysis of malfunctions and failures during development.

e. Reliability Data File. Effective planning and control of materiel reliability depend heavily on the availability of detailed information on past experience with components, assemblies, and subsystems. This information is derived both from developmental tests and from operational experience. Each command and agency involved in materiel development is required to maintain a reliability data file that includes both technical data and tactical and operational data. *Technical data* on individual items of materiel include such information as critical design or manufacturing features, applicable specifications or standards, failure data (modes, causes, and stresses), methods of detection or test, types of failure distributions, recommended preventative or corrective action, estimates of reliability for various applications, and prime manufacturer and alternate sources. *Tactical and operational data* include such information as mission reliability, reliability data for tactically or operationally significant phases of the overall mission, and data for environmental and operational conditions varying from the normal.

Section III. OTHER CHARACTERISTICS

9–7. Physical Characteristics

a. General. The physical characteristics of an item, such as weight, size, and configuration, affect its performance and also its design. In some cases, they derive from the performance characteristics; to achieve a desired operating range, for instance, an aircraft with a given powerplant cannot exceed a certain weight. In other cases, the physical characteristics are dictated by other requirements; the dimensions of an air-droppable vehicle for instance, are constrained by the aircraft that will carry it. The physical characteristics set forth in the Qualitative Materiel Requirement, from which applicable technical characteristics must be developed, include the following:

(1) Weight limits of the system and major assemblies or components, where considerations such as transport, supply, and packaging apply.

(2) Configuration, silhouette, dimensional and cube limitations, crew space, operator station layout, ingress, egress, and access for maintenance.

(3) Details of transport and storage, such as tiedowns, palletization, packaging, and containers.

(4) Durability factors indicating the degree of ruggedness, such as resistance to corrosion, that is required.
(5) Health and safety criteria, including any adverse explosive, mechanical, and biological effects that may occur. This is particularly important for materiel that involves potentially hazardous radiation, such as nuclear and electromagnetic equipment.
(6) Command-control for nuclear systems.
(7) Vulnerability factors, including consideration of atomic, chemical, biological, and radiological operations, electromagnetic radiation, fire, and impact.
(8) Climatic protective requirements.

b. Transportability.

(1) *Policy.* Because of the increasing emphasis on mobility in operations, and because of the farflung activities of the Army, requiring the transportation of men and materiel over immense distances, the transportability of materiel has become a major consideration in research and development. Army policy in this area derives from the Department of Defense Engineering for Transportability Program; it is set forth in AR 705–8. This policy requires that specific consideration be given to transportability in the design of new materiel. The mode or modes of transportation required to meet logistical and operational commitments must be specified at the time when other basic characteristics of the materiel are established. The materiel must be of a weight and dimensions that permit handling by transportation facilities currently available or programed to be available when the materiel enters the inventory. The policy also requires specific attention to the accommodation of materiel that has fragile, sensitive, or dangerous characteristics to blocking, bracing, slinging, and tiedown procedures, and to safety precautions. If a new item of materiel exceeds certain dimensions or meets certain conditions (for instance, sensitive or dangerous characteristics) specified in AR 705–8, the developing agency must request a Transportability Evaluation and appropriate transportability Agency.

(2) *Responsibilities.* One agency in each military department has been designated as a Transportability Agency to implement the Department of Defense Engineering for Transportability Program. For the Army it is the Director of Transportation, Deputy Chief of Staff for Logistics. The Transportability Agency issues supplemental instructions on transportability, conducts Transportability Evaluations of new materiel as required, and maintains liaison with the Transportability Agencies of the other military departments, the Military Airlift Command, and the Military Sea Transportation Service, and with the Director of Defense Research and Engineering.

(3) *Air-portability and airdrop.* Army policies and procedures for air-transportable and air-droppable materiel are set forth in AR 705–35. The Army's increasing use of airmobile combat forces imposes a requirement for the development of materiel that can accompany these forces or that can be dropped to them from transport aircraft. The primary requirement, of course, is for lightness and compactness, although this requirement must not impair essential operational characteristics or impose excessive overall costs. The design and development of air-transportable materiel must take account of both the planned operational use of the materiel and the aircraft that will be available to carry it. Operational requirements are oriented to the three phases of airborne operations.

(*a*) *Phase I—parachute and assault landing.* Combat and support material to be used in this phase must

be capable of delivery by assault-type aircraft or airdrop by light and medium transport aircraft, and of immediate effective employment (except for selected construction equipment, which must be capable of employment within 1 hour after delivery).

(*b*) *Phase II—initial air-landing.* Materiel for this phase must be capable of delivery by light and medium transport or assualt aircraft, and of effective employment within 1 hour (or 2 hours for selected airfield construction equipment).

(*c*) *Phase III—heavy air-landing.* No time requirement is specified for this phase, but the materiel must be capable of being loaded and transported in heavy transport-type aircraft.

(4) Specific data on the payload and significant dimensions of Army and Air Force transport and assault aircraft are provided in appendixes I and II, AR 705–35; more detailed data can be found in specifications and technical documents published by the two services. The Chief of Research and Development is responsible for the overall research and development program for air-portable and airdrop equipment. The Commanding General, Army Materiel Command, is responsible for implementation of this program. The Director of Transportation, Deputy Chief of Staff for Logistics, is responsible for providing data on the characteristics and quantities of Air Force aircraft, and for preparing and coordinating technical guidance on positioning and restraint procedures for the movement of materiel by Army aircraft.

9–8. Maintenance Characteristics

a. General. The increasing complexity and technical sophistication of Army materiel impose increasingly heavy demands on the Army's maintenance organization. They also tend to magnify the cost of materiel maintenance. Accordingly, increasing management attention and emphasis are being directed toward reducing the amount and frequency of required maintenance, the technical skills required to perform maintenance, and the amount of supply support that is required for Army materiel. The development manager plays a key role in achieving these objectives, because the frequency and ease of maintenance for an item of equipment are determined in great measure by its design. Careful attention to the maintenance aspect of design in the early stages can pay great dividends; in one instance, the addition of an inspection hole to a clutch assembly, precluding the need for teardown, reduced the inspection time from 15 man-hours to 15 minutes.

b. Maintenance Concept. The maintainability of a new item of materiel must be considered from the outset of the development. This consideration begins with the definition of a maintenance concept, which should be stated as a part of the requirement document and reflected in the item's technical characteristics. The maintenance concept defines the degree of maintainability that is desired, the types of scheduled and corrective maintenance to be performed at the various levels of maintenance, and the related manpower and skill requirements. The maintenance concept and the design of the item may interact; for example, the use of printed circuits or special test equipment may dictate that certain kinds of maintenance can be performed only at the higher levels, where highly skilled maintenance specialists are available. The maintenance characteristics to be provided in the Qualitative Materiel Requirement include the mean time to repair for the item, and user requirements for the elimination, reduction, or simplification of maintenance. The latter might include the use of modules to accomplish "repair by replacement," or design to permit ease of accessibility to often-checked items such as batteries. filters, and lubrication checkpoints.

c. Army Maintainability Program. The Army's Maintainability Program for Materiel and Equipment is set forth in AR 705–26. Maintainability is defined in MIL–STD–778 (Main-

tainability Terms and Definitions) as the probability that an item will conform to specified conditions within a given period of time when maintenance action is performed in accordance with prescribed procedures and resources. It is closely related to reliability. Maintainability is a basic characteristic of materiel and equipment; however, the need for maintainability of materiel and equipment is affected by its reliability characteristics. It is important that the required reliability characteristics be predicted accurately and incorporated into the delivered materiel so that the scope and magnitude of the maintenance design and engineering effort can be realistically determined. Army policy calls for specific emphasis on the achievement of maintainability goals during the design and development phase, when the inherent maintainability of the item is established. It also calls for the establishment of maintainability goals and minimum acceptable levels, regular review of progress toward these goals during development, accumulation of test and operational data on equipment maintainability, and the publication of maintainability design guides for pertinent commodity areas.

d. Major Responsibilities. The Chief of Research and Development has Army General Staff responsibility for policy formulation and overall supervision of the Army Maintainability Program. The Deputy Chief of Staff for Logistics has overall General Staff reponsibility for maintainability as it is related to maintenance policy and planning. Both the Deputy Chief of Staff for Logistics and the Assistant Chief of Staff for Force Development are charged with the implementation of maintainability policies in their respective areas of interest. Field commands and agencies involved in materiel development are required to establish and keep in operation maintainability activities at appropriate levels to assure effective coordination of maintainability functions and the implementation of policies.

e. Maintainability Information. Data of various kinds are required for maintainability planning and control during the design, development, test, and evaluation process, as well as in the phases of materiel management that follow type classification. These data are required in requirements documents, Technical Development Plans, and feasibility studies associated with total feasibility evaluations. The information required in maintainability falls into the same categories as the information called for in connection with reliability (para 9–6*c*). It includes *operational* information (planned deployment, turnaround time, reaction time, mission reliability, availability or combat-ready rate, operational and maintenance environmental conditions, mission duration, and planned utilization rate) and *planning* information (mean time to repair, reliability after storage, minimum allowable time between scheduled maintenance, degree of repair desired by component assembly replacement, test and checkout methodology, categories of maintenance, and maintenance personnel).

f. Maintainability Plan. Based on the information described above, a maintainability plan must be prepared to explain how the maintainability requirement will be achieved. The plan should include the following information:

(1) Quantification of maintainability—the development and application of numerical measures of maintainability, such as mean time to repair, and the allocation of overall system measures to all major elements of the system.

(2) Prediction or determination of operational and test environmental conditions.

(3) Statement of system maintainability requirements and goals.

(4) Test specifications, ground rules, and statistical or figure-of-merit methods of demonstrating maintainability.

(5) General test plans and schedules for all systems, subsystems, materiel, and equipment, including a description of sample sizes.

(6) Objectives of tests listed in (5) above, including the state of development of the materiel to be tested.

(7) Maintenance task and skill analysis.

(8) Apportionment of system requirements or goals to be demonstrated, and the circumstances of demonstration.

(9) Procedures for maintainability evaluation, analysis, and design improvement.

(10) Plans for in-process reviews of maintainability specifications.

(11) Plans for maintainability design reviews.

(12) Special procedures for malfunction and failure reporting, data feedback, and analysis during development and early production.

g. Maintainability Data File. Effective planning and control of maintainability depend on the availability of detailed information on past experience with components, assemblies, subsystems, and systems. This information is derived both from developmental tests and operational experience. Each command and agency involved in materiel development is required to establish a maintainability data file, to include such information as pertinent maintenance criteria, predicted maintenance skills and man-hours, design criteria, critical design or manufacturing features, applicable specifications or standards, modes of failure, types of failure distribution, maintainability difficulties, recommended preventive or corrective action, and estimates of maintainability for various applications.

h. Maintenance Support Planning.

(1) Maintenance support planning begins with the development of the maintenance concept portion of the Qualitative Materiel Requirement. Planning becomes progressively more definitive through the feasibility, design, development, evaluation, production, and procurement phases. Timely and effective maintenance support planning is required to assure that all elements of maintenance support are developed concurrently with the development or procurement of the item and are available prior to or at the time of equipment distribution. Maintenance support planning is discussed more fully in chapter 16.

(2) The maintenance support plan is the management tool designed to identify action elements of maintenance support that require timely execution and completion by the responsible agencies. A maintenance support plan is prepared for each supportable end item, assemblage, or system as soon as the development project is sufficiently advanced to warrant scheduling of key elements, but not later than the date when a contract is awarded for development test models. The elements of maintenance support covered in the plan include requirements for maintenance personnel, new or changed skills, instructor and operator personnel, repair parts, tools and test equipment, support and ground handling equipment, technical manuals, technical assistance, maintenance float, modification work orders, and calibration.

(3) Maintenance evaluation is a phase of maintenance support planning that begins at the time of preparation of the Qualitative Materiel Requirement or Small Development Requirement and is completed prior to quantity production or procurement of the item for its initial entry into the Army inventory. It consists of maintenance engineering analysis, including teardown and test, where necessary, of early production prototype and/or development models by maintenance engineers for the purpose of determining the most feasible method of supporting the equipment, determining the definitive requirements of each element of maintenance support, completing maintainability analysis of selected equipments at the time of each in-process review (para 9–12), allocating maintenance operations to the appropriate maintenance categories, and detecting design parameters that have an impact upon main-

tenance and forwarding recommended improvements for inclusion in the maintainability data file.

9–9. Human Engineering Characteristics

a. General. Human engineering characteristics express the requirements for compatibility of an item of materiel with the physical and mental capabilities of operating and maintenance personnel. These requirements embrace a wide range of considerations, from the ability of a mechanic to reach a bolt to the need for protection from atomic radiation. The factors that must be taken into account include the areas that may require human factors engineering to eliminate potential personnel support problems, requirements for personal and protective equipment to be worn or carried by user personnel, environmental factors induced by the operation of the equipment (vibration, blast, noise), and information needs for operator decisions—fields of view, warning alarms, and communication procedures and systems, among others.

b. Responsibilities. The Chief of Research and Development has Army Staff responsibility for planning, programing, coordinating, and supervising Department of the Army nonmateriel research in human factors. This research ranges from personnel measurement to studies in motivation and leadership. The Army Materiel Command is responsible for research to produce human factors engineering data required for the design and development of materiel. It also has responsibility for applying human factors engineering to all materiel for which the Command has development responsibility, to insure compatibility of equipment with operational and maintenance personnel. Each subordinate command of the Army Materiel Command is required to maintain a human factors engineering activity to proved design assistance and insure adequate consideration of human factors in the development process. The Surgeon General is responsible for Army research in psychophysiology and for the human factors engineering of all Army medical materiel. The Chief of Engineers is responsible for human factors engineering of materiel in his assigned area of development responsibility.

Section IV. MANAGING THE TECHNICAL DEVELOPMENT

9–10. Priorities Among Characteristics

a. Technical Characteristics. In the Qualitative Materiel Requirement, the item's characteristics must be listed in their order of priority, with weights assigned when appropriate to indicate their relative importance. Human engineering characteristics are not listed as a separate priority; they are considered an associated characteristic integral to performance, physical, maintenance, and other characteristics. The priority of characteristics gives the development manager a guide to the areas of primary management attention as the development proceeds. It also has a significant influence on the design of the materiel; a high priority on system reliability, for example, may dictate the use of redundant circuits with a concomitant increase in weight. The priority list also helps to keep the distinction clear between essential features and desirable or "nice-to-have" features that may have to be sacrificed in order to meet the primary objectives of the development.

b. Schedule and Cost Requirements. Technical requirements can rarely be considered apart from their schedule and cost implications. The complexity and difficulty of the development determine the amount of time and money that it will entail. Conversely, time or cost limitations may influence or even dictate some aspects of the design—for example, a state-of-the-art propulsion system may be preferable to one that promises better, more economical performance, but that involves an unacceptable extension of the development time. Thus, schedule and cost requirements in many cases take equal priority with technical considerations; the two dominant objectives of the Lance missile development, for example, are reliability and unit cost.

9-11. Standardization, Specifications, and Standards

a. Standardization Objectives. A degree of standardization may be applicable in any phase of the materiel cycle prior to disposal. The objectives of standardization in the Army are to—

(1) Improve the operational readiness of the military services by increasing efficiency of design, development, materiel acquisition and logistics support.

(2) Conserve money, manpower, time, facilities and natural resources.

(3) Minimize the variety of items, processes and practices which are associated with design, development, production and logistics support of equipment and supplies.

(4) Enhance interchangeability, reliability and maintainability of military equipments and supplies.

b. Specifications and Standards. The primary means to achieve these objectives are the issuance of Federal and Military specifications and standards. Specifications are defined as documents intended primarily for use in procurement, that are clear, accurate descriptions of the technical requirements for items, materials, or services, including the procedures by which it will be determined that the requirements have been met. They include both general specifications (which cover the common requirements for a family of items) and detailed specifications (which cover the detailed requirements of a specific item). They may define requirements in performance terms of capacity, function, capability, or operation; or they may define requirements in enough design detail so that the item can be made by any competent manufacturer. Design characteristics are usually described on drawings, which are made a part of the specification by reference. Standards and specifications are prepared by the Federal Government for items that are used by two or more Government agencies, and by the military departments for items with applications that are solely military. They are also developed by industry—by industrial and professional associations for industry-wide use, and by individual companies for their own use. Most specifications are a combination of performance and design requirements. Standards are defined as documents that establish engineering and technical limitations and applications for items, materials, processes, methods, designs, and engineering practices. They have three purposes—

(1) To limit the selection of materials, items, and services in order to provide for functional and physical interchangeability of parts, subassemblies, assemblies, components, and equipments.

(2) To establish basic engineering terminology and codes.

(3) To limit the variety of end-use items that can be procured for stock and issue.

c. Application to Materiel Development. Wherever feasible, military operational requirements for materiel shall be satisfied through the use of existing military designs or commercial products. If a military need can be satisfied only through new development, the new development authorized is to encompass, to the greatest extent practicable, all equivalent needs of the Military Departments and Defense Agencies. Military operational requirements generated by one Military Department/Agency for equipment and supplies that may have application in another Department(s)/Agency(s) will be disclosed to such Department(s)/Agency(s) to insure the opportunity for standardization. In the phase of exploratory development and advanced development, the use of existing standard items and engineering practices is advocated in the interest of economy, where these satisfy the needs of such program efforts. However, use of standards is secondary to the prime objective of these development categories; e.g., proof of a concept. In engineering development and operational system development where the systems and equipment are engineered for eventual service use, a maximum degree of standardization is to be achieved without causing unacceptable compromise of performance, reliability, timely availability or cost of systems

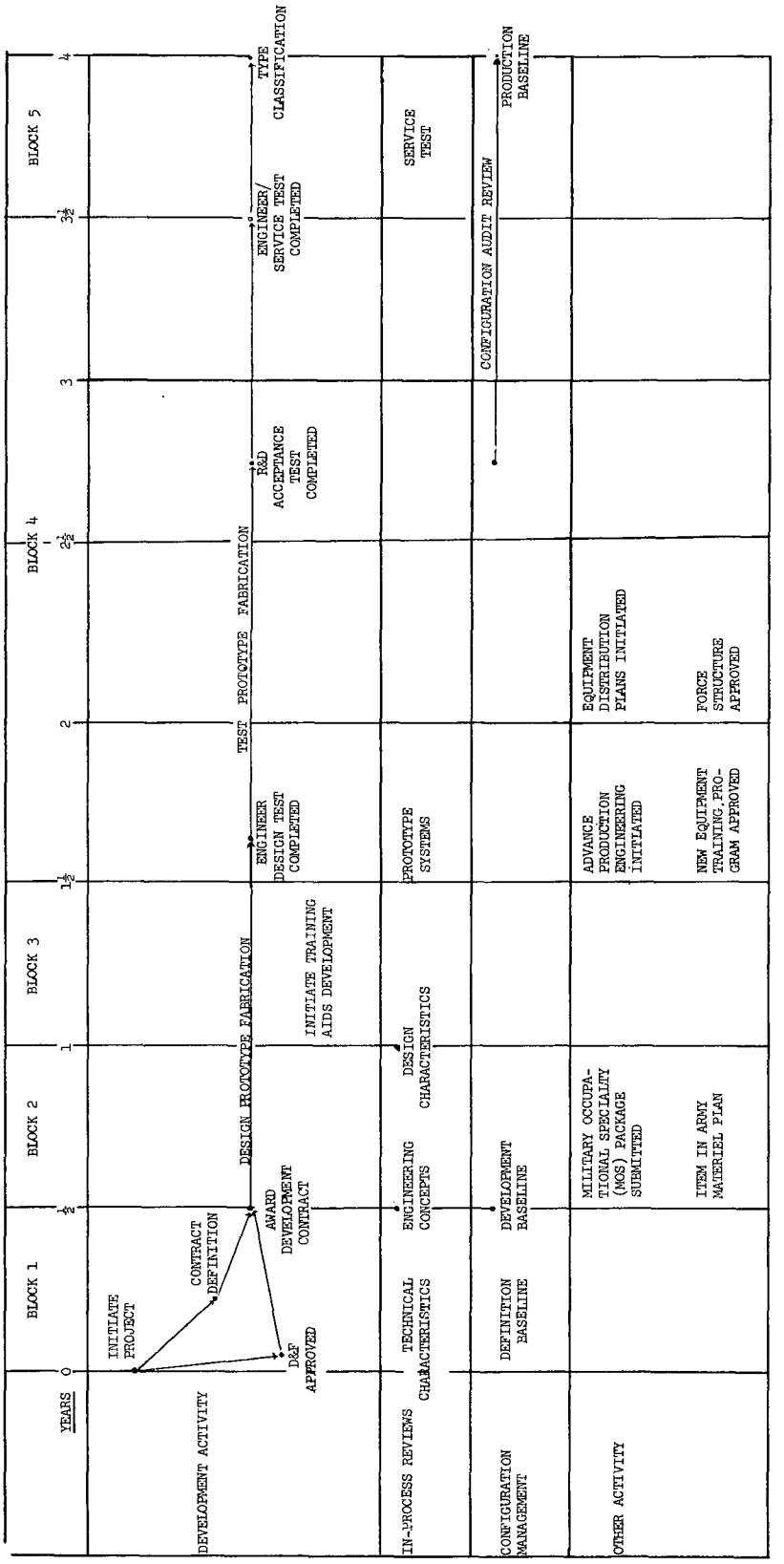


Figure 9-1. Development network.

and without preventing the application of the most advanced proven techniques or hardware.

9–12. Controlling Technical Development

a. General. The process of controlling technical development is carried on through a combination of reviews, reports, and monitoring by telephone, and by visits to the site of the development effort, whether it is being undertaken in-house or by a contractor. The management information systems available to the manager of a development project, including the Configuration Management System for controlling changes and insuring the physical integrity of the equipment, are described in chapter 11. This section describes the system of in-process reviews by which the Army monitors the progress of a development at key points. It also refers to related events of significance in the development process.

b. The Development Network. The discussion that follows is keyed to the network shown in figure 9–1. This network represents a typical development project, time-phased semiannually over a 4-year period. The network is not prescriptive; in an actual project, additional activities and milestones might occur, and some of those shown in the network might be eliminated. Moreover, lead time considerations might change the timing substantially; the process of concurrent development and production is discussed in paragraph 9–13.

c. Project Initiation. The initiation of a development project occurs at the time when funding shifts from the Exploratory or Advanced Development categories to Engineering or Operational Systems Development. For designated projects, it marks the transition from Concept Formulation to Contract Definition. An approved Determination and Findings (D&F) is required as authority to enter into a contract by negotiation.

d. Technical Characteristics Review (Block 1). The review of technical characteristics is the starting point for the development. This review is conducted to insure that the developer understands the requirements and has properly stated them in terms of technical characteristics. These characteristics, once approved by the proper authority, are used as the basis for full-scale development, either in-house or under a contract. The approval of technical characteristics also provides the basis for establishment of a Definition Baseline, the first of three reference points in the Configuration Management System.

e. Engineering Concepts Review (Block 2). The review of the engineering concept is conducted to insure that the contractor or in-house facility is not starting a program that is beyond the state of the art or that contains too many areas of high risk. For a project that has undergone Contract Definition, it is held after the receipt of reports from the contractors and before award of the development contract. For developments that do not go through Contract Definition, it should be held before finalizing the award of a development contract. For in-house projects, it should be held after finalizing the engineering concept and before proceeding to actual protoype hardware or model fabrication. The engineering concept review provides the basis for the Development Baseline, the second reference point in the Configuration Management System. As the development proceeds, the Military Occupational Specialty package, describing the knowledge and skills required for operation and maintenance of the equipment, is evolved. During the same period, information is developed on the item under development for incorporation in the Army Materiel Plan, which sets forth the Army's procurement plans for major and secondary items and high-cost repair parts. The Army Materiel Plan is described in chapter 14.

f. Design Characteristics Review (Block 3). The review of design characteristics is held prior to release of the design for prototype fabrication. It is generally held after a mockup or model has been fabricated. It provides the basis for development of a prototype to be used for Engineer Design Tests and Maintenance Evaluation Tests (described in ch 12). During this period, the requirements for training aids and devices are determined, and Small Development Requirements for their development are prepared.

g. Prototype System Review (Block 4). Upon completion of the Engineer Design Tests, which are performed to collect design data, confirm preliminary concepts and calculations, and determine the capability of components, the prototype system review is conducted. The purpose of this review is to examine the actual hardware, performing as a complete system, and to compare it with the physical and performance characteristics specified in the Qualitative Materiel Requirement. This review provides the basis for fabrication of Engineer/Service Test models or prototypes. It may also be the basis for initiation of advance production engineering, the first step in the production phase. During this period, other planning activities include the following:

(1) *New Equipment Training Program.* This program identifies all necessary personnel and training activities, and their interfaces with the development, production, and distribution milestones for each component or subsystem.

(2) *Initiation of Equipment Distribution Plans.* These plans provide an approved distribution plan for each new combat-essential end item from its initial inclusion in the Army Materiel Plan until its ultimate disposal. They are described in chapter 14.

(3) *Approval for Inclusion in the Force Structure.* This activity provides the basis for scheduling for production in the Five-Year Force Structure and Financial Program. It permits projects, when desirable, to go from Engineering Development to Operational Systems Development before the development phase is completed.

(4) *Completion of Engineer/Service Test Prototype Fabrication.* This signals the satisfactory completion of the fabrication of models for Engineer and Service Tests, and initiates the Research and Development Acceptance Tests.

(5) *Research and Development Acceptance Tests.* These are tests conducted by or under the control of the development agency for contractor-developed items to insure that the requirements of the development contract have been fulfilled and that the item is acceptable for further testing by the Test and Evaluation Command.

(6) *Completion of Engineer Design.* This phase is completed when the test models have been shipped to the testing agency for Engineer/Service Tests.

(7) *Configuration Audit Review.* This is the first major review required in the Configuration Management System. It is a technical audit in which available documentation is compared with prototype hardware. It normally is initiated before the start of Engineer/Service Tests, but is not completed until after the Service Test in-process review. It provides the basis for the Production Baseline, the third reference point in the Configuration Management System.

(8) *Engineer/Service Tests.* These tests, usually conducted together, are intended to determine the technical performance and safety characteristics of the item and its suitability for use by the Army. The Service Test provides a basis for recommendations for type classification. This phase is completed when the test reports have been approved and recommendations have been submitted to the Department of the Army.

h. Service Test Review. This is the final in-process review. It is conducted upon completion of the Service Test or integrated Engineer/Service Tests, in order to arrive at a recommendation for adoption of the item as standard or for action to remedy shortcomings and deficiencies found during the testing. It is followed by type classification, which marks the end of the development phase.

9–13. Concurrent Development and Production

a. Criteria. Under normal circumstances, the development process is completed before production begins. In some instances, however, a drastic shortening of the time from initiation of a project to delivery in the field is necessary. In these circumstances, attempts to compress the individual steps in development and production rarely meet the urgency of the needs. Accordingly, it is sometimes necessary to overlap the development and production phases. Concurrent development and production requires extremely careful planning; it usually entails the expenditure of additional funds; and it often results in major retrofit programs. For these reasons, it is essential that only those projects with a genuine need for early delivery be considered for concurrent development and production. The primary requirements are a proven need well ahead of the time that normal procedures would allow, and evidence that the additional costs to be incurred are justified by the benefits derived from the time saved. The initiation of concurrency procedures is permissible only upon direction by higher authority.

b. Procedure. Concurrent development and production normally will be accomplished by a single contractor and facilitated by a single contract covering development, advanced production engineering, fabrication of Engineering and Service Test models, limited production, and an option for the first standard-model production contract. The process involves virtually all the development and production milestones of the normal materiel life cycle; however, their relative sequence is different. The principal changes are the early initiation of advance production engineering and limited production. This procedure follows the same system of in-process technical reviews and Configuration Management baselines that the normal procedure does. But it requires very close coordination between development and production personnel, both in the Army and in the contractor organization.

9–14. Controlling Performance, Schedule, and Cost

a. Systems Aspects. Many—perhaps most—items of Army materiel have applications that involve other items. Thus a component is part of an assembly; a radio, part of a communications network; a shell, part of a weapon. Many items have multiple applications, each involving systems aspects. A tactical radio, for example, may be used in Army aircraft and by ground units for air-to-air and air-ground communication; on the ground, it may be used by infantry, artillery, and armor units. The development manager must, accordingly, be continually aware of the systems implications of the item for which he is responsible. If the item itself is a system, his primary concern will be for the effective physical integration and the well-coordinated development of all the subsystems. If the item is a component or subsystem, he must be constantly alert to the applications for which it is intended, and particularly to its interfaces with other hardware. These interfaces almost invariably have implications for the schedule and cost objectives, as well as for the technical requirements. The selection of an aircraft engine, for example, affects not only the aerodynamics, structure, and performance of the aircraft, but also its unit cost, operating cost, and, possibly, development time. The problem is often complicated by the timing of separate developments that must be integrated into a single system. The development of aircraft electronics equipment (avionics), for example, usually takes longer than the development of an airframe. However, because the avionics are generally provided as Government-furnished equipment to the airframe contractor, their development and production should be completed ahead of that of the airframe. Unless the manager of the system development is alert to this problem and gives early, concentrated emphasis to the selection and scheduling of compatible equipment, the project may go seriously out of phase, with attendant schedule slippages and cost increases.

b. Value Engineering. Value engineering is a systematic approach to the analysis of equipment design. Its objective is to assure the

achievement of the required function at the lowest practicable overall cost (development, production, and support), without any degradation in quality, reliability, performance, maintainability, interchangeability, or delivery requirements. It is performed by value engineering teams (both in-house and contractor) whose members represent various functional disciplines—design engineering, industrial engineering, manufacturing, and procurement, for example. The application of the value engineering should begin as early as possible in the development cycle, preferably at the design characteristics review. It should continue until it is determined that no further benefits are possible.

c. Trade-Offs. Throughout the development process the development manager is confronted with the necessity of making trade-offs among technical parameters and among technical, schedule, and cost objectives. He may have to choose between two guidance systems for a missile—one a well-defined, reliable, but relative costly system, and the other much less expensive but unproven. He may have to choose between two approaches to the development of a tactical radio-one combining low weight and limited versatility of application, the other offering great versatility but substantially greater weight. He may have to balance the requirement for a specified level of reliability against the increases in cost, weight, maintainability, and equipment volume that will be required to achieve that level. To maintain control of the development and to make trade-offs wisely, the manager must be informed of the status of the technical effort, and he must have a means of directing his attention to the most critical areas. One such means is the "impact matrix," which portrays in the order of their priority the technical requirements that must be met and the degree of progress toward their achievement at a given time. This technique is discussed in Army Materiel Command Regulation 11–16, Volume II. On the basis of the information that he has on the status of technical performance, schedule, and cost, the manager may direct that studies be made to analyze and evaluate the available alternatives. These may range from paper analyses through the use of mathematical optimization techniques such as linear programing to the development of full-scale mathematical models and the simulation of equipment performance in operational conditions. Many such studies take the form of a cost/effectiveness analysis. The cost/effectiveness approach is best known and most commonly used for the comparison of alternative weapon systems, but it has equal value in the analysis of alternatives for a system under development, whenever the alternatives vary significantly as to the cost of development, production, or support.

CHAPTER 10

SOURCE EVALUATION AND SELECTION

10–1. Sources Available

a. The Four Categories. In general, a decision must be made early in the materiel development planning process in regard to the type of sources that will be employed in carrying out a particular Army development effort. For this purpose, potential sources may be grouped into four broad categories.

(1) Army in-house facilities.

(2) Other Federal agencies.

(3) Domestic profit-making and nonprofit-making organizations and institutions.

(4) Foreign sources.

b. In-House and Domestic Resources. Of the four categories, two—Army in-house and domestic sources—are the most frequently used for Army materiel development programs. The decision as to whether a particular materiel development program should be performed in-house, by contract, or through a combination of the two can be made by the developing agency.

c. Factors in Source Determination. The responsible command should consider a number of factors in making a source determination. For example, it is a general policy that the Federal Government should not provide products or services that can be obtained from private industry at lower cost and at no detriment to military readiness. In effect, this policy expresses a strong preference for satisfaction of military needs by contract. At the same time, the responsible command generally has the option to use existing in-house facilities to the extent that they are available. An example of in-house development and production is the M–60 tank, which is a product of the Army Tank-Automotive Center at Warren, Mich.

d. Relative Percentage of Expenditure. Typically, a larger percentage of research and development dollars than production dollars is used in-house. Of the obligational authority annually available for Research, Development, Test, and Evaluation, Army, approximately 50 percent is spent in-house, while only about 20 percent of all Procurement of Equipment and Missiles, Army, dollars is spent in-house. Also typical is the fact that most of the in-house dollars for research and development are expended early in the cycle—that is, in Research and Exploratory Development, and to some extent in Advanced Development.

e. Other Criteria. In addition to the Presidential policy of avoiding Government competition with industry, several other criteria for consideration are available to the commander who must make the in-house or out-of-house decision. The key question should be: Who can do the job most effectively, an in-house facility or a contractor? In this respect three elements stand out: capacity, technical competence, and cost. AR 705–55, pertaining to management of in-house laboratory facilities, indicates that these are the important criteria and that the choice should not depend on some arbitrary, predetermined limit or ratio.

10–2. Evaluation and Selection of Outside Sources

Once it has been decided to conduct materiel development out-of-house, a further source selection problem is apparent. From the whole universe of potential contractors, which one or ones should be selected to carry out the development? The objectives are easily stated—to select the source most likely to meet the Gov-

ernment's requirements in an optimum manner, and to conduct the selection efficiently. To attain these objectives, however, is often a difficult matter. First, because of the technological uncertainty of development work, predicting which contractor or contractors will do the most effective job is very difficult. Moreover, the selection process is not carried out in a technological vacuum; rather, it occurs in the real world of conflicting economic, political, and personal interests. Accordingly, source selection is truly subjective, and human fallibility is sometimes evident.

10–3. Bases for Outside Source Selection

a. Essentially, there are two bases for contractor selection: price and the ability to perform. The latter is defined as both technical and business capability. The relative weight given to technical and business capability on the one hand, and price on the other, depends on the relative importance attached to the two, combined with the availability of appropriate data. Technical and business considerations usually predominate during the early stages of the development spectrum for two reasons: the success of the program may depend on selecting the contractor with the greatest technical and business skill, and technological uncertainties at this early stage make price projections unreliable criteria for selection. Later, as solutions are found to various technological problems and the system moves through final design and testing into early production, technical and business requirements become less demanding and more predictable. In effect, it then becomes increasingly possible to define the minimum standard of technical and business competence required for successful performance. This standard permits greater emphasis to be placed on price considerations in selecting from among sources that can meet the technical and business management standards. When the production phase is well along, the materiel requirement can be so clearly defined by specifications, drawings, and other documentation that sources will be both willing and able to develop

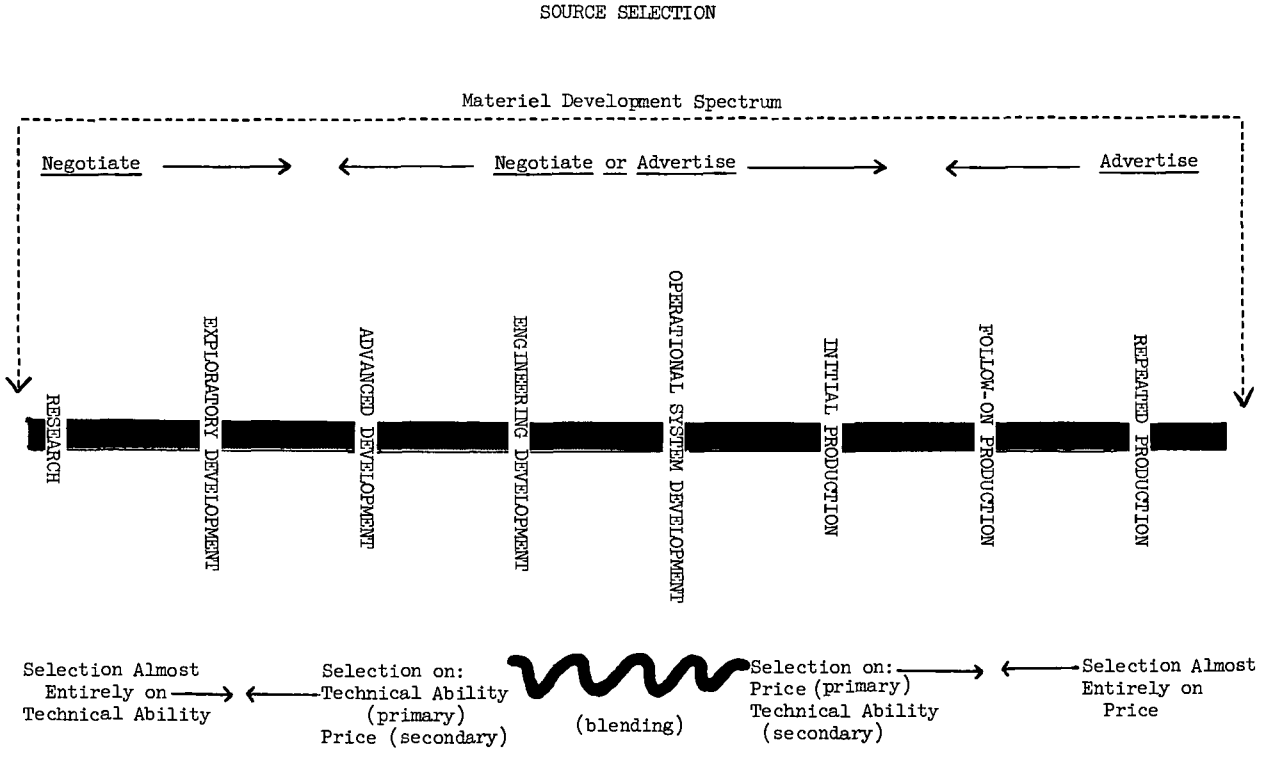


Figure 10–1. Source selection.

and commit themselves to firm quotations. At this point, formally advertised competitive procurement becomes feasible. A generalized pictorial display of this process is set forth in figure 10–1.

b. The Armed Services Procurement Act and the implementing Armed Services Procurement Regulation specify that formally advertised, competitive bidding is the preferred method of procurement and must be used where feasible. Before formal advertising can be an effective method of procurement, plans and specifications must be reasonably definitive; there must be enough bidders to assure adequate competition; and there must be time to carry out the bidding process. If all these conditions do not exist, then the procurement should be made by negotiation. Procurement by negotiation, however, does not automatically mean that price is unimportant in the selection process—at the research pole of the materiel development spectrum, price is considered to a substantially lesser degree in selection. Throughout the center section of the spectrum, price (as well as technical and business considerations) is a factor.

c. The Armed Services Procurement Regulation [3–102(c)] also provides that negotiated procurements shall be on a competitive basis to the maximum extent practicable. Adding this requirement to the preference for price competition, a priority of bases for selection in negotiated procurement can be developed in descending order, as follows:

(1) Price competition, with award going to the lowest responsible offeror (preferred choice).

(2) Price, technical, and business competition, with award going to the contractor having the best mix of these factors (second preference).

(3) Technical and business competition only, with award going to the contractor having the highest technical and business capability (third choice).

(4) Award to a sole-source contractor tested neither by price nor by technical and business competition (least preferred).

d. Price is the easiest basis for selection, since it is the most objective criterion and by nature is quantitative. Award to the low responsible bidder or offeror after competition is a solid answer to any objection raised by disappointed competitors. In addition, it is most conservative of public moneys. As pointed out earlier, however, price competition cannot be meaningful unless the buyer is reasonably certain that the prospective bidder can satisfy his requirement and that prospective bidders have an adequate basis for development firm price quotations.

10–4. Selection Primarily on Other Than Price

a. General. This section considers the processes and problems of source selection where technical and business criteria are the primary bases of selection. As noted earlier, other criteria than price assume an increasingly important role in the selection process as one approaches the research end of the research and development spectrum. Precisely what criteria are used or what weights are attached to them will, of course, depend on an analysis of program requirements. For example, in the case of small-dollar-value Basic or Applied Research efforts, the availability of one or more specific technical skills may be the overriding consideration. As the program increases in size and complexity, various management capabilities (as well as technical capabilities) obviously will be required of the selected source for successful performance. A thorough understanding and careful analysis of the work to be performed and skills required for such performance are absolutely essential for effective selection of research and development sources.

b. Policy.

(1) A number of policy statements have been developed that provide broad guidelines for source selection, at the same time allowing the selecting official considerable latitude to tailor specific procedures and criteria to the particular program. AR 715–6 established within the Army the basic De-

fense Department policy applicable to the following types of programs:

(*a*) New production systems or projects where the anticipated cost is estimated to exceed $100 million, except where award is to be made solely on the basis of price competition.

(*b*) New Operational Systems, Engineering, or Advanced Development contracts where the cumulative research, development, test, and evaluation cost is estimated to exceed $25 million.

(*c*) Whatever other specific systems or projects the Secretary of the Army may designate.

(2) The projects that fall under this directive are thus the same as those to which Contract Definition is applicable (ch 8). That Contract Definition and source selection go hand in hand should be self-evident. Contract Definition has proven invaluable from a source selection standpoint by providing a clear definition of precisely what must be done prior to final selection, and by making possible a comparison of competing firms. In addition, by keeping competition open until the nature of the effort has been fully established and technological uncertainty reduced, Contract Definition, in effect, permits substantially greater emphasis to be placed on price as a selection factor.

c. Responsibility for Source Selection. The source selection policies and procedures of AR 715–6 provide that selection will ultimately be made by a "Source Selection Authority." This Source Selection Authority may be the Secretary of Defense. Usually, however, for Army procurements this responsibility is delegated to the Secretary of the Army and may be redelegated not lower than the head of a commodity command or the equivalent. The choice of level for the Source Selection Authority will depend upon the military and political importance of the procurement. The Source Selection Authority, in turn, appoints a Source Selection Advisory Council made up of members who represent all areas concerned in the specific procurement (that is, the user, research and development, logistics, other Department of Defense components, and other Government agencies). The Source Selection Advisory Council establishes evaluation criteria and weighs them in order of their relative importance; decides the relative importance of evaluation criteria to be included in the Request for Proposal; and establishes a Source Selection Evaluation Board and names its chairman. When proposals are received, the Source Selection Evaluation Board evaluates and scores the proposals against technical and operational requirements established in the Request for Proposal. It prepares a narrative justification for the evaluation results, and forwards this justification to the Source Selection Advisory Council; the Board also provides any briefings and consultation required by the Source Advisory Council. The Council then reviews contractor program histories. If necessary, it may interview particular contractors and/or visit the contractor's facility. It then reviews the Evaluation Board's findings and applies the established weights to the evaluation results. Next, the Council prepares the proposal analyses and forwards the package to the Source Selection Authority. This Authority makes the source selection decision after careful analysis of all the information and data made available by the Source Selection Advisory Council. Finally, the Council Documents for the Source Selection Authority's signature a justification for the selection.

d. The Source Selection Authority. This source selection process is continuously under the supervision and direction of the Source Selection Authority, who is responsible for assuring that the selection procedure is consonant with the requirements of the Armed Services Procurement Regulation. The Authority is also responsible for seeing that evaluation, selection, negotiation, and award are accomplished within 18 calendar weeks of the submission of proposals, unless he has approved some deviation from this time schedule.

e. Procedural Variations. As has been stated, the policies and procedures of AR 715–6 expressly apply to major procurements only. However, the functions and processes included in it are substantially common to all source selections, regardless of dollar amount, where price is not the primary basis of selection. Only the formalities and the high level of the Source Selection Authority distinguish high-dollar from lesser-dollar selections. Thus, for lower-dollar-value selections, variations on the policies and procedures enumerated above are permissible. It is not uncommon to combine the functions of the Source Selection Advisory Council with those of the Source Selection Evaluation Board; or for the Source Selection Authority to be, in reality, a validating rather than a selecting official. Again, however, the important point is that the functions and processes for all source selections are generally similar.

f. The Request for Proposal.

(1) *Preparation of Proposals.* An important—perhaps the most important—task in source selection is the preparation of the Request for Proposal, since this document largely determines the nature and scope of data that will be available for source selection. Extreme care and close coordination between the functional specialists in the Government are essential to the preparation of a good Request for Proposal. Contractors prepare their proposals on the basis of the information contained in them. If the proposals are to be meaningful, they must clearly state what the Government wishes to buy and all the conditions under which it wishes to buy. This does not mean that no latitude should be permitted the contractor in responding. On the contrary, the fact that research and development programs, by nature, include some degree of technological uncertainty suggests that it is desirable to allow prospective sources to propose alternative approaches. However, such flexibility should not be permitted as an excuse for an ambiguous or incomplete statement of work.

(2) *Guidance for Proposals.* In addition to describing the required work, the Request for Proposal should provide guidance on the nature and scope of the proposals to be submitted by prospective contractors. Such guidance is extremely important in making sure that those responsible for evaluating and selecting prospective sources are supplied with the data they need. The types of data that should be requested depend on the particular procurement. At a minimum, the Request for Proposal should require the contractor to set forth his proposed technical and management approaches, major milestones, estimated costs, and pertinent prior experience. A more detailed breakout of information required under each of these categories is generally desirable. Consideration should be given to the types of criteria that will be used in evaluating the proposals. It may, in fact, be helpful to list such criteria (but not their weights) in the Request for Proposal.

(3) *Limitations on Proposals.* If some Requests for Proposals have failed to request important information, others have asked for too much. This, together with the natural tendency of competing firms to try to "cover the waterfront," has resulted in unnecessarily long and complex proposals. In one recent procurement, for example, the proposals submitted completely filled a room twenty feet square. In other instances, the size of proposals has been measured not by the number of pages but by the number of volumes. Such voluminous proposals are extremely expensive to prepare—there have been cases in which proposals have cost the would-be contractor $10 million. A large share of this cost is ultimately borne by the Government through overhead charges to other Government contracts. In

addition, the voluminous proposal imposes a tremendous burden on Government personnel who must attempt to separate the relevant data from the irrelevant. Because of this, some procuring activities have imposed limitations on the number of pages included in the proposal. Such limitations have served to encourage better organized and more clearly thought-out proposals and have contributed significantly not only to a reduction of the time required for evaluation but, even more important, have improved the effectiveness of the evaluation.

g. Developing a Source List.

(1) A second important task in the source selection process is the development of a source list of potential contractors. Various inputs may be used in drawing up an appropriate source list—

(*a*) Recommendations from technical personnel based on their knowledge of the field.

(*b*) The procurement agency Bidders List.

(*c*) Records of other agencies buying similar products or services.

(*d*) Sources supplied by the agency small business specialist.

(*e*) Information contained in the Army Materiel Command Research and Exploratory Development Data Bank (Army Materiel Command Regulation 70–25).

(*f*) Presolicitation notices.

(*g*) Returns from advance notices for research and development sources in the *Commerce Business Daily* (Armed Services Procurement Regulation 1–1003.4).

(*h*) Unsolicited proposals.

(2) Frequently the problem is too many potential sources rather than too few. It is, of course, a basic tenet of Government procurement that all contractors shall have an equal opportunity to obtain Government business. This does not mean, however, that proposals should be solicited indiscriminately from all firms that might conceivably be interested in the work. Armed Services Procurement Regulation 4–205.2 provides that for research and development procurements, the contracting officer shall request proposals only from contractors who have been evaluated and found qualified to perform research and development in the fields involved in the proposed contract. If an unsolicited contractor responds to synopsis (publication of the proposed procurement in the *Commerce Business Daily*, as prescribed in Armed Services Procurement Regulation 1–1003) or other publicity, a Request for Proposal is furnished unless the contractor has been found unqualified in the field or fields required in the past 6 months. If the requesting contractor has not been evaluated in the past 6 months, the Request for Proposal is accompanied by an explanation of the reasons for limited solicitation and a warning of the likelihood that another source may become the successful proposer. In this manner equality of opportunity is preserved while, at the same time, preparation of proposals by organizations that appear to lack the necessary capability is discouraged.

h. Preproposal Conferences. Preproposal conferences can help prospective contractors learn more about Government procedures and the specific requirement. The conferences tend to mitigate the inherent limitations of the printed word contained in the Request for Proposal, thus assuring that the quality and the quantity of the data received in the proposal are what the Government desires. Preproposal conference are frequently scheduled for research and development procurements. Here Army technical and management personnel may discuss

in varying detail the nature and background of the procurement requirements, the anticipated scope of the contract effort, and the contractor qualifications considered necessary for selection. They will also answer questions submitted orally or in writing at or before the conference by the contractors. Generally, the preproposal conference is considered useful in defining the nature of the requirement and what is required of the contractor in order to be in the running for selection. In this respect, the preproposal conference may serve as a screening device in that attending contractors may, on the basis of information received at the conference, determine not to propose.

i. Late Proposals. Another function in the selection process that sometimes presents practical difficulty is the receipt of proposals or modifications to proposals after the deadline specified in the Request for Proposal. The general rule is that late proposals or modifications may not be considered, a result often contrary to the wishes of program personnel. However, there are certain exceptions to this rule. If the late proposal or modification is mailed in time to reach the contracting officer before the deadline but is delayed in the mail, and if this can be shown by a registered or certified mail receipt plus a statement from postal authorities, it may be considered for award. Or if the proposal or modification was received at the Government installation in time but was delayed in reaching the designated depository by mishandling in the internal mail systems, it may be considered. One other exception is available. The Secretary of the Army may waive the general rule of nonconsideration in cases where the proposal or modification is of extreme importance to the Government. The contracting officer must then resolicit all qualified offerors. To determine whether this Secretarial exception should be applied for, the contracting officer must open and evaluate all late proposals and modifications. (The contracting officer can freely receive any modifications over the table during the ordinary conduct of negotiations.)

j. Evaluating Proposals.

(1) As discussed earlier, the evaluation of research and development proposals can be an extremely complex and demanding task. For other than the simplest procurements, evaluation is best conducted by a team consisting of functional specialists—business, technical, audit, legal, project mangement, and any others having an interest in the particular procurement. Normally, each functional specialist on the team will be assigned the evaluation responsibilities best suited to his specialty. It is essential that the evaluation be thorough in all areas, for the contractor with the best technical capacity is not satisfactory if he goes bankrupt during performance or requires more funds than should reasonably be obligated for the procurement. It is highly desirable to use some sort of scoring system, numerical and/or adjectival, in the evaluation process for the highly subjective areas of business and technical evaluation. This technique provides the best method of comparing among criteria and comparing among evaluators with respect to the same criterion. But it is very important to remember that the scoring system itself, even though it is a quantitative one, is not a "cure-all" that will insure the best selection. Rather, it is a tool meant to be of help in arriving at the best selection. In addition to the evaluation of the proposals received, evaluation-team members may use other techniques in their search for the best contractor. Such techniques include—

(*a*) Contractor interviews.

(*b*) Plant visits.

(*c*) Reference checks (business and technical).

(*d*) Ratio analysis and other techniques of financial analysis.

(*e*) Analysis of contractor's past performance.

(2) Regulations now require that, in evaluating proposals for Advanced Development, Engineering Development, or Operational Systems Development estimated to exceed $1 million, evaluation personnel must obtain a transcript of performance evaluations of all competing contractors from the Defense Documentation Center, Attention: DDC–OSB, Cameron Station, Alexandria, Va. The performance evaluation record may also be referred to in cases under $1 million.

CHAPTER 11

CONTROL TECHNIQUES AND PROCEDURES

Section I. REQUIREMENTS

11-1. General

a. Once authorized, every Army project, task, or unit of work involved in the process of materiel development must undergo some form of reporting and control. The particular form used will vary according to the requirements within the research and development cycle. Thus, in the Research and Exploratory Development categories, reporting and control procedures are broad. As materiel development proceeds from Advanced Development through Engineering and Operational Systems Development, increasingly complex techniques and procedures are used. Hence, the use of particular control techniques and procedures should always be related to the type of materiel development objectives being sought. In this chapter, both the broad requirements for reporting and control and the most frequently used large, complex control techniques and procedures will be discussed.

b. In the first category (i.e., broad requirements) are the Army Research, Development, Test, and Evaluation Information System and Scientific and Technical Information Program; in the second are such requirements as Program Evaluation and Review Technique (PERT), PERT/Cost, and Configuration Management. Since control techniques such as PERT and Configuration Management are the most complex of these requirements, they will be discussed at some length. Then other reporting requirements, such as the Research and Technology Resume, will be taken up.

11-2. Army Research, Development, Test, and Evaluation Information System

a. This information system has four specific objectives. First, it integrates information related to the functional areas within the Research, Development, Test, and Evaluation program; for example, planning, programing, budgeting, project supervision, and program review. Second, it establishes procedures for improving the timeliness and accuracy of Research, Development, Test, and Evaluation program information. Third, it provides a technique to facilitate the identification of problem areas and to highlight significant progress. Finally, it makes maximum utilization of information techniques and procedures capable of being supported by either automated or manual means, or by both.

b. The system is an automated and integrated information system based on the concept of a central data bank and integrated reporting requirements from the developing agencies. Within this framework, coordinated systems and procedures are used throughout each developing agency for collecting and reporting information to support the functional areas within the Research, Development, Test, and Evaluation program.

c. For effective development of this system, commanders at all levels of command must define accurately their information needs for satisfying both internal and higher authority requirements, and when appropriate, design command-wide systems to integrate procedures for collecting and reporting information.

11-3. Scientific and Technical Information Program

a. The Scientific and Technical Information program provides for handling and disseminating technical data and documents or their abstracts; publishing technical journals; preparing and conducting technical meetings and

symposia; and disseminating information that is produced by (or in direct support of) Army research, development, test, and evaluation and related processes and their management, from the phase of design release to production.

b. The basic objective of the program is to improve the flow of technical information into, through, and from the Department of the Army. This will secure economies by reducing research and development lead time and by eliminating unnecessary duplication of effort. It will help improve program management, and will support the information needs of scientists,, engineers, and managers. The program is designed to establish a coordinated network of generally decentralized information activities operated and administered by major commands and other Department of the Army components.

11–4. Project Master Plan

a. A most important example of a comprehensive planning and control requirement, but one that is still at a high, or aggregate, level of detail, is the Project Master Plan and reporting system used on projectized programs. This plan is a compilation of individually approved planning documents accomplished by the project manager, with assistance from participating organizations and contractors, which places in context the plans, schedules, costs, and scope of work and resources to be provided by the Project Management office, functional organizations within the developing or procuring agencies involved, and each participating organization.

b. In the Army Materiel Command the key elements of the Project Master Plan (Army Materiel Command Regulation 11–16) are the Weapon (or Equipment) System Description, the Work Breakdown Structure, the Work Assignment Plan and Schedule, the Financial Status Report, and the Technical Performance Chart. The specific reporting requirements used to update and indicate status against these elements of the Project Master Plan are described in paragraph 11–22*b*.

11–5. Milestone Planning

a. A highly important aspect of any planning, control, and reporting requirement is a common definition and understanding of key milestones that represent discrete points of accomplishment during the life cycle of materiel development. It is only when such milestones are clearly defined and understood that different reporting systems, and the various levels of reporting, are meaningful within a common frame of reference.

b. There are a number of different milestone groupings in the Army, including the Department of the Army or Department of the Army System Staff Officers' milestones, Army Materiel Command project manager's milestones, and so forth. Army Materiel Command Regulation 11–27 establishes uniform and standard definitions for Army Materiel Command milestones which must be accomplished during the life cycle of a major item or weapon (equipment system. The official milestones listed in this regulation are mandatory for planning, directing, controlling, and reporting on activities of major items and weapon (equipment) systems at the major subordinate command and by project managers.

Section II. PERT AND PERT/COST

11–6. General

a. With the advent of complex research-and-development-oriented programs in the Army that involve a high degree of technical and organizational interface, and the necessity for improving performance against schedule, cost, and technical objectives, an improved planning and control technique was required. Standard bar charts and financial reporting requirements, which had been used historically, could not reveal complex interfaces and areas of critical project performance on a "before-the-fact" basis.

b. PERT was originally developed and first applied in a military research and development

effort on the Polaris Program, beginning in 1958. At first the technique was solely concerned with planning and reporting in the "time domain"; then, in 1962, the Secretary of Defense authorized the issuance of a Department of Defense PERT/Cost Guide that included the factor of cost. The term PERT/Cost is now defined as a specific planning and control technique that covers the areas of both schedule and cost.

c. PERT/Cost applies primarily to one-time-through activities, as distinguished from repetitive, production-type activities. The PERT/Cost technique has continuing use throughout the life cycle of a project, since one-time-through activities must be planned and monitored even during the production phase. For example, the output of production units or batches must be coordinated with such one-time-through activities as design modification and fiscal year funding procurement. In general, PERT/Cost is applied to larger projects (it is mandatory for over $25 million research, development, test, and evaluation and $100 million Procurement of Equipment and Missiles, Army, projects). In simplified forms, however it can be successfully applied to smaller projects and tasks.

d. The objectives of the PERT/Cost system are to identify and define all elements of work that involve the expenditure of time and dollar resources; to establish reasonable and attainable time and cost targets, both intermediate and terminal; and to identify critical problem areas during project planning and throughout project execution.

11–7. Work Breakdown Structure and Work Packages

a. The Work Breakdown Structure is a basic tool of PERT/Cost. After project objectives are identified, they are specified in terms of end items that are deliverable to the Government or that constitute a commitment on the part of the contractor. The subsequent division of each end item into its component parts creates a project Work Breakdown Structure. This then serves as the framework for planning and controlling the project. This framework provides for the identification of all project tasks involving the expenditure of funds, from design through initial provisioning of troops. It serves as an index to PERT networks. Finally, the hardware portion of the Work Breakdown Structure represents the common point of reference for planning and controlling time, cost, and technical performance from design through initial provisioning of troops.

b. Figure 11–1 shows an example of a Work Breakdown Structure. Below the project level, major end items (models, hardware, service, equipment, facilities and so forth) are identified in accordance with the system configuration and support requirements.
Major end items are then divided into end component parts (systems, subsystems, components), and the component parts are further divided and subdivided into more detailed units. The subdivision of the Work Breakdown Structure continues to successively lower levels, reducing the dollar value and complexity of units at each level until they reach the level where the end-item subdivisions finally become manageable units for planning and control. The end-item subdivisions that appear at this last level in the Work Breakdown Structure are then divided into Work Packages.

c. Work Packages constitute the basic units in PERT/Cost for cost planning and control. They represent a breakout of end items into elements of work whose beginning and ending points may be directly related to network events. A Work Package is the unit of work required to complete a specific job or process; it may be a report, a design, a document, a piece of hardware, or a service. The content of a Work Package may be limited to the work that can be performed by a single operating unit in an organization; or it may require the contributing services of several operating units. The overall responsibility for the work content of a Work Package should be assigned to a single organization or responsible individual.

d. A useful guide to the size of Work Packages is that they cover a time span of not more than 3 months and represent no more than a $100,000 expenditure. In this way, the time

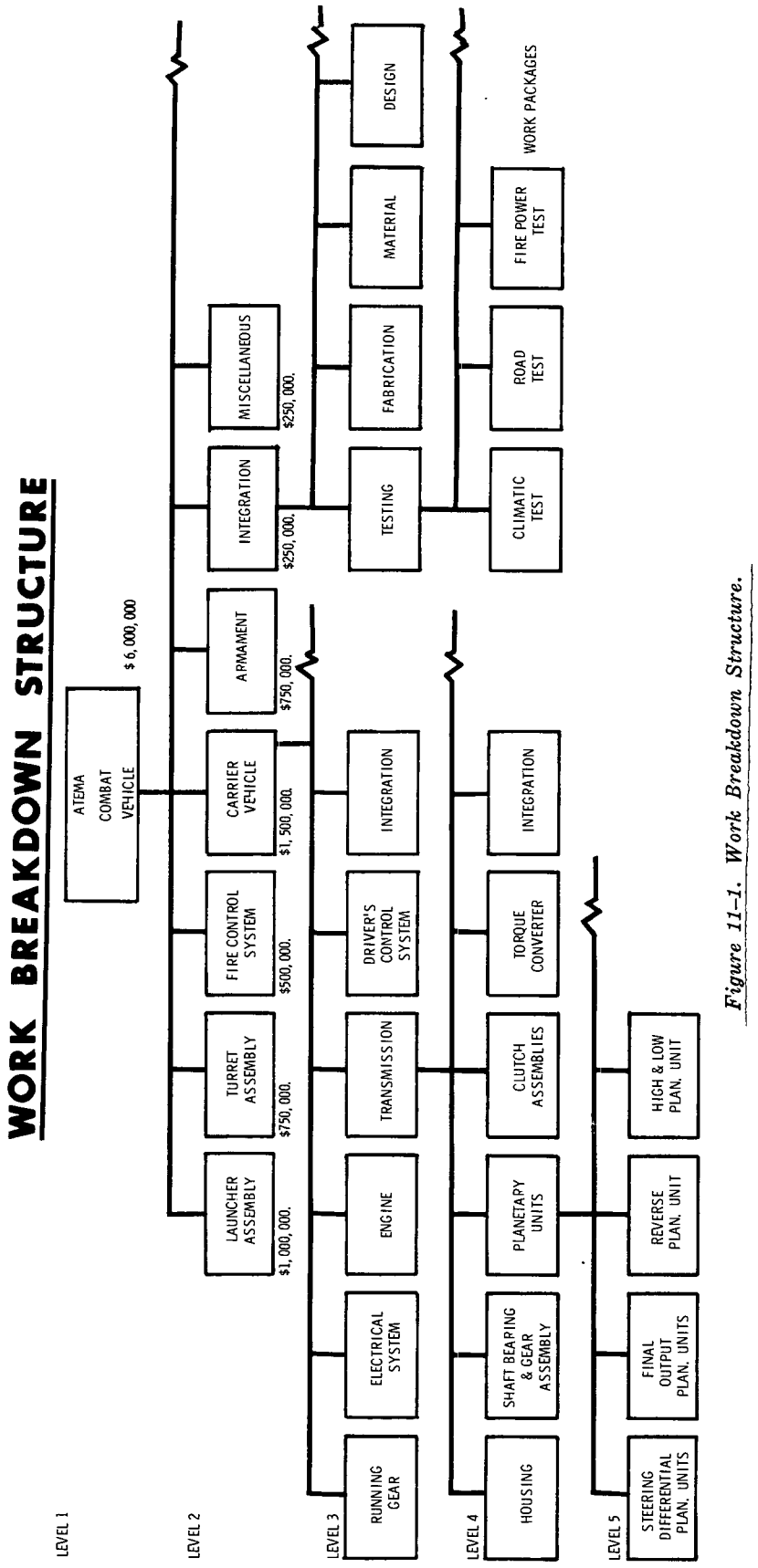


Figure 11-1. Work Breakdown Structure.

span and amount of investment between positive reports to management may be limited. However, this guide is by no means rigid. Small projects may require much smaller Work Packages for proper control. On large projects, on the other hand, the subdivision of work to such a level of detail could conceivably result in excessive fragmentation of homogeneous tasks. In such cases, these guidlines need be applied only to those portions of the total job where complex technical problems are anticipated and where, therefore, overruns and slippages are most likely to occur.

e. Charge numbers are assigned at the Work Package level so that costs may be summarized and analyzed in a variety of ways. The end item must be identified so that costs may be summarized up through the Work Breakdown Structure. Contributing and responsible organizations should be identified for analysis along organizational lines. Function and subfunction identification allows for summarization and analysis by functional categories. Other identification (for instance, contract, type of funds, and so forth) may be included as required. For an understanding of the output reports that result an application of PERT/Cost, see appendix B.

11–8. Networks

a. The network is a flow diagram showing the activities and events that must be accomplished to reach the project objectives. For the total life cycle of a project, it shows the planned sequences of accomplishment, interdependencies, and interrelationships. It is a basic tool in the project management decision-making process for planning the work to be performed, reporting progress, and taking corrective action from design through initial provisioning of troops. It shows for each step in the plan what activities must precede, what other activities may be carried on simultaneously or independently, and what can follow. The network includes all actions involved, and is not limited to "work" activities. Time-consuming actions, such as lead time for procurement of purchased parts, shipment of materiel from one location to another, and management action, are shown on the network.

b. As in the case of the Work Breakdown Structure, the construction of networks starts at the highest level and proceeds, through the successive identification of greater detail, to the lowest selected operating levels. Major milestones and add-on milestones are first identified. The milestones thereby identified are forwarded to contributing organizations for elaboration of significant intermediate events. The process goes on through successively lower levels of detail until activities are identified that may be directly related to work packages on the Work Breakdown Structure. For an understanding of basic PERT network methodology, see appendix B.

Section III. CONFIGURATION MANAGEMENT

11–9. General

a. Background. A most important requirement recently introduced into the materiel development process is Configuration Management, now an approved Army Materiel Command management discipline. The term "configuration "refers to the physical and functional characteristics of systems and equipment. The complete description, identification of requirements, and responsibilities relating to Configuration Management are contained in Army Materiel Command Regulation 11–26. This regulation stipulates that the provisions contained in it apply to all systems and equipment during development (in the Engineering and Operational Systems Development categories), and the production and operational phases.

b. Flexible Application. These regulatory provisions may also be applied, in whole or in part, to Advanced Development projects or to commercial items procured by the Department of the Army—with one reservation. The Configuration Management identification and accounting requirements and associated procedures will not be applied to existing systems and equipment when such application will result

in uneconomical changes in previously existing configuration documentation and records. Thus, the Army's use of the Configuration Management Control technique is broad in scope, but flexible in the detailed application to specific situations.

c. Objectives of the Technique. To define Configuration Management the reasons for its application to the materiel development process must be summarized. Configuration Management is a discipline that applies technical and administrative direction and surveillance to identify properly the total configuration of systems or equipment; to control changes to them; and to record the status of change implementation. The basic objectives of this important control technique are to—

(1) Support and enhance contract definition.

(2) Increase the effectiveness of standardization and item-entry control.

(3) Provide a formal system for control of project design and engineering.

(4) Support optimum competitive procurement and breakout through the development and maintenance of a current technical data package.

(5) Make contract administration more uniform.

(6) Attain maximum economical consistency in Configuration Management data, forms, and reports, with special emphasis on interfaces with other Department of Defense components and industry.

(7) Provide appropriate managers with the level of identification, control, and status reporting for systems and equipment necessary to facilitate the achievement of logistic support, weapons readiness, visibility, and traceability.

(8) Provide managers at all levels with sufficient configuration information for making appropriate, timely decisions during the development, production, and operational periods.

(9) Make sure that the evaluation of a proposed configuration change is timely and includes a thorough consideration of the change's *total* impact on cost, operational capability, and support, with regard to both hardware and documentation.

(10) Assure the efficient and timely implementation and incorporation of all aspects of approved changes.

d. The Three Phases of Configuration Management. The success of the Configuration Management technique depends on the balanced integration of three interrelated, mutually supporting phases: (1) Configuration Identification; (2) Configuration Control; and (3) Configuration Status Reporting. Each of these will be discussed in some detail below.

11–10. Configuration Identification

a. General. Configuration Identification is the *documented* description of systems and equipment. It represents the complete technical description, as reflected in drawings and other appropriate documentation, required for orderly development, fabrication, test, acceptance, operation, maintenance, and logistic support of systems and equipment or any portions of them. In Configuration Identification, the performance requirements, design criteria, and test and evaluation requirements are identified in System and Development Descriptions. The System Description defines the objectives for the entire system (for example, Missile System) ; while on the other hand, Development Descriptions define the system in terms of its major end items (for example, Engine, Radio, 50-caliber Machinegun, and so forth) and assigns portions of the overall system objective to each. The performance, design, test, and evaluation objectives contained in the individual Development Descriptions should, when combined, equal the total system objectives.

b. Preparation of System Descriptions. A System Description is prepared at the beginning of the development phase and describes overall system performance, including all available design criteria and the test and evaluation requirements for determining compliance with

performance requirements. Special emphasis is placed on insuring that all requirements that enhance or constrain the design of the system or equipment are adequately identified and described. Army Materiel Command Regulation 11–26 clearly describes the format and contents of the System Description, as it does all other documentation required by the Configuration Management technique. The detailed requirements of the System Description are not discussed in this manual, but it is important to understand that formal documentation is a basic part, not only of Configuration Identification, but also of the complete Configuration Management control technique.

c. Reviews for Adequacy. After initial preparation, the System Description is reviewed by the individual responsible for the Configuration Management Office or Function, to assure adequacy for Configuration Identification, Control and Status Reporting. In addition, it is reviewed during the Technical Characteristics In-Process Review to insure that the Description fully supports the Qualitative Materiel Requirement or the Small Development Requirement. After approval, the System Description becomes the reference document for the *Definition Baseline*—the first of three baselines or reference points utilized in Configuration Management. (Further explanation of these baselines is contained in para 11–13.)

d. Development Descriptions. Development Description for configuration end items are obtained as a direct result of the contract definition phase, or from a similar analysis conducted either by the Army in-house or by a contractor. A configuration end item is defined as an item of equipment or a major component into which a system may be divided for Configuration Management and contracting. Development Descriptions specify design, performance, and test and evaluation criteria for configuration end items that comprise a system; these Descriptions may become integral parts of contract work statements applicable to full-scale development efforts. Approval and release of a Development Description for a particular configuration end item in a system establishes the identification for the *Development Baseline* for that item. Full-scale development requires the completion of the following types of development descriptions:

(1) *Equipment Development Description* describes requirements for development of configuration end items.

(2) *Minor Item Development Description* generally describes relatively simple equipment that could consist of a major component, but where configuration is not critical and very few changes are anticipated.

(3) *Critical Component Development Description* describes components and assemblies designated as either engineering or logistics critical. It is also used to designate company standard parts.

(4) *Facility Development Description* describes facilities necessary to support a system.

(5) *Inventory Items Development Description* specifies existing inventory items necessary to support or be installed in a system or equipment.

11–11. Configuration Control

a. Definition. Configuration Control is the systematic and timely evaluation, coordination, approval or disapproval, and release of all proposed changes or waivers to documentation of an established baseline. Under Army Materiel Command Regulation 11–26, individual Command activities establish for each item the degree of Configuration Control necessary to insure current and accurate identification throughout the life cycle of that item.

b. Evaluation of Changes. Any materiel developed and produced for the Army is subject to change. Some proposed changes are definitely required, while others will produce marginal improvement if, in fact, they produce any real benefit at all. The rationale and the procedures supporting the Configuration Control concept are designed to facilitate the effective determination of the worth of proposed changes. Those deemed necessary to the successful and efficient use of given systems and equipments are expeditiously approved and

processed. Those of doubtful or marginal value are disapproved with equal dispatch.

c. Formal Introduction of Changes Into the System. The first step in the process of Configuration Control is to communicate with the Configuration Office or Function whenever a proposed change to a system or equipment appears necessary. Although informal communication is not ignored, the Configuration Control procedure requires the execution and submission of an Engineering Change Proposal. Regardless of whether the Army first learns of the proposed change by formal or informal means, conclusive and definitive action on the change cannot be accomplished until the Engineering Change Proposal is formally introduced to the system. These Engineering Change Proposals are then reviewed for their total impact on the system or equipment by the Configuration Office or Function, and the appropriate decision is rendered. A more detailed discussion of the Engineering Change Proposal and its processing will be given below.

d. Policy on Configuration Control. The requirements of the Engineering Change Proposal, the Army's change policy, and the review step are the cornerstones of effective Configuration Control. All these items or steps are formally documented in Army Materiel Command Regulation 11-26 in order to provide—

(1) The necessary policies and procedures for maintaining Configuration Control of systems and equipment.

(2) A standard procedure for the preparation and submission of proposed engineering changes and requests for waivers to Department of the Army activities.

(3) The requirements for submitting the technical, fiscal, and logistic supporting information necessary to define the impact of a proposed engineering change on a system or piece of equipment.

(4) The instructions for submitting the information necessary to maintain the Configuration Identification documenting a Configuration Management Baseline in a current status.

e. Summary of Configuration Control Objectives. In summary, then, the Configuration Control phase is designed and implemented to—

(1) Limit the number of changes incorporated into systems and equipment to those that are of recognized benefit to the Army.

(2) Reduce the number of varying configurations for a given system/equipment in the Army inventory.

(3) Control and channel the expenditure of engineering effort to areas that promise the greatest probable benefit to the Army.

11-12. Configuration Status Reporting

a. General Description. Configuration Status Reporting involves the reporting and recording of formal baseline definitions and of the status of implementation and incorporation of approved changes to Configuration Identification after the formal establishment of baselines. The resulting data bank (and its maintenance) is designated as the Configuration Status Reporting System. Command activities designing and implementing these status reporting systems must insure that they are compatible with such other existing record procedures as the Army Equipment Reporting System.

b. How the Data Bank Originates. The Configuration Status data bank originates with the initial documentation and release of System Descriptions, Development Descriptions, and Production Descriptions. From this point forward, throughout the life cycle of the system or equipment, maintaining current reporting of hardware and software configuration is the primary function of the Configuration Status Reporting System. This is done by recording all proposed, approved, and disapproved changes —a record that is necessary to furnish the varying information required for the efficient management of the development, production, and logistics phases including application of modification work orders or changes during rebuild. The status records employed in the reporting process must precisely depict the configuration of equipment, as designed, as manufactured, and as modified. In addition, they

must adequately reflect the status of documentation and the schedules for approved changes.

11–13. The Baseline Concept

a. General. The foregoing discussion of the three elements of Configuration Management identified these important functions as basic and necessary to the successful implementation of the concept. But against what base does the Army identify, control, and report the Configuration Status of a given system or equipment? In order to establish departure or reference points on which to base the entire function, the Army, at specific points in the development of materiel, formally establishes what are called baselines. These baselines, or reference points, are utilized to provide continuity and to establish a frame of reference for traceability throughout development. Baselines are defined by documentation released for use in either development or production.

b. The Three Baselines. The baselines used in Configuration Management are (1) the Definition Baseline, (2) the Development Baseline, and (3) the Production Baseline. Once the baseline documentation is reviewed, approved, and released, the defining documents cannot be changed without coordination, evaluation, approval, and the formal execution and release of a change document (the Engineering Change Proposal). This change management procedure is the control element of the Configuration Management technique; it applies equally to *all* proposed changes to the system, the equipment, or the documentation and other supporting materiel. The documentation describing baselines, the proposed changes to this documentation, the status of approved changes, the implementation status of approved changes, change effectivity points, and other data pertinent to the configuration of a system or equipment are reflected in the Configuration Status Records for purposes of project analysis and control. Figure 11–2 depicts the general relationship of the three baselines, together with System, Development, and Production Descriptions and their associated documentation, as shown in relationship to the total life cycle of a particular system or equipment. The three baselines employed in Configuration Management are further defined as follows:

(1) *Definition Baseline.* The baseline established prior to the initiation of the definition phase of development to which systems and equipment are controlled.

(2) *Development Baseline.* The baseline established prior to the beginning of full-scale development, to which configuration end item design and fabrication are controlled.

(3) *Production Baseline.* The baseline established prior to the start of production, to which configuration end item manufacture is controlled. This baseline establishes the foundation for control during both the production and operational periods.

c. Baselines as Progressive Developments. It is important to understand that although the three baselines can be identified separately, they are in reality progressive developments. For instance, the Development Baseline is the summation of the Definition Baseline and all approved and incorporated changes to it, plus the results of the definition phase of development. Similarly, the Production Baseline results from the Development Baseline, plus changes approved and incorporated during development effort.

11–14. Engineering Change Policy

a. General. The introduction of Configuration Management has had a significant effect upon the prevalent attitude and policies concerning engineering change. Proposed engineering changes now receive a greater degree of scrutiny than they ever did before. In today's environment, technical feasibility alone does not constitute the sole justification for the approval and incorporation of engineering changes to hardware or software. Proposed changes must survive the supercritical and constant investigative probing of the Configuration Management Office or Function and ultimate approving authority in order to achieve acceptance. This analysis of the proposed change con-

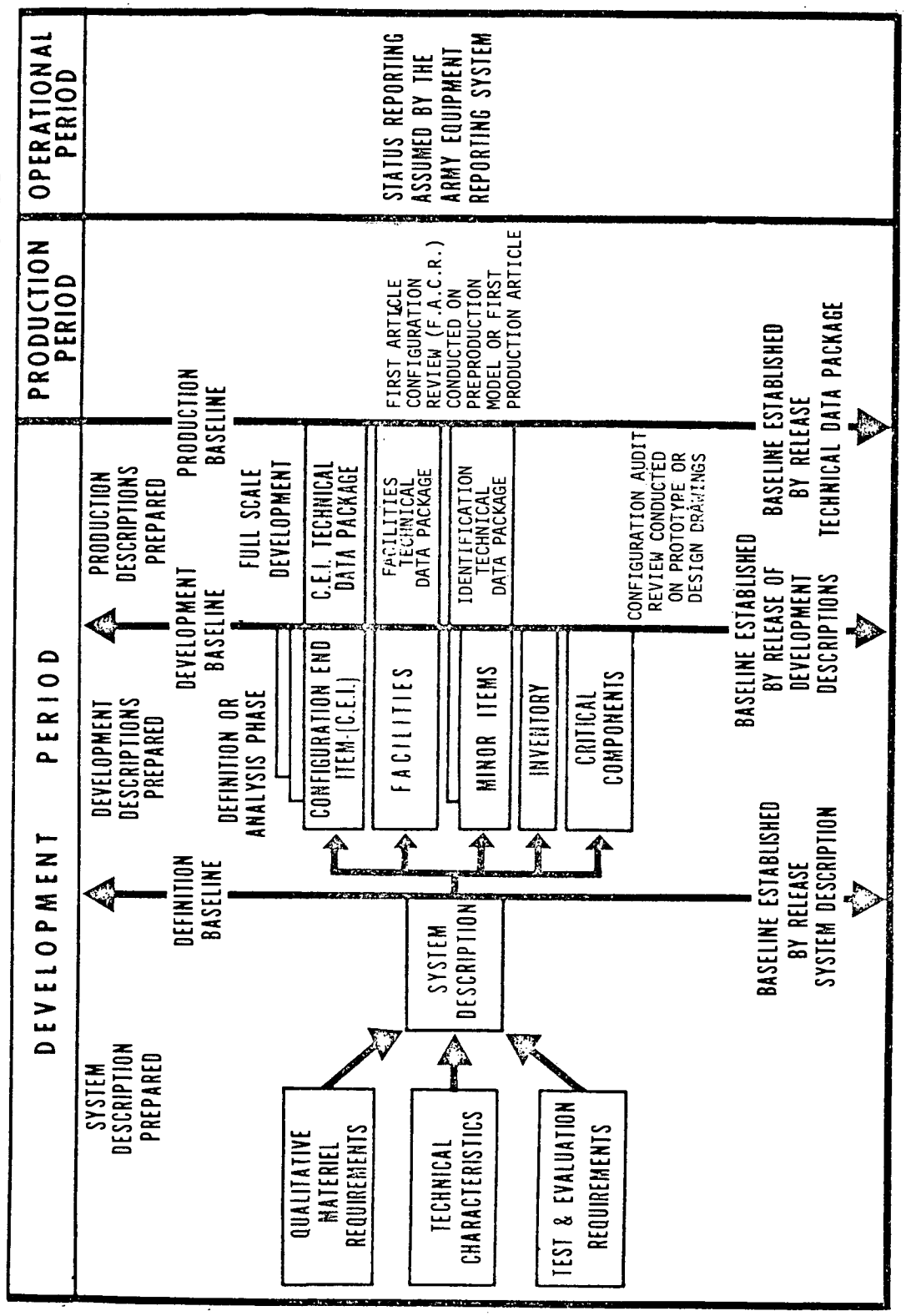


Figure 11–2. Life Cycle Configuration Management.

sists of an unrelenting application of trade-off considerations that must ultimately prove the worth of the change. These considerations are based on the sound and realistic criteria that the proposed change is necessary to correct design deficiencies; to react to, and provide for, approved changes in operational characteristics; to effect overall net savings; to relieve production stoppages; or otherwise to offer a significant net benefit to the Government.

b. Specific Policies. To enhance the effectiveness of the above policy still further, additional organizational and procedural policies have been concurrently established. The more significant of these are as follows:

(1) Configuration Management responsibilities will be assigned to individuals insofar as practicable, or to Configuration Management Offices, to insure that Configuration Identification, Control, and Status Reporting are effectively integrated into a complete management program and are continuously applied during all applicable life-cycle periods. In addition, required documentation will be retained as permanent records throughout these periods.

(2) Joint Configuration Management plans will be developed and documented prior to the initiation of development and production programs that involve more than one Service or Command activity.

(3) A single individual, rather than a group, will have final reponsibility for approving and releasing engineering changes.

(4) Configuration Identification, Control, and Status Reporting will be applied to all new systems and equipment. However, the magnitude and complexity of the individual Configuration Management effort will be commensurate with the size, scope, period of life cycle, nature, and complexity of the system or equipment involved.

(5) Configuration Management responsibilities for projectized systems or equipments will be immediately assigned as operational functions of newly designated project managers.

11–15. Configuration Management Procedures

a. Necessity for Periodic Review. Because one of the basic objectives of Configuration Management is control, its procedures must incorporate periodic checkpoints to insure that events and activities associated with materiel development are producing the desired results. Under Army Materiel Command Regulation 11–26, Configuration Management procedures require two check or review points. These are the Configuration Audit Review and the First Article Configuration Review. In addition to these reviews, Army Regulation 705–5 imposes upon the materiel development process five additional in-process technical reviews, conducted at critical points of the development cycle, to evaluate the status of the project, accomplish effective coordination, facilitate proper and timely decisions bearing on the future course of the project, and assure the materiel's ultimate acceptability for use by the Army.

b. Timing of Reviews.

(1) *General.* Figure 11–3 gives a general picture of the approximate timing of these review points during the materiel development life cycle. However, a further explanation of Configuration Management review requirements, their relationship to the in-process technical reviews, and their place in the normal order of development is necessary.

(2) *Technical Characteristics Review.* This review is held upon receipt by the developing agency of the Qualitative Materiel Requirement or Small Development Requirement and prior to finalizing the technical characteristics. The primary purpose of this review is to insure that the developer understands the requirement and has adequately and properly stated it in terms of technical characteristics.

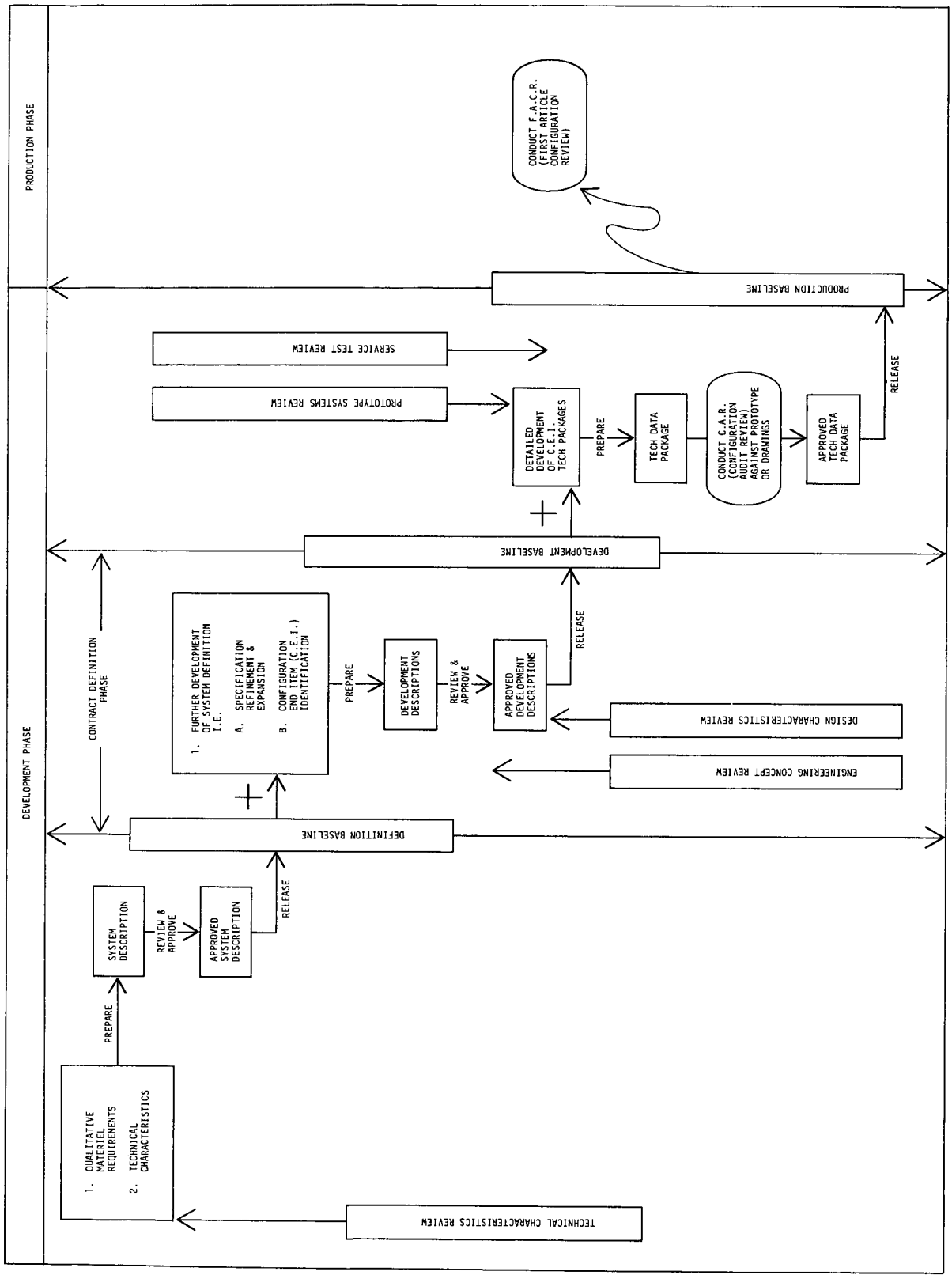


Figure 11–3. Configuration Management.

(3) *Engineering Concept Review.* This review is held upon completion of the engineering concept to insure that the contractor or in-house facility is not embarking upon a program that is beyond the state of the art, or one that contains an inordinate number of high-risk areas. It also assures that all feasible engineering approaches are being utilized.

(4) *Design Characteristics Review.* This review is held upon completion of the determination of the design characteristics, and prior to release of the design for development. At this point, appropriate consideration must be given to updating the Qualitative Materiel Requirement, if necessary, to insure that the developed hardware will satisfy the stated and approved requirements.

(5) *Configuration Audit Review.* This review, a Configuration Management requirement, is a technical audit accomplished by, or under the direction of, the Command Activity Configuration Management Office or Function for comparing prototype hardware with the technical documentation (specifications and/or drawings) to be used in describing the Production Baseline. When prototype hardware is not available, a Command activity engineering review of the supporting documentation will be substituted for the Configuration Audit Review. The technical documentation used for the Configuration Audit Review, plus any changes to it that result from tests or changes in requirements, will become part of the technical data package describing the Production Baseline.

(6) *Prototype Systems Review.* This review is held after delivery of prototype development hardware.

(7) *Service Test Review.* This review is held after completion of the Service Test or combined Service Test/Engineering Test to insure that all aspects of the test program, both completed and to be conducted, thoroughly measure the ability of the materiel to meet the Qualitative Materiel Requirement.

(8) *First Article Configuration Review.* This review, which is also a Configuration Management requirement, is a technical inspection that compares the resulting hardware with the documentation that describes the Production Baseline. The First Article Configuration Review is accomplished on, or during the assembly of, a preproduction model, when available, or the first production article. The First Article Configuration Review will be used to verify the reliability, validity, and completeness of the Production Baseline documentation. The technical documentation of the Production Baseline for the item preproduction model, or first production article, is compared directly with the as-manufactured configuration of the same unit, identified by part numbers and serial numbers appearing on the manufactured parts and assemblies and in manufacturing records.

c. Additional Reviews. The seven reviews enumerated here do not represent an inflexible approach to materiel development status review. Additional reviews can be imposed upon a given program by any of the participating agencies, when, in their opinion, the complex nature or circumstances characteristic of the particular system warrant these extra controls and surveillance.

Section IV. DOCUMENT CONTROL

11–16. Scope

a. The word "document," as applied to the materiel development process, has far-reaching implications. Included under this category are—

(1) Drawings and specifications.
(2) Operational instructions.
(3) Maintenance directives, procedures, standards, wear tolerances, lubrication orders, and so on.
(4) Technical handbooks and bulletins.
(5) Technical reports, graphics, errata pages, and similar items.
(6) Magnetic tapes, program tapes, punched cards, aperture cards, microfilms, documentary films, and so on.

b. It is clear that any record of data or a concept, in any form from which information can be derived, constitutes a document. For the Army as a whole, document control is big business. Imposing limits on documents involved in the materiel development process does little to simplify the problem. Generally, Army materiel can neither function in accordance with its intended use nor be efficiently deployed and maintained in the field without the imparting of extensive instructions to the user and supporting elements. It is imperative, therefore, that necessary documentation be provided to users, and that it be kept current.

11–17. Technical Data

a. The introduction of the Army Configuration Management concept to the materiel development process does not affect hardware alone —document control over technical data is also a major benefit. The Baseline concept and Configuration Control activity contribute significantly to the improvement and efficiency of document control over technical data.

b. It will be recalled from paragraphs 11–9 through 11–15 on Configuration Management that all proposed engineering changes must be reviewed for accuracy and completeness prior to approval, and its impact on documentation determined. The Engineering Change Proposal utilized to recommend the proposed change has specific sections identifying the document interface, as well as the necessity for and extent of the required document change. This section of the Engineering Change Proposal, therefore, plays the key role in the actual implementation of document control over technical data.

11–18. Procurement Packages

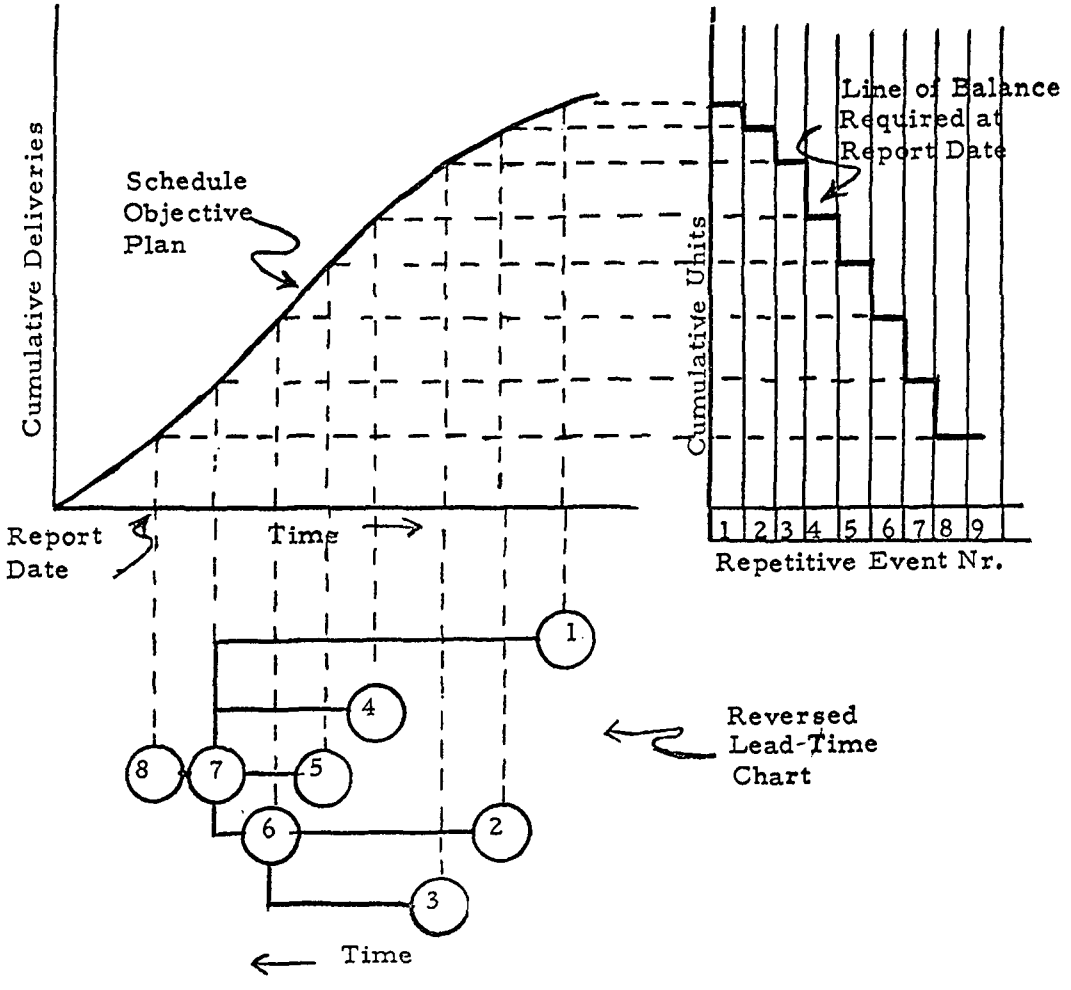
The complexity of document control and the associated procedures for implementing it bear a direct relationship to the phase of the system/equipment life cycle. As we proceed from development into production, the complexity of document control increases almost geometrically. This is due to the frequent complexity of the procurement package, which consists of all technical data and/or documentation necessary to effect acquisition of the required services or hardware for the Army, in accordance with the currently applicable Armed Services Procurement Regulation and Army Regulations. Whenever possible, the Army strives to achieve effective competition in procurement. Therefore, the content and quality of the procurement package bear a direct relationship to this objective. However, the size and complexity of the procurement package is not constant —it is a function of the complexity of the service or hardware being acquired. Procurement packages, therefore, represent a broad spectrum of size and detail. One procurement package may consist of a single sheet of paper, containing only a few universally accepted words that clearly define the object of the intended procurement to all who review it. Another may be of tremendous proportions and may require detailed analysis by hundreds of technicians, engineers, and management personnel over an extended period of time. Naturally, the procurement packages cited represent extreme ends of the spectrum. In fact, all conceivable variations between the two extremes are experienced and actually employed on a day-to-day basis.

Section V. LINE-OF-BALANCE SYSTEM

11-19. Description

a. Once an item of materiel has entered the procurement and production phase, a number of reporting techniques can be used to control progress. Generally speaking, PERT, which is best applied to "one-time-through" (nonrepetitive) activities, is not used for the detailed control of repetitive production work. A commonly used system for controlling production progress is the Line-of-Balance system, first introduced in World War II.

Schedule Objective Plan and Lead-Time Chart



Circled numbers represent Repetitive Event Numbers. Events may include delivery of a component, assembly of a subsystem, fabrication of a part, assembly of the finished item, and the like.

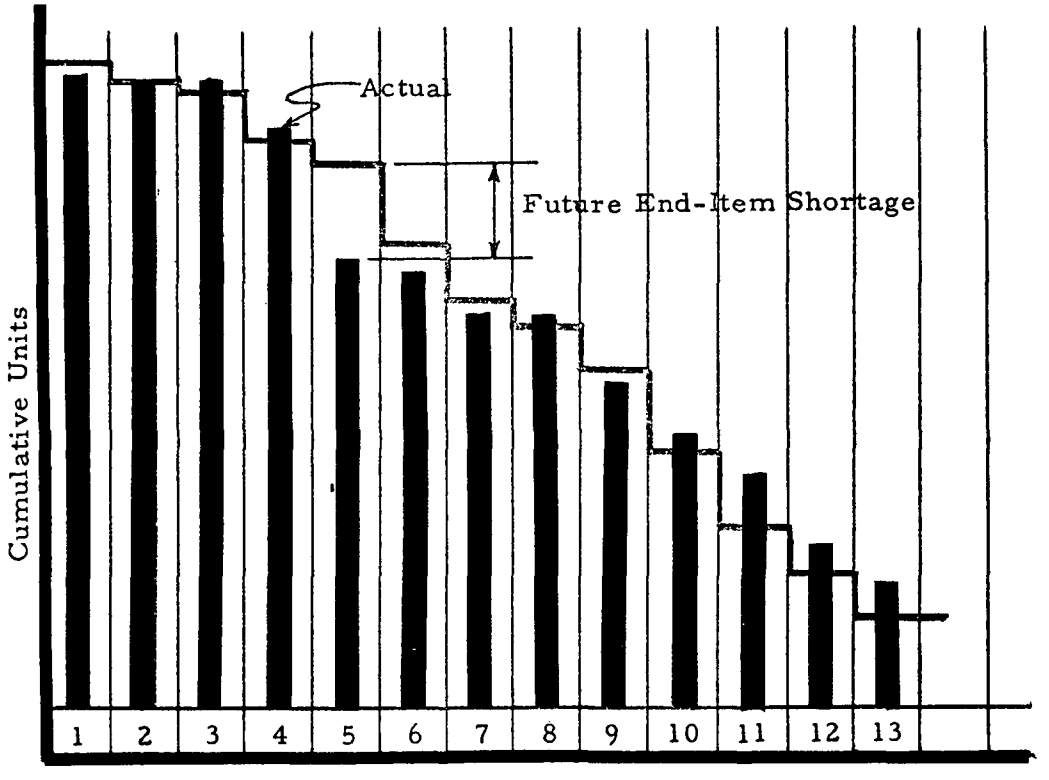
Figure 11-4. Schedule Objective Plan and Lead-Time Chart.

b. Line of Balance is a control system that essentially involves schedule and hardware quantity factors, although cost has also been applied to it. It is most often used in programs that involve a medium range of production volume such as tanks, airplanes, and radars that are not being made on a continuous, assembly-line basis.

11-20. Line-of-Balance Graphic Display

a. The Line-of-Balance technique provides a display showing the status of repetitive activities, such as the fabrication, delivery, and assembly of parts, at a given time. It requires the development of a Schedule Objective Plan and a Lead-Time Chart (fig. 11-4). The Lead-Time Chart portrays the sequence and elapsed time for the activities in the program, drawn to a time scale. The Schedule Objective Plan shows the planned status of each of these activities at successive intervals. The Line of Balance for a given date can be determined by putting the Schedule Objective Plan and the Lead-Time Chart on the same horizontal time scale, and

Line-of-Balance Chart with
Production Status Information



Solid vertical lines represent actual status for each event (e.g., number of components on hand). Horizontal, "stepped" lines represent requirement for each event--the "line of balance"--in order to meet the schedule objective.

Figure 11-5. Line-of-Balance Chart with Production Status Information.

then reversing the Lead-Time Chart (right to left, instead of the conventional left to right time scale). Next, a vertical line is projected from the repetitive event to its intersection with the schedule objective. This intersection is then projected horizontally to a Line-of-Balance Chart that portrays the minimum inventory to meet the schedule objective as of a particular date. The Line-of-Balance requirements can be predicted for any future date by lining up the final event of the reversed Lead-Time Chart with the required date on the Schedule Objective Plan, and going through the procedure described above.

b. To use this technique as a control device, actual assembly or component inventory on the date in question can be portrayed on the Line-of-Balance Chart. The maximum amount by which the actual inventory differs from the required inventory at any repetitive event number is the amount of end-item shortage that will occur, as shown in figure 11–5. To correct the future end-item shortage (based upon today's component inventory shortage), corrective action will be required. If such a shortage exists, resources should be added to the production of the low-inventory part or component to make up the deficit. Resources may be diverted from production of parts or components with excess inventory.

Section VI. REPORTING SYSTEMS

11–21. General

a. Large organizations engaged in tasks and missions that are both complex and of significant proportion are confronted with challenging problems of communication and control. Certainly the Army and its materiel development process fall into this category. Therefore, the reporting systems employed by the Army are of paramount importance to the communications and controls necessary to support an efficient and responsive materiel development effort.

b. In general, materiel development process reporting falls into two basic categories—recurring and nonrecurring (or exception) reporting. Because nonrecurring or exception reporting is employed in "unforeseen" circumstances, this treatment of reporting will primarily cover the recurring reports associated with the materiel development process. However, mention will be made of examples of exception reporting and the circumstances that may prompt their use.

11–22. Recurring Reports

a. Verbal. Recurring reports can be either verbal or documented, with the second definitely outnumbering the first. Normally, the recurring verbal report is encountered in the case of high-priority, projectized systems or equipments. Examples are the regularly scheduled briefings of project status to high-level Army and Department of Defense management.

b. Examples of Major Documented Reports.

(1) *Technical Development Plans.* [Reports Control Symbol CSCRD–21(R)]. The Technical Development Plan is prepared by the responsible Army developing agency for each project or major task that requires such a plan as a result of specific designation by the Chief of Research and Development. The Chief of Research and Development also designates the initial dates for the submission of the Technical Development Plan for major development projects and tasks. After the appropriate developing agency prepares and submits the initial Technical Development Plan, any significant change to the Plan must be made within 30 days after the necessity for the change has become apparent. Whether the Technical Development Plan for any given project or task must be updated or not, all existing Technical Development Plans will be reviewed annually between 1 January

and 1 March to insure that the most accurate and current information is available to the Director of Defense Research and Engineering during his review of apportionment requests. Technical Development Plan updating is determined by and scaled to individual circumstances, and can be accomplished by simple errata sheets or completely revised Plans—the method used is left to the discretion of the reporting agency. Revisions necessitated by annual reviews are forwarded to the Chief of Research and Development, the Director of Defense Research and Engineering, and other interested agencies on or before 1 April. If an active project or task is terminated, a supplement to the Technical Development Plan must be accomplished within 30 days of the termination action. This termination supplement includes the reason for termination and a report of results obtained up to the point of termination. To facilitate easy access to the information contained in the Technical Development Plan, it is arranged in four sections—

(*a*) *Section I—Narrative Summary.* This section includes the statement of the requirement (including justification of the need), scope, and objective of the project; planned scientific or engineering approach; description of performance characteristics; operational concept, advantages and disadvantages of the new item, and whether or not it replaces an existing item; funding requirements; brief development plan; estimates for completion of major phases; Coordinated Test Plan; identification of directing agency and prime contractor; and joint programing aspects (participating agencies in Navy, Air Force, Marines, National Aeronautics and Space Administration, and so on).

(*b*) *Section II—Detailed Development Plan.* This section includes sketches, diagrams, photographs, tables, lists, and narrative explanation that clearly describe the details of the end item and its components; performance characteristics; planned schedule of development and progress to date; schedule of appropriate milestones; list of project tasks; existing facilities; and construction requirements.

(*c*) *Section III—Reliability and Maintainability Plan.* This section includes coverage of such areas as determination or prediction of the materiel operational and test environmental conditions; statement of the system reliability, requirements and goals; reliability activities for evaluation, analysis, and product improvement; mean downtime allowable; minimum allowable time between scheduled maintenance functions; categories of maintenance or maintenance concept to be used and specific maintenance responsibilities for each; and maintenance personnel (numbers and skills) and training allocated for support of materiel.

(*d*) *Section IV—Detailed Development Funding Plan.* This section includes information on such items as breakout of funding data by appropriation source; actual obligations for prior years; initial program and planned and actual obligations for current fiscal year; and estimated funds by fiscal year necessary to complete the development project.

(2) *Research, Development, Test, and Evaluation Phase Scheduling Report* [Reports Control Symbol AMCRD 104]. The contents of this report constitute the basis for the Army Materiel Command's input to the Army

Research, Development, Test, and Evaluation Progress Report. It is the uniform method for reporting actual, as compared to scheduled, Research, Development, Test and Evaluation project progress, and it reflects the reasons for any experienced or anticipated alteration in established schedules. Projects to be covered by this report are included in the Exploratory Development, Advanced Development, and Operational Systems Development categories, and cover work being conducted that will result in an end item. Excluded are Research, Management Support, and those Exploratory Development projects not intended to result in end items. The Army Materiel Command Research, Development, Test and Evaluation Phase Scheduling Report is prepared by the responsible developing agency and/or project manager as of the end of each quarter. It is then submitted to the Commanding General, Army Materiel Command, by the fifth workday of the month following the end of the report period. When a phase is not completed on schedule, either a revised phase or the same phase (depending upon the impact) will be rescheduled for later completion. When a forecast for a future quarter is revised because of schedule acceleration or slippage, the affected phase will be rescheduled for completion at an earlier or later period, whichever is applicable. To permit meaningful analysis of future performance against the revised schedule, the report will contain a completely revised schedule covering all phases to the completion of the project. The Enginering and System Test phases are reported by the developing agency. The schedules for these phases are developed in conjunction with the Army Test and Evaluation Command.

(3) *Research, Development, Test, and Evaluation Progress Report* [Reports Control Symbol CSCRD-8(R3)] (DA Form 1774-R). This report, prepared by developing agencies at the end of each fiscal quarter, is submitted to the Chief of Research and Development and other Department of the Army Staff agencies by the fifteenth working day after the close of the quarter. The report is designed to impart progress information on developmental end items scheduled for phase completion in accordance with existing approved schedules. It will indicate all changes made during the reported quarter in the phase schedules and In-Process Review schedules of items under development. When a phase or In-Process Review is not completed on schedule, a complete revised phase or In-Process Review schedule will be submitted, together with an explanation of the reason for the schedule change.

(4) *Research and Technology Resume* [Reports Control Symbol CSCRD-103]. The Research and Technology Resume (DD Form 1498) is a very important input to the Army materiel development reporting system. At the project or task level, DD Form 1498 is used to report on projects and major tasks not covered by Technical Development Plans, or other specified exemptions. A DD Form 1498A is used to report technical and management data on scientific and technical work in the categories of Research and Exploratory Development at the work unit level. The detailed requirements for submission of DD Form 1498 are set forth in AR 705-27. DD Form 1498 is the basis for the preparation of the punched cards (or, under special conditions, magnetic tape) that become a part of a mechanized reporting system, in accordance with AR 70-9.

(5) *Project Management Reporting.* Certain reporting requirements are uniquely associated with materiel development under project management. Much information is furnished to top

level Army management concerning projects currently active within a major developing agency such as the Army Materiel Command. The intent of the Army Materiel Command project-reporting requirements, as described in Army Materiel Command Regulation 11–16, is not to duplicate, but rather to combine higher authority reporting requirements with the information and data required for adequate management within the Command. Progress reporting in support of project management is the means by which the Commanding General, Army Materiel Command, is periodically informed of individual project status. This reporting is essential to facilitate intelligent and responsive decisions and knowledgeable assessment of project status. The reporting system used is more than just a means of acquiring information. It is based upon a uniform methodology calculated to provide for retrieval and progressive summarization at each level of control. The entire progress reporting structure begins at the plant, laboratory, or arsenal level, and is progressively summarized for each level of management up to the Commanding General. This uniform reporting system for analyzing performance against time, cost, and technical performance objectives for all phases of the project life cycle goes even beyond the materiel development phase. This system includes four basic types of reports—

(*a*) *Redline Reports* are submitted on an emergency or crisis basis, and generally solicit the personal intervention or assistance of the Commanding General, Army Materiel Command. This is a basic example of an exception report on an "as occurs" basis.

(*b*) *Weekly Significant Action Reports* provide a means by which the Commanding General, Army Materiel Command, may be apprised of current significant events and/or by which he may be forewarned of any situation that may become troublesome to the success of the project or the performance of the weapon or equipment system.

(*c*) *Monthly Highlight and Progress Reports* are periodic reports designed to provide project information relative to significant events scheduled for completion during the succeeding 90 days, identification of decisions required of higher authority, slippages occurring during the report month, corrective actions taken, problems requiring Office of the Secretary of Defense action, and changes in estimated funding requirements.

(*d*) *Quarterly Project Master Plan Reports.* During the very early stages of any project, a Project Master Plan is prepared. Such plans are required for systems/equipments selected for project management. The Project Master Plan must be completed no later than 3 months after a project is designated for special management within the Army Materiel Command. Although the content of the Plan will be governed, to a great extent, by the phase of the project's development when it is designated for special management handling, a complete system or equipment package will consist of time, cost, and technical performance information. The Quarterly Progress Report provides Army Materiel Command top management data that are assessed against the currently approved plans—it updates the Project Master Plan relating to those elements of the program which have progressed or changed during the quarterly reporting period.

11–23. Other Forms of Reporting

a. Reporting inputs to the materiel development process may originate from many sources. For example, research and development symposia, conferences, and technical meetings may be conducted under the sponsorship of the Army, contractors, associations, societies, or other institutions. No matter who the sponsor is, these forms of reporting can, and often do, make significant contributions to the materiel development process through the verbal exchange of ideas and data, or through reports on the proceedings of such sessions.

b. In addition to meetings, other forms of reporting include the Mutual Weapons Development Data Exchange Program and Defense Development Exchange Program. Under the first of these programs, participating countries exchange with the United States technical and scientific information of mutual interest. The second program is similar to the first, but is limited to scientific and technical information exchanges between the United States and countries of the Far East.

c. The Army's Research, Development, Test, and Evaluation Information System and the Scientific and Technical Information Program are both designed to eliminate duplication, improve management, keep scientists, engineers, and managers informed, and, by these means, reduce research, development, test and evaluation lead time. Under the staff direction of the Chief of Research and Development, they make a significant contribution to the efficient and responsive reporting of the materiel development process.

d. One of the important feedback reports to production and development personnel regarding problem trends and maintenance costs is the reporting of field problems on Army materiel under the Army Equipment Reporting Syetem (TM 38–750) and ammunition malfunction reporting (AR 700–1300–8). These reports provide indicators on materiel deficiencies that may require redesign or further development.

CHAPTER 12

MATERIEL TESTING

Section I. THE ROLE OF TESTING IN MATERIAL DEVELOPMENT

12–1. Scope and Objectives of Materiel Testing

a. Virtually all military materiel, particularly any to be used by combat elements of the armed forces, is subject to some test and evaluation process. The primary objectives of this effort are to insure that the materiel meets the approved statement of need and that safety requirements are met. The item or system is tested under specified conditions to determine to what degree the item or system and its associated tools and test equipment perform the premission.

b. Army materiel testing also provides a factual basis for the continuation of equipment improvement, verification of reliability and maintainability, assessment of product quality, and the identification of maintenance and supply requirements. Consequently, tests are conducted throughout the production and operational phases of the materiel life cycle. To meet all the needs that arise during this cycle, it is necessary to have accurate, purposeful, and flexible test planning that involves the minimum lead time and minimum duplication of tests, facilities, and personnel.

12–2. General Materiel Testing Policies

a. Accomplishing Test Programing and Planning. Test programing and planning are accomplished by the major developing agencies on either an item-by-item or a system basis. Tests are programed, planned, and conducted in such a manner as to avoid delays caused by improper application of administrative and operational procedures.

b. Timing. Testing begins as early as practicable. Tests must be conducted in the minimum time required to determine the suitability of the item being tested. A test lead-time goal of 1 year or less, within the overall Army lead-time goal of 4 years from project initiation to first production roll-off, has been established. Test programing, component development, and concurrent development of special tools and test equipment are significant ways to reduce the lead time of development and testing. As such, they must receive adequate funding support.

c. Testing Assignments. Appropriate commanders review and analyze their testing responsibilities, and then designate an identifiable organizational element within their headquarters with overall responsibility for the coordination and supervision of testing. Necessary coordination among the heads of the major developing agencies and action by commanders within these agencies must be accomplished in such a way as to insure that duplication of testing effort, facilities, or programs does not occur. The testing facilities available to major developing agencies are used as appropriate to support Army-wide requirements, including field experimentation required in research, development, and production test programs. When practical, use is made of tests performed by other services and Government agencies.

d. Exceptions to Required Testing. Under emergency or other unusual conditions, and only with the approval of Headquarters, Department of the Army, certain development tests may be eliminated in order to reduce testing lead time, as follows:

(1) *Integrated Engineering/Service Tests.* Evaluation would be based wholly on the Engineer Design Test.

(2) *Engineering Tests.* The Engineer Design Test would be used for technical evaluation.

(3) *Service Tests.* A limited Engineering Test would be conducted instead to verify safety and determine gross deficiencies.

e. Expedited Development Projects. During expedited development projects, such as those for certain guided missiles and special weapons, type classification for limited production occurs prior to the Engineering and Service Tests. In such cases, these tests are conducted with limited production models rather than with developmental models. Quantities required for Engineering and Service Tests will be included in the proposed limited production quantity. Type classification as limited production without completion of Engineering and Service Tests will be considered as an exception to normal development procedure.

f. Test Coordination with Other Commands. Test plans prepared for Engineering, Service, Check, and Confirmatory Tests are coordinated by the major developing agencies with the Commanding General, United States Army Combat Developments Command, who is also given an opportunity to comment on the results of these tests. Test plans for Confirmatory Tests are coordinated by the major developing agencies with the Commanding General, United States Continental Army Command, and with oversea commands as appropriate. Plans and reports of tests of air defense materiel developed for the Continental United States air defense are coordinated by the major developing agency with the Commanding General, United States Army Air Defense Command.

Section II. TYPES OF MATERIEL TESTS

12–3. Introduction

a. Common Characteristics. Materiel tests serve a variety of purposes, and are performed by many organizations. Consequently, it is necessary to have an overall view of the types of tests that are likely to be used in connection with materiel development. All of these materiel tests have two general characteristics. First of all, they follow a chronological pattern. This does not necessarily mean that the tests are conducted sequentially but, rather, that there is a progressive approach. The type of data sought ranges from the highly technical and quantitative to operational and qualitative The second general characteristic is that the tests are associated with specific types of organizations. Thus, they range from very technical—conducted by contractors or Government laboratories and engineering agencies—to those intended to produce an operational, qualitative assessment. The latter, including Service and Troop Tests, normally are conducted by using Army troop unit personnel.

b. Types of Tests. The types of tests used by various Army organizations are described in paragraph 12–4 under headings that indicate the general nature and purpose of each test. The general chronological arrangement of some of the more significant tests is illustrated in figure 12–1. This figure also portrays the relationship of certain key development events to the test cycle.

12–4. Materiel Test Descriptions

a. Research Tests.

(1) *Research Test.* These tests are conducted during the research phase in order to confirm concepts and to further research projects or tasks.

(2) *Feasibility Test.* These tests determine, through a process of technical examination and study, the possibility of attaining end-item materiel development. The Feasibility Test consists of two parts: a very long-range state-of-the-art study wherein the probability of attaining general technological goals is determined, and a

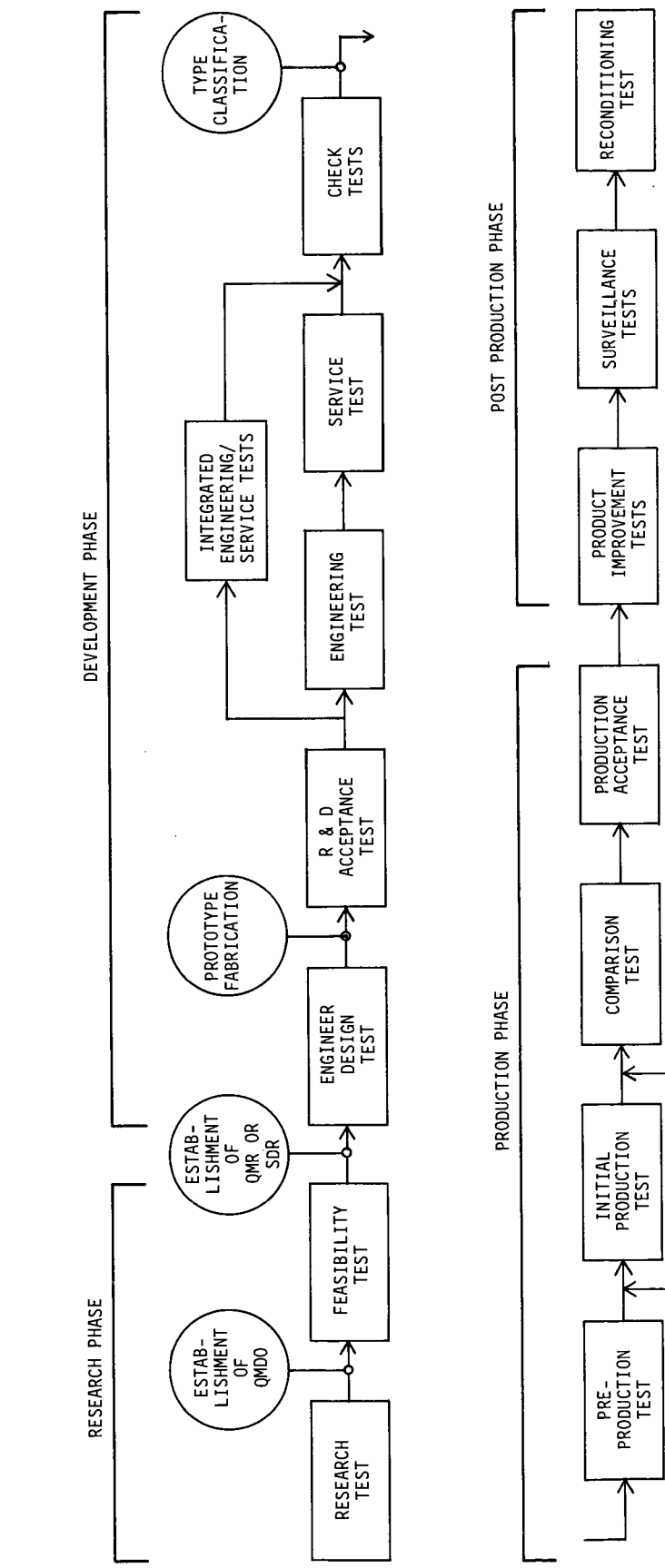


Figure 12-1. Testing Performed at Various Phases in Life Cycle of Army Materiel.

detailed feasibility study of a desired end item after military characteristics are known.

b. Development Tests

(1) *Engineer Design Test.* This test is conducted by or under the control of the design agency. Its objective is to determine the inherent structural, electrical, or other physical and chemical properties of construction materials, or of a component, subassembly, prototype assembly, item, or system, including the effect of environmental stresses on these properties. The test is characterized by controlled conditions and the elimination of errors in human judgment as far as possible, through the utilization of laboratory equipment, modern statistical methodology, and personnel trained in engineering or scientific fields. The test is used to collect design data, confirm preliminary concepts and calculations, and determine the compatibility of components. In the case of a highly complex system consisting of a number of major integrated components (for example, a guided missile system), the Engineer Design Test may be expanded to include a complete system demonstration. Here, following completion of subsystem testing, the design agency demonstrates the engineering feasibility of complete system operations.

(2) *Research and Development Acceptance Test.* This test is conducted by the developing agency on an item or system designed and developed by a contractor. Its purpose is to insure that the specifications of the development contract have been fulfilled. Acceptance of the item or system for engineering testing is contingent on its passing the Research and Development Acceptance Test.

(3) *Engineering Test.* This test is conducted during Engineering/Operational Systems Development by or under the supervision of a separate test agency that is not a part of the developing installation or activity concerned. Using an engineering approach, the test seeks to determine the technical performance and safety characteristics of an item or system and its associated tools and test equipment as described in the Qualitative Materiel Requirement, its technical characteristics, and other characteristics indicated by the particular design. It includes the measurement of the inherent structural, electrical, or other physical and chemical properties, and may utilize data previously generated in Engineer Design Tests. The Test is characterized by controlled conditions and the elimination of human errors in judgment, as far as possible, through the utilization of environmental chambers; physical measurement techniques; controlled laboratory, shop, and field trials; statistical methodology; and the use of personnel trained in the engineering or scientific fields. The Engineering Test provides data for use in further development. It also aids in determining the technical and maintenance suitability of the item or system for Service Test.

(4) *Service Test.* This test is conducted under simulated or actual field conditions. Its objective is to determine the performance of the equipment and its logistic acceptability to include maintainability and reliability; attainment of the technical characteristics prescribed by the Qualitative Materiel Requirements or Small Development Requirements, including evaluation as to safety, if appropriate; requirement for additional design changes to the equipment; evaluation of the draft technical manuals, repair parts and special tool lists, lubrication orders, maintenance allocation chart, tools,

test and support equipment (organization through General Support Maintenance levels); recommended changes in training and doctrine; military personnel and skill requirements; and durability of equipment under test. The test uses military personnel representative of type that will operate and maintain the equipment in the field. The Service Test also provides a basis for recommendation or deferment of type classification action.

(5) *Integrated Engineering/Service Test.* An integrated test is one in which Engineering and Service Tests are integrated to an optimum degree, normally at one location. An integrated test may be characterized by complete integration throughout the test, or by partial integration involving only certain phases. In some cases, an integrated test may be expanded to include an Engineer Design Test.

(6) *Subtests.* Within major tests there are a number of subtests, including air-portability and air-droppability, endurance and reliability, human factors analysis, vulnerability, and environmental and special tests.

c. *Special Materiel Tests.*

(1) *Check Test.* A Check Test is a retest performed on a Service Test model of selected items to determine whether major deficiencies revealed in the Service Test have been corrected. These deficiencies had previously made the item unsuitable for type classification.

(2) *Confirmatory Test.* A confirmatory test is conducted for one of two objectives: type I, to determine on early production models the suitability of modifications found to be necessary but not accomplished on the development item; and, type II, to preclude time consuming retrofit programs on selected items of recently standardized equipment by intensive testing in the field, using TOE-type units. When a confirmatory test has been determined to be necessary, Headquarters, Department of the Army, will indicate the appropriate test objective.

(3) *Troop Test.* A Troop Test is a test conducted in the field (using Table of Organization and Equipment units) for the purpose of evaluating operational or organizational concepts, doctrine, techniques, or procedures to gain further information on materiel. These tests are usually conducted in conjunction with tactical field exercises in order to examine the effectiveness of the unit in operation with, and in relation to, other organizations.

(4) *Environmental Test.* Environmental Tests are conducted to determine whether an item performs effectively in the environment of its intended use. Environmental Tests form an integral part of testing in all phases—Engineer Design Tests, Engineering Tests, Service Tests, and Troop Tests. Testing in simulated climatic extremes is ordinarily used to the maximum extent in the Engineer Design and Engineering Test phases. Testing in extreme natural climatic environments is used to substantiate or supplement data obtained from simulated tests. Testing in natural environments will, as a rule, be Engineer/Service Tests. Since testing in natural locations of extreme climate is costly in terms of manpower, money, materiel, and time, each item's requirements for testing in natural environments must be carefully determined before submitting the item for such testing. Such predetermination of necessary testing in natural environments is vitally important and should not be omitted in test design.

(5) *Special Test Programs of Army Aircraft and Allied Equipment.* These programs comprise the following tests:

—*Phase A. Contractor's flight tests.* Tests conducted by the contractor to demonstrate that the aircrafts is safe for further testing and that the components essential for flight are satisfactory.

—*Phase B. Contractor's compliance flight tests.* Tests to insure that the contractor has complied with all specifications contained in the contract.

—*Phase C. Design refinement tests.* Tests conducted both prior to and after delivery of production aircraft in order to determine the suitability of modifications design to correct deficiencies revealed during other tests, and to expedite product improvement.

—*Phase D. Airworthiness and performance tests.* Tests conducted to obtain and compile detailed information on stability, control, performance, and handling characteristics for inclusion in technical manuals and other publications on in-service aircraft.

—*Phase E. Service tests.* Tests conducted under simulated or actual operational conditions to determine to what degree the item meets the military requirements stated in the Qualitative Materiel Requirement.

—*Phase F. Logistical evaluation tests.* Tests conducted to determine and develop component service life and inspection cycles; to advance aircraft serviceability through improvements in technical publications, procedures, development of quick change kits and modifications; to determine manpower, tool, equipment, and skill requirements; to verify the adequacy of special and common tools and equipment; to confirm levels of maintenance and the training requirements therefor; to develop repair parts consumption data for use during provisioning and supply control, verification of source coding, and refinement of supply authorization documents; and to develop maintenance and operating cost data.

(6) *Test and Evaluation of Foreign Materiel.* Tests of foreign materiel are performed for a number of reasons. Such tests provide objective appraisals of foreign technology and military capabilities; aid in the determination of United States countermeasures requirements; and determine whether foreign items are suitable for Army use or for further consideration for Army use. These tests also help to reduce lead time in the development of materiel for Army use. They are often performed as part of international cooperative military programs.

(7) *Tests for Manufacturers, Contractors, and individuals.* Tests of materiel or equipment for defense contractors or private industry may be performed only when they are clearly in the interest of national defense. Such tests must be approved by the Commanding General of an Army Materiel Command major subordinate command and performed under directions issued by Headquarters, Army Materiel Command. Tests for foreign private industry may be performed only when approved by Headquarters, Army Materiel Command.

(8) *Tests on Materiel Developed for Other Users.* Materiel being developed for other services or Government agencies will be subjected to Engineering Tests to insure that design requirements have been met, unless the requirement is specifically waived by the sponsoring agency. Service Tests, if performed, are the responsibility of the sponsoring Government service or agency concerned, but may be accomplished or participated in by the Army Materiel Command, as requested.

d. Production Tests

(1) *Preproduction Test.* A Preproduction Test is a type of engineering test, conducted by or under the supervision of the responsible procuring agency in

coordination with the developing agency. Using a preproduction model procured in accordance with the supply procurement specifications and drawings (and by means of the same methods, materials, and equipment that will be used during regular production), the test seeks to verify production drawings, processes and materials.

(2) *Initial Production Test.* Conducted by or under the supervision of the responsible procuring agency in coordination with the developing agency, this test is made on an early item or system from the first production run. Its purpose is to verify the adequacy and quality of the materiel when manufactured according to the production drawings and the mass production process.

(3) *Production Acceptance Test.* An Acceptance Test is a test of individual products or lots of materiel items that have been submitted for acceptance. Its objective is to determine conformance of the products or lots with requirements, prior to acceptance.

(4) *Production Comparison Test.* A Comparison Test is a test of random samples of production line items, conducted as a quality assurance measure. Its purpose is to detect any design, manufacturing, or inspection deficiencies that may reduce the effective operation of the items by the using agency.

e. Postproduction Tests

(1) *Product Improvement Test.* This test is conducted on standard items that have been modified to correct deficiencies discovered during use, to simplify equipment operation or design, to increase reliability, maintainability, and durability, or to promote personnel safety. Its purpose is to insure that essential military characteristics have not been adversely affected; it also establishes the durability, operational capability, and maintainability of the modified item.

(2) *Surveillance Test.* Surveillance testing is performed on items that possess a possible storage safety hazard or are subject to rapid deterioration of materiel or performance. These items are stored and tested on a continuing basis in all climatic environmental conditions until maximum storage life is determined.

(3) *Reconditioning Test.* Conducted on standard items that have been reconditioned, renovated, rebuilt, or overhauled, this test seeks to determine the quality level of the reconditioning process, and verifies the degree to which the item meets the appropriate specification.

Section III. RESPONSIBILITIES FOR TESTING

12–5. Introduction

a. The planning and execution of Army materiel testing is a staff and command effort that involves the participation of numerous organizations. The complexity of the task is exemplified by the comprehensive nature of its scope and objectives and by the variety of tests performed. Consequently, there are very few organizations within the Army that are not involved to some extent. Of necessity, the bulk of the test work is planned and executed by organizations that act for the customer through their specialized testing capabilities.

b. Several of the general testing policies (expressed in para 12–1 and 12–2) and the entire organizational structure for testing (described in subsequent paragraphs) are an outgrowth of the 1962 Army reorganization, and reflect the experience gained since that time. Because of the kinds and diversity of activities at various stages in the life cycle of an item, the overall task must be divided and assigned to organiza-

tions with special capabilities and interests. It naturally follows that comprehensive planning and coordination is a principal ingredient of any major test program.

12–6. United States Army Materiel Command

a. The Army Materiel Command is the field command with primary life-cycle responsibility for Army materiel. Consequently, this Command is the principal Army agent for materiel test activities. Within this Command, the test responsibilities of each major organization vary according to its mission.

b. Overall responsibility for specific projects throughout the development, production, and deployment cycle of assigned materiel remains with the appropriate commodity command, project manager, or separate installation or activity reporting directly to Headquarters, Army Materiel Command. From a testing standpoint, this responsibility includes timely transition of a project from Engineer Design phase activities into the Enginering and Service Test phases. After the Test and Evaluation Command conducts an independent evaluation of materiel (based on test results), commodity commands and separate installations and activities reporting directly to Headquarters, Army Materiel Command, or project managers for project-managed items are responsible for initiating corrections, resubmitting the materiel for test when required, and initiating actions leading to type classification when appropriate. These groups are also responsible for overall materiel evaluation, including product quality and reliability assessment.

c. The responsibility of the Army Materiel Command, as related to test and evaluation of materiel, is to assure that provisions are made for determining reliability, durability, and maintainability in the test program. During the preparation of test plans, the Army Materiel Command assists the Test and Evaluation Command to assure adequate coverage of all maintenance aspects. In addition, the Army Materiel Command is responsible for assuring adequate Surveillance Test programs. The Army Materiel Command reviews final test reports leading to type classification action. It must also provide maintenance and supply support for tests, as required.

12–7. United States Army Test and Evaluation Command

a. The basic mission of the Test and Evaluation Command is to provide an independent evaluation (through Engineering Tests, Service Tests, Engineering/Service Tests, Check Tests, and Confirmatory Tests) of all materiel for which the Army Materiel Command has developmental responsibilities. In discharging this mission, the Test and Evaluation Command is responsible for establishing the test objectives, preparing and approving the test plan, conducting and reporting the test itself, and evaluating and distributing the test report. The results of this category of tests lead to recommendations pertaining to type classification.

b. A concurrent mission of this command is to perform a supporting test service to other agencies. In these cases, the requesting agency is responsible for the establishment of test objectives, preparation and approval of the test plan, and the evaluation and instructions for distribution of the test report.

c. Source documents for Test and Evaluation Command planners are the Army Materiel Command Program Budget Guidance and Directive, which covers Research, Development, Test, and Evaluation development programs, and the Army Materiel Command Program Interchange Information which furnishes requirements for production and postproduction testing. Environmental testing requirements are stated during annual conferences with the Arctic, tropics, and desert test activities. By continuous refinement of the inputs from these sources, the test program is developed and presented in the Army Test and Evaluation Command Schedule which is used as a master planning guide for the entire command.

12–8. United States Army Combat Developments Command

a. The role of the Combat Development Command in testing is simultaneously that of

operator, observer, and user. The observer function is performed with respect to the test activities of the various materiel development agencies. Combat Developments Command personnel observe and analyze test programs test programs to determine whether developments meet objectives and requirements, and to provide user guidance, as appropriate. This function includes a review of development test results to determine the acceptability of the tested items in relation to requirements and improved combat effectiveness.

b. The Combat Developments Command also conducts the Army Combat Development Evaluation Program. This program consists of two phases: the Combat Development Experimentation Program, which, through field experimentation, war-gaming, miniaturized exercises, and other methods results in the development of new or improved doctrine, organizations, materiel development objectives, and materiel requirements; and the Combat Development Troop Test Program, which through Troop Tests and field exercises conducted in conjunction with other commands, provides for test and evaluation of new or improved doctrine, tactics, procedures, and organizations, and gains additional information on materiel.

12–9. Staff Responsibilities

a. For Research, Engineer Design, Engineering Tests, Service Tests, and related tests of development items, the Chief of Research and Development has primary Army Staff responsibility. For Preproduction, Production, and Postproduction Tests, the Deputy Chief of Staff for Logistics has primary Army Staff responsibility.

b. The Assistant Chief of Staff for Force Development has primary Army Staff responsibility for Troop Tests, and has Army Staff responsibility for programing the costs of Confirmatory Tests (Type II), which are conducted using Table of Organization and Equipment troops.

Section IV. TEST PROGRAMS, PLANS, AND SUPPORT

12–10. Test Programs

a. Consideration in Overall Program. Early in the development cycle, consideration must be given to the overall test program that is to be followed in assessing the merit of the item under development. The Engineer Design Test can often be a useful foundation upon which to build other major test efforts. Test data from this early work can be made available for later use in an Engineering or Service Test. If practical, such data could eliminate the need for some portions of these later tests, thereby potentially reducing time and cost.

b. The Coordinated Test Plan. A document that portrays the overall test program is a Coordinated Test Plan. Such a plan is required for all items of materiel approved for development by the Department of the Army. Its objectives are to insure maximum efficiency in the use of materiel and rapid and complete distribution of test information. The developing activity (normally an Army Materiel Command commodity command) is responsible for preparation of the Coordinated Test Plan and should include in it brief statements of Engineering and Service Test requirements. The Coordinated Test Plan is contained in the Research and Technology Resume or the Technical Development Plan. The Coordinated Test Plan data obtained from the Test and Evaluation Command are listed in a Test and Evaluation paragraph of the Technical Development Plan. Developing activities include appropriate data concerning the Coordinated Test Plan in Command Schedules, Program Data Sheets, and Research, Development, Test, and Evaluation Phase Scheduling Reports. The Coordinated Test Plan data are also included in the Research and Development Resume or Technical Development Plan at the time a development project is initiated. The developing activities invite the Test and Evaluation Command to provide representation at all In-Process Reviews in which the Coordinated Test Plan or matters affecting items under it for which the Test and Evalu-

ation Command is responsible (such as item quantities, test scheduling, and test funding), are to be discussed.

c. Three Combinations of Engineering and Service Tests. In developing this plan, consideration must be given to establishing the most practical and beneficial relationship bebetween the Engineering Test and the Service Test. Three general alternatives are available:

(1) *Integrated Test Program.* An integrated (Engineering/Service) test program is the goal of all test planning, and should be given first consideration in the early planning of all development programs. An integrated test program is appropriate when tests involve expensive, low-density materiel; when the number of prototypes available is inadequate for concurrent testing; and when the validity of test results is not jeopardized by such a program.

(2) *Concurrent Test Program.* A concurrent (Engineering/Service) test program will be considered when an integrated test program is not advisable. A concurrent test program is appropriate when tests involve high-density materiel, and when the number of available prototypes is adequate for a program.

(3) *Sequential Test Program.* A sequential (Engineering/Service) test program is appropriate when integrated and concurrent test programs are inadvisable; when the number of prototypes available inadequate for concurrent testing; or when a requirement exists for separate, unusual test conditions and facilities.

d. Requirements for Documentation. Prior to initiation of a development project, the Test and Evaluation Command furnishes the developing activity with estimates of the following requirements for inclusion in the Technical Development Plan or Research and Technology Resume (DD Form 1498):

(1) A brief statement of test objectives.

(2) The type of Engineering and Service Test program proposed (integrated, concurrent, or sequential).

(3) The number of items required for the proposed test (including environmental tests).

(4) The length of time required to conduct each portion of the test program from delivery of test items to receipt of the report by Headquarters, Army Materiel Command.

(5) The funding requirements for conducting Enginering and Service Tests.

(6) The special test support requirements, including equipment, facilities, and manpower.

e. Test and Evaluation Command-Sponsored Tests. Paragraphs 12–3 and 12–4 indicated that certain types of tests are a basic responsibility of the Test and Evaluation Command, whereas for other tests it only provides support, or is not involved at all. In the following discussion, the emphasis will be on the Test and Evaluation Command approach to the entire testing process. The pattern of the Test and Evaluation Command approach within the Army Materiel Command is fully illustrative and will make it practical to cite and use terms as they apply in a systematic planning operation. Obviously, tests will be performed by various organizations for a variety of reasons at a number of points in the materiel life cycle. Uniformity in planning and reporting, therefore, is not to be expected. However, testing under Test and Evaluation Command control, particularly the Engineering Tests and Service Tests done by organizations within this command, can be accomplished through a concept that involves a planning pattern and standard terminology.

f. Nuclear Materiel. Although much of the concept expressed in the section on test programs, plans, and support is applicable to the testing of nuclear materiel, many aspects of such tests follow a different pattern. This is because other agencies of the Government are involved, and also because special safety and reliability requirements would have to be applied. Comment on these special cases is provided in paragraphs 12–14 and 12–15.

12–11. Test Planning

a. General. Test planning is a broad functional task that is addressed to the questions of what to test and how to test in order to assess the materiel properly. Since every test must be preceded and supported by some type of planning, test planning begins very early in any development program and continues throughout the life of an item. The tests are planned so that all interested agencies will derive the maximum benefit from each test. Similarly, they are planned to insure that each test embodies the best available techniques and scientific methodology. Emphasis is placed on using methods that produce factual data and eliminate the element of personal bias in results and conclusions.

b. Goals. A major task of commodity commands, project management offices, and the Test and Evaluation Command is to seek the greatest possible integration of the testing effort so that duplication of tests, test facilities, equipment, and personnel will be minimized. This can be accomplished through the Coordinated Test Plan. However, as indicated earlier, the Coordinated Test Plan is basically an instrument to relate the activities of Engineering Tests, Service Tests, or other tests. For other tests, the developing agency, often represented by an in-house laboratory or a contractor, is responsible for establishing the test objectives and test plan, and also for processing the test data. In such cases, the status of the hardware is such that tests for design capability may be quite different from those conducted during the Engineering or Service Test phase. Nevertheless, elements of the test planning process are similar, and include the various instruments described below and depicted in figure 12–2.

(1) *Planning Directives.* Planning directives are used primarily to initiate

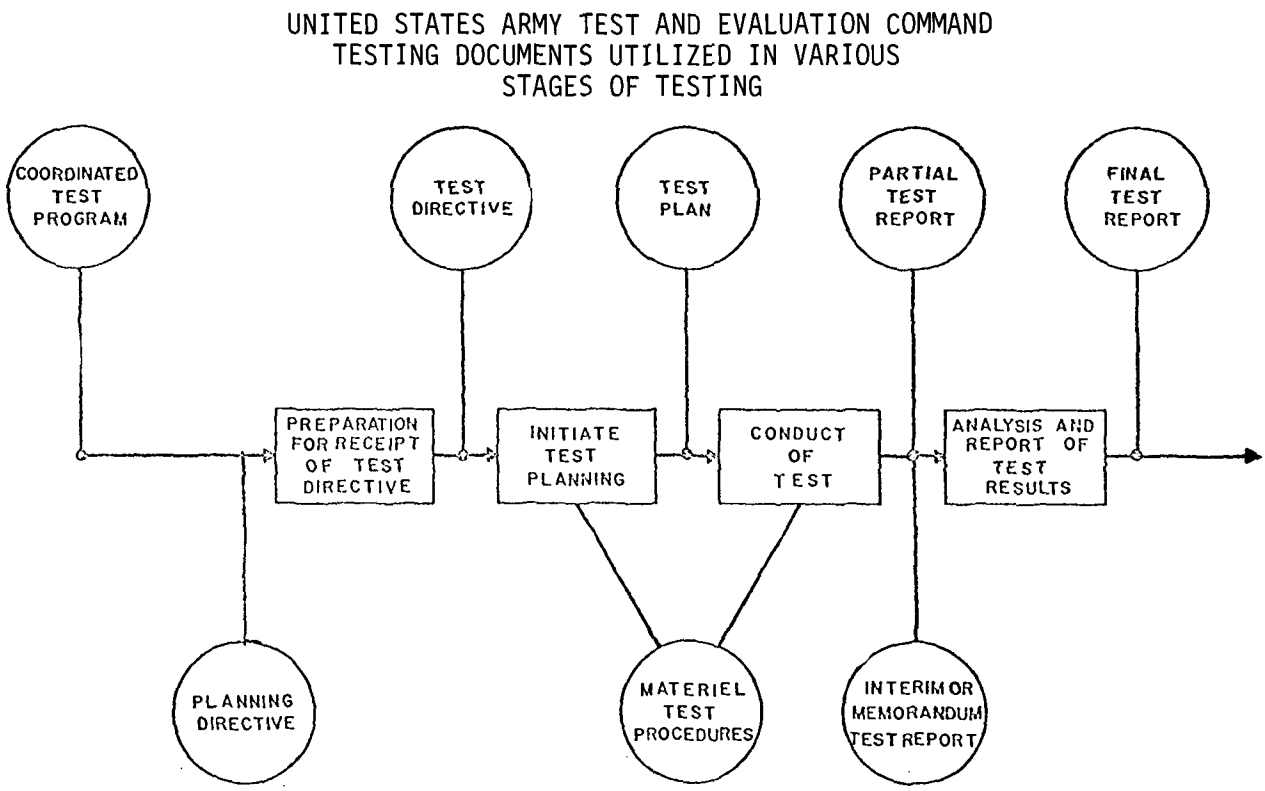


Figure 12–2. United States Army Test and Evaluation Command Testing Documents Utilized in Various Stages of Testing.

planning and/or to direct participation in the development of a Coordinated Test Plan. The planning directive is not, however, used to initiate actual testing activities. This directive is based on initial available information that, in most instances, is fragmentary.

(2) *Test Directives.* Test directives are based on Department of the Army-approved test programs and provide clear guidance in test execution. They state test objectives, limiting the scope and length of testing to those necessary objectives, and they assign specific responsibilities to the test activities and coordinating agencies, including responsibilities for preparing complete test plans and test reports.

(3) *Test Plans.* A test plan is the basic document defining all assigned tests to be performed on Army materiel, items, or systems. Test plans are prepared to assure that Army materiel is properly and significantly tested, and to reduce testing lead time and costs. They are usually prepared for a specific test phase of Army materiel, such as Engineering Testing or Service Testing, and they embody the best available testing techniques and methodology. Emphasis is placed on test methods that produce factual data and eliminate personal bias or prejudicial opinions and conclusions that might affect test results. Test plans limit testing activities to the actions necessary to determine the requirements stated in Qualitative Materiel Requirements, Small Development Requirements, Technical Characteristics, and and test directives. They also include provisions for accumulating data on which to base a Safety Release and/or Safety Confirmation document. They provide a concise statement of approach, test criteria, test objectives, and the scope and length of tests. Specific subtests necessary to determine the degree to which an item meets or exceeds the Qualitative Materiel Requirements, Small Development Requirements, and Technical Characteristics are prescribed. Subtests required to develop appropriate safety statements are defined in accordance with the provisions of related regulations. All required tests are defined; in some instances, data known or later determined from prior testing may be used for this purpose. Specifically, test plans define test objectives; indicate areas of test design and scope; insure development of adequate test data; assign responsibility for planning, conducting, and reporting tests; and insure the most efficient use of test materiel.

(4) *Test and Evaluation Command Materiel Test Procedures.* The Test and Evaluation Command Materiel Test Procedures are a collection of documents that define the test procedures utilized by that command in the Engineering and Service Testing of Army materiel. These test procedures are a compromise between the complete detail of a fully developed test operations plan and a broad statement of Engineering and Service Test requirements. These documents do not provide detailed task procedures. They present test criteria and describe general testing procedures and techniques. They also provide an outline for the logical acquisition of the required test data by scientific engineering, and military personnel.

12–12. Test Reports

a. Types. A test report is the basic document for describing the results of tests and for presenting factual data. Several types of test reports are used—

(1) *Partial Test Report.* A Partial Test Report is a formal report describing a specific phase or period of testing.

The particular phase or period covered in the report is, in itself, considered final and complete. Therefore, each Partial Test Report is considered final as far as that phase goes, and is so handled. The last report of a series of Partial Test Reports contains the conclusions and recommendations of the test activity. Periodic Partial Test Reports or a series of Partial Test Reports may contain conclusions and recommendations applicable to that portion of the test project.

(2) *Final Test Report.* A Final Test Report is a formal report prepared at the completion of testing. The Final Test Report contains the conclusions and recommendations of the test activity or test activities for a Coordinated Test Program.

(3) *Firing Report.* Firing Reports are formal data records on round-by-round (group of rounds) performance or occurrences during a Firing Test program.

(4) *Letter Report.* Letter Reports are abbreviated Final Test Reports in letter form that generally follow the prescribed test report format. A Letter Report is used in place of a Final Test Report whenever it is adequate to meet reporting requirements.

(5) *Interim or Memorandum Report.* Interim or Memorandum Reports are informal information or progress reports prepared as a result of significant testing incidents or actions, or at the end of testing periods. Interim or Memorandum Reports may contain the interim conclusions and recommendations of the test activity. In this case, they are processed in the same manner as Final Reports.

(6) *Technical Progress Report.* A Technical Progress Report is an informal report describing technical progress on an assigned project. Content and format are specified on a project basis in the test directive, which also specifies distribution of this report.

(7) *Equipment Failure Report.* This report provides a rapid means of disseminating to the commodity commands or developing activity information concerning individual failures or deficiencies discovered in equipment undergoing test.

(8) *Data Report.* A Data Report consists solely of raw and/or reduced data.

(9) *Miscellaneous.* This category includes synopses, summaries, and all other reports not specified above.

b. Definitions. In order to make sure that defects are reported in a uniform and timely manner, the following definitions have been established for use throughout the Test and Evaluation Command complex:

(1) *Deficiency.* A deficiency is a defect or malfunction, discovered during the life cycle of equipment, that constitutes a safety hazard to personnel; results in serious damage to the equipment if operation is continued; indicates improper design or other cause of serious impairment to the equipment's operational capability; disables or immobilizes the equipment during normal operational test phases; or serves as a deterrent to type classification.

(2) *Shortcoming.* A shortcoming is an imperfection or malfunction, occurring at any time during the life cycle of the equipment, that should be reported since it must be corrected to render the equipment efficient and serviceable. A shortcoming may not necessarily cause an immediate breakdown, jeopardize safe operation, or materially reduce usability of the materiel or end product. However, if it occurs during testing phases, it should be corrected immediately without unduly complicating the item or producing other undesirable characteristics, such as increased cost, weight, and so forth.

(3) *Suggested Improvement.* A suggested

improvement is an increase in quality or performance that is desirable, but not imperative. For example, replacing cast-iron handles with aluminum or plastic handles to prevent rusting would be a suggested improvement.

(4) *Reportable Incident.* A reportable incident is any occurrence during test action that affects the operation, durability, safety, reliability, or acceptability of an item undergoing test. Components, special tools, test and support equipment, or draft technical manuals not available at the start of testing are considered reportable incidents.

c. Test Results. Test reports are prepared by the individual test activities. Test results are reflected in test reports as *factual* data. If subjective observations, opinions, and conclusions are contained in the test report, they must be clearly identified as such.

12–13. Test Support

a. Planning for test support is an integral part of test planning and is included in the early stages of funding and the development of Coordinated Test Plans. Necessary logistics support, including repair parts, must be available throughout the testing cycle in order to avoid delays through failures in materiel under test or in ancillary test support equipment. Integrated planning for test support for Environmental Testing is particularly important when suitable climatic and terrain conditions are available only for short test seasons.

b. A test support plan should include the listing, quantity, and firm availability date of test support and control items; arrangements for transportation of the test items, special tools, special test equipment, repair parts, technical literature, and other test support items to the test site at the specified time; and emergency transportation provisions to avoid delays during critical test periods. Where applicable, tables of distribution and allowance should be modified to authorize required items. In all cases the installation property officer should be advised of requirements in a timely manner to permit orderly supply action. It should also provide for the availability of testing facilities maintenance support, and competent personnel support, including contractor assistance when needed, and should assign responsibilities, including funding responsibilities. For guided missiles, the plan should include a statement from the appropriate national range commander indicating his coordination and his estimate of the additional facilities and instrumentation required by the range to support the plan.

c. When requested by the major developing agency, the Continental Army Command provides the necessary troop support for Service Tests. The appropriate field commander provides the necessary personnel, facilities, and logistic support for Service Tests conducted in Alaska, the Panama Canal Zone, and oversea theaters.

d. Procurement of Equipment and Missiles, Army, items needed to support tests may be furnished (within priority and availability) from depot stocks. However, nonexpendable items must be returned in the same condition as when they were loaned (fair wear and tear excepted), and reimbursement must be made for the expendable items consumed. The cost of renovating and returning the loaned items to "ready for issue" condition is charged to the Research, Development, Test, and Evaluation appropriation. Missiles to support Service Tests are included in Research, Development, Test, and Evaluation programs and budgets, and are charged to the Research, Development, Test, and Evaluation appropriation. For standard stock items procured by the Operations and Maintenance, Army, appropriation or Army Stock Fund in support of testing, requisitions will cite Research, Development, Test, and Evaluation funds for reimbursement.

e. Certain considerations exist in regard to facilities for test support. For example, heads of major developing agencies are to give continuing consideration to establishing integrated test facilities and to closing duplicate and marginal test agencies and facilities. It should also be noted that Army plans for facility construction emphasize development of integrated test centers. In addition, the Chief of Research and

Development and the Deputy Chief of Staff for Logistics review funding requirements for capital equipment needed to modernize test facilities; they also consider concurrently the related requirements for construction of development and production test facilities.

Section V. TESTING OF NUCLEAR MATERIEL

12–14. Nuclear Weapons Testing

a. Nuclear weapons test comprise several separate categories of tests in which the responsibilities of the services, the Atomic Energy Commission, and the Defense Atomic Support Agency differ greatly. The Department of the Army, in conjunction with the Navy, the Air Force, the Atomic Energy Commission, and the Defense Atomic Support Agency, plans those nuclear tactical exercises, operational tests, and effects tests that involve the expenditure of fissionable and fusionable materiel. During the development of an Army nuclear weapon, the requirements of both the Army and the Atomic Energy Commission must be satisfied.

b. The Department of the Army, in conjunction with the Navy, the Air Force, and the Defense Atomic Support Agency, plans nuclear weapons effects tests that involve the evaluation of scientific phenomena and the response of biological specimens and materiel to the effects of nuclear detonations. The Commanding General, Army Materiel Command, accomplishes Army coordination with the Commanding General, Combat Developments Command, the Chief of Engineers, and the Surgeon General, for nuclear weapons effects test projects. Such projects are then submitted to the Chief of Research and Development, Department of the Army. The Chief of Research and Development coordinates the projects within the Army General Staff and forwards the approved projects to the Chief, Defense Atomic Support Agency.

c. Engineering and Service Tests of special weapons materiel consisting of atomic warhead sections, atomic projectiles, and atomic demolition munitions are expensive projects that involve a substantial portion of total development program costs. In order to keep these costs to a minimum, tests must avoid duplication and must be designed to accomplish more than merely testing the results of a development program. They must also test the effectiveness, suitability, reliability, and safety of the production items for troop use. Therefore, Engineering and Service Tests should be conducted with production materiel as opposed to research and development prototypes. The tests must be completed early enough to permit recommended changes to be introduced in the production design with a minimum of expensive retrofits.

d. Engineering and Service Tests are conducted with other than production type materiel only when it is not feasible to use production items to meet the required capability. Normally an Integrated Engineering/Service test is conducted. Concurrent testing may be carried on for those portions of the tests that do not lend themselves to consolidation. Requirements are kept to a minimum by the free exchange of data and observers. Maximum use must be made of missiles allocated for Engineering and Service Tests, warhead section tests, and missiles system tests.

e. A continuing and critical analysis of the safety and reliability of nuclear weapons materiel is carried on throughout each Army development program. This analysis is conducted both independently by the agencies involved and jointly by groups established for that purpose. The Commanding General, Army Materiel Command, is required to make and record a determination of the safety and reliability of each system. Limited production need not be delayed because complete test data upon which to base a positive statement are lacking. However, every effort is made to provide as positive a certification as possible before nuclear weapons materiel is issued for tactical employment.

12–15. Nuclear Reactor Systems Testing

a. The Army Nuclear Power Program, a joint developing agency of the Army and the Atomic Energy Commission, develops nuclear reactor systems for use by the three services,

exclusive of ship propulsion and aerospace applications. In the formulation of testing programs, the dual nature of this joint developing agency becomes evident.

b. The phase test program for nuclear reactor systems includes Engineer Design Tests and Service and Acceptance Tests. Engineer Design Tests performed by the contractor are conducted early in development. Service and Acceptance Tests are made on the fully assembled reactor system and use the capabilities of the developing contractor, the Department of Defense, and the Atomic Energy Commission. Operating crews normally are provided by the Department of Defense.

c. Within the Department of the Army, the Chief, Army Nuclear Power Program, monitors tests and reviews results during Engineer Design Testing. It is also his responsibility to plan Service and Acceptance Tests and provide the plan to the Atomic Energy Commission; provide military personnel experienced in military reactor operations to conduct qualitative observations of the Service Tests; provide a military crew to perform the major portion of systems operation throughout the Service Tests; and monitor and review Service and Acceptance Tests.

d. The Chief of Engineers participates in Service Tests or reactor systems and consolidates, evaluates, publishes, and forwards the test results, with appropriate recommendations, to the Chief of Research and Development.

e. The policies concerning Environmental Tests, Check Tests, and Confirmatory Tests, discussed in paragraphs 12–1 through 12–4, also apply to nuclear reactor systems testing.

Section VI. TYPE CLASSIFICATION

12–16. General

a. Type classification is a vehicle for categorizing items or materiel on a life cycle basis. Its importance to the materiel development phase lies in the fact that acceptance as an adopted standard type is theoretically the end point in the development effort.

b. All end items and assemblages of current materiel are type classified in order to provide a uniform basis upon which to judge the qualitative adequacy of Army materiel. This classification also provides a formal record of the item throughout its life cycle and assists in the planning and execution of procurement, supply, maintenance, and disposal.

12–17. Classification Categories

a. Criteria for Classification. All items are assigned to materiel categories to record their status from the standpoint of development and suitability for service use. Classification considers the item of materiel in relation to the Army's requirement and need. It also takes into account the urgency of the Army's need.

b. Development Category. Materiel in the Development Category is classified in one of two ways, depending on the urgency of the Army's requirement. The first classification—*Development Type*—covers items on which development will be completed before any production and/or troop issue is undertaken. Such materiel developments are responsive to approved Qualitative Materiel Requirements or Small Development Requirements. The *Limited Production Type* classification may be assigned to a developmental item when development is expected to be completed upon introduction of production items. Normally, it is assigned to items required to meet urgent Operational Requirements. If such an item is available commercially or from other Government agencies, and no other existing item is adequate for the Army's requirement, the Limited Production classification may be employed. To justify this classification, the available materiel must appear to fulfill an approved Qualitative Materiel Requirement (or other Department of the Army-approved requirement) and must be considered sufficiently promising for operational use to warrant procurement for troop issue prior to completion of development. The use of this classification is limted to exceptional cases and requires Army Staff approval, coordinated

by the Chief of Research and Development. When this classification is employed, stringent controls are exercised over the quantities procured and the duration of the procurement (customarily 2 years for aircraft and missiles, and 1 year for other materiel). At the expiration of the specified period, materiel is reclassified as Development Type, one of the Standard Types, or Obsolete (with termination of the development program). In extreme cases, extension of the period of Limited Production classification may be authorized.

c. The Adopted Category. The Adopted Category classifies, according to its value to the Army, Standard Types of materiel not under development. The Standard Types designate items that have been adopted as suitable for United States Army use (or other agencies when the Army is the supply agency); Standard also designates items acceptable as assets to meet Operational Requirements; items authorized for inclusion in equipment authorization documents; and items described in published Adopted Items lists (SB 700–20). There may be more than one Standard Type, or more than one item of any specific Standard Type, to fulfill the same requirement. Standard Types are subdivided as follows:

(1) *Standard A.* A combat-acceptable item that will fill an Operational Requirement and is being produced in quantity or could be produced to fill shortages.

(2) *Standard B.* An item that will satisfy an Operational Requirement but is being or has been replaced by a new generation or series of items.

d. The Contingency Training Category. These are items that are not acceptable for Army Operational Requirements and will not, therefore, be counted as assets against Operational Requirements. Items in this category are limited to those that are not acceptable to meet Operational Requirements but are useful in training; and those that are not exceptable to meet Operational Requirements of the Army but are being retained to meet interim contingency requirements pending availability of a Standard A item.

e. Obsolete Category. These are items that are no longer acceptable for United States Army use, and will be disposed of in accordance with appropriate regulations.

12–18. Responsibilities for Type Classification

a. The Chief of Research and Development, Department of the Army, is responsible for obtaining Army General Staff coordination and recommendations for initial type classification or reclassification from the Development category to the Adopted, Contingency, or Obsolete categories. When an item is to be initially type classified in an Adopted category as the result of research and developmental activity, reports of Engineering/Service Tests will be submitted to the Chief of Research and Development, Headquarters, Department of the Army, by the appropriate developing agency. Concurrently, or sooner if practicable, the developing agency will initiate the required type classification action for formal consideration by the technical committee.

b. The Assistant Chief of Staff for Force Development, Department of the Army, is responsible for initially determining and directing reclassification action on those items in the inventory that are being replaced. He is also responsible for initiating reclassification action on those items which are no longer acceptable to meet the Operational Requirement, which are no longer required, or for which commercial hardware is available and acceptable. The Assistant Chief of Staff for Force Development will forward coordinated type reclassification instructions to the appropriate technical committee for formal action.

c. The Deputy Chief of Staff for Logistics, Department of the Army, is responsible for initiating, in coordination with the Assistant Chief of Staff for Force Development, the review and reclassification of standard items in the inventory which are uneconomical to repair or operate or for which no replacement has been forecast and normal life expectancy has been or will be exceeded. Coordinated instructions for type reclassification will be forwarded to the appropriate technical committee for formal action.

12–19. The Technical Committee System

a. General. The Army Technical Committee System provides a uniform, expeditious method of coordinating, approving, and recording actions and decisions that pertain to research, development, test, and evaluation; type classification; security classification; transfers of logistic responsibilities; and other similar materiel matters. Developing agencies, including the Army Materiel Command, The Army Security Agency, the Office of the Chief of Engineers, and the Office of the Surgeon General, are parent agencies of technical committees.

b. Committee Composition. Each technical committee will be composed of members who are empowered to render decisions for the agency they represent. Specifically, it will include—

(1) Representatives of the parent agency, one of whom will be designated chairman.

(2) Representatives of other Army developing agencies, when their agency heads deem it appropriate.

(3) Representatives of the Combat Developments Command.

(4) Representatives of the Secretary of the Army and the Army General Staff to be provided by the Chief of Research and Development. Other representatives of the Army General Staff to be provided by the Assistant Chief of Staff for Force Development and the Deputy Chief of Staff for Logistics.

(5) Representatives of the Army Strategic Communications Command for agenda items pertaining to strategic communications and communications security equipments only.

c. Headquarters Representation. As indicated, Headquarters, Department of the Army, representation is provided by the Chief of Research and Development, the Assistant Chief of Staff for Force Development, and the Deputy Chief of Staff for Logistics. The Chief of Research and Development exercises overall Army Staff supervision of the entire Technical Committee System and develops the Army General Staff position on the formal items covered in paragraph 12–17*a* above. The Assistant Chief of Staff for Force Development and the Deputy Chief of Staff for Logistics develop the Army General Staff position on the formal items covered by paragraph 12–17*b* and *c*, respectively.

d. Types of Actions Considered. A Technical Committee considers both formal actions and read-for-record actions. Formal actions are those matters placed before a technical committee that require either the concurrence of all interested members or the approval of higher authority. Such matters include project and task initiation or termination; approval of technical characteristics, engineering concepts, and design characteristics; actions that will change the scheduled date of type classification or release for initial production by one fiscal quarter or more; actions that will require funding changes in amounts above the reprograming authority of the head of the developing agency; decisions on type classification or reclassification of materiel; and changes in the Department of the Army priority of projects and tasks. Read-for-record actions are Department of the Army Staff decisions or other actions that require neither the concurrence of all interested agencies nor the approval of higher authority, but are of sufficient importance to be duly recorded according to committee procedures.

Part Five

PRODUCTION AND SUPPORT

CHAPTER 13

INTRODUCTION

13–1. Purpose

This manual deals with the whole spectrum of management processes, from the initial identification of a materiel requirement to the phase-out of the obsolete item. In the preceding parts, however, it has necessarily concentrated on plans and actions taken prior to the physical entry of a new operational item into the Army inventory. The purpose of Part Five is to provide the research-and-development-oriented reader with an appreciation of the complex of production and support actions that are taken during the operational life of equipment. It stresses, in particular, the dependence of such actions on many kinds of decisions made in the development phase.

13–2. Scope

Part Five contains three chapters: Chapter 14 describes requirements and distribution planning for principal and major secondary items; trade-offs between quantitative and qualitative requirements; and the important concept of balanced requirements and capability among functionally related items of equipment. Chapter 15 begins with a discussion of the procurement process, and then considers methods of advanced planning for production. It treats the production phase as a continuation of the development phase, with emphasis on the increasing cost and complexity of engineering change management as production progresses. Next, it treats quality assurance as a control on engineering and production performance and a source of continued development effort. The final section deals with mobilization production planning, and the interaction between peacetime procurement schedules and the capacity of the mobilization production base. Chapter 16 describes the range of requirements that need to be considered in order to support equipments during their service life. It emphasizes the many ways in which development decisions influence the cost and effectiveness of support throughout the life of an item.

CHAPTER 14

QUANTITATIVE REQUIREMENTS

Section I. INVENTORY MANAGEMENT

14-1. Stratification of Army Inventories

a. Principal Items. Principal items are selected items earmarked for review and control at the Army General Staff level. They are set apart because of their military essentiality, high dollar value, and other exceptional charcteristics. Whether to select an item as a principal item depends, therefore, on the importance of having all elements of assets and requirements reviewed at the top planning level, and not on isolated physical or commodity characteristics. The principal items are varied. They include high-unit-cost and low-density end items such as aircraft, tanks, and missile launchers; low-unit-cost and high-density end items, such as small arms and protective masks; sophisticated instruments, such as the avionic components of aircraft; and war consumables, such as field wire and ammunition. Items that function together as components or a system may be identified as distinct principal items, as are the missile and the missile launcher. Or an item may be designated principal only because of some temporary abnormal condition (for instance, a critical shortage of supply), and then removed from this special status once a normal condition is restored.

b. PEMA Financed Secondary Items. Procurement of Equipment and Missile, Army financed secondary items also form a selected list, and are next in priority after the principal items. Because these items are insurance, safety of personnel, or depot reparable type items, they are earmarked for review and control at the Army Staff or Army Materiel Command level. Many subassemblies and repair parts, such as engines and transmissions, are in this category.

c. Stock Funded Secondary Items. These are all items not assigned to the principal or PEMA financed secondary item categories. They consist mostly of repair parts; however, among them are also a number of end items that, although listed in authorization documents, do not receive the special control given to the principal and PEMA financed secondary groups.

d. Budgetary Control of Principal and Secondary Items. The principal and PEMA financed secondary items together make up less than 1 percent of the total line items in the Army inventory, but they account for more than 80 percent of the value of annual procurements. These items are financed under the budget appropriation, Procurement of Equipment and Missiles, Army. They are entered by line item in the Army Five-Year Force Structure and Financial Program (Materiel Annex, Part I—Procurement of Equipment and Missiles, Army, Procurement List) when the estimated total dollar value for each exceeds $2 million in any one year of the prescribed programing period. They are also listed in the Army budget presented to Congress when the total dollar value exceeds $500,000.

e. Management Control Over Secondary Items. Secondary items, managed within the Army Stock Fund, are placed under less exhaustive budgetary and management controls than are those supported by Procurement of Equipment and Missiles, Army, funds. (Nevertheless, certain nonrecurring types of requirements for these items, such as initial and provisioning requirements, are reimbursed from Procurement of Equipment and Missiles, Army.) It is often said that the supply and

demand status of secondary items is largely determined by a relatively small number of the Procurement of Equipment and Missiles, Army-funded items; and this is the main justification given for the stratification of Army materiel into heirarchical management categories. Now, however, there is growing dissatisfaction with too rigid a classification based solely on item distinctions. Correspondingly more attention is being given to considerations that draw items together as meaningful aggregates. Two approaches that cut across the traditional categories are discussed later in this Part: one emphasizes the interdependence of end items grouped in a weapon system complex, and the other emphasizes the relationship between the end item and its components over the total cycle of their service life.

14–2. The Army Materiel Plan

a. Purpose. The Army Materiel Plan is a statement of proposed actions by which the Army will reach established goals for the materiel support of its forces. The plan integrates the various elements of logistics to show the present status of materiel resources and their proposed use to meet future requirements. A second objective is to achieve a balanced inventory of modern weapons. Because it is rooted in a complex and changing environment, the Army Materiel Plan must be continually revised to reflect changes and developments in force structure, logistics, guidance, technology, production and attrition, and funding constraints—all of which can have a significant impact at any time during the programing or budget cycle.

b. Scope. The Army Materiel Plan is the basis for the development of the Materiel Annex to the Army Five-Year Force Structure and Financial Program. It also provides detailed supporting data required for the development of the annual Procurement of Equipment and Missiles, Army, budget. In published form, it is a collection of item studies prepared in a standard format (DA Form 2624) and under carefully defined computational guidelines. The Army Materiel Plan focuses on those items planned for procurement that are most important from the standpoint of budget dollars and operational necessity. Consequently, it includes detailed studies for less than 1,000 of the approximately 12,000 items in the Procurement of Equipment and Missiles, Army, category, and presents summary data by commodity group on miscellaneous items falling below the dollar level prescribed for individual study preparation.

14–3. Elements of the Plan

a. General. Army Materiel Plan preparation involves the sequence of steps portrayed in figure 14–1. The steps identified in the chart correspond to the major planning elements that, together, make up the total Plan. The responsibilities for the various steps are also depicted. Thus initial actions are taken by staff agencies; the computation of gross requirements is performed by the Army Major Item Data Agency; and responsibility for completing the plan and defending individual item studies rests with the commodity commands and their control points. The rest of this section takes

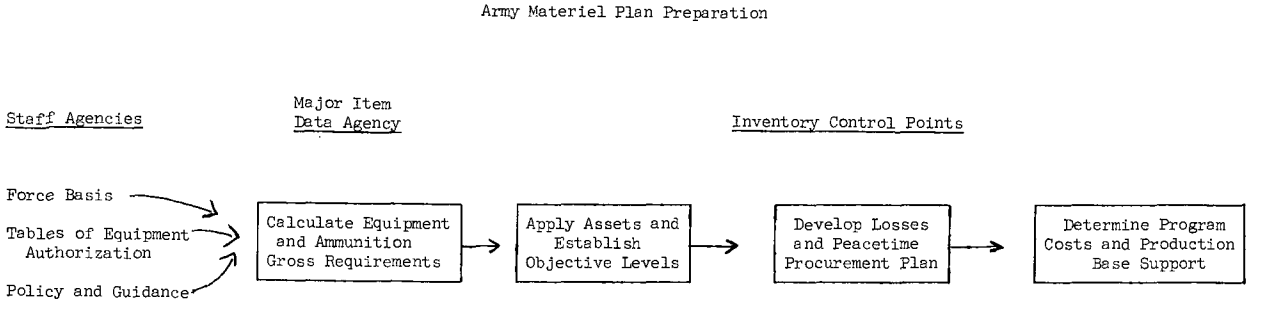


Figure 14–1. Army Materiel Plan Preparation.

up these steps in turn. It concludes by pointing to a dynamic aspect of the planning process whereby the results of certain steps can change assumptions on which the results themselves depend.

b. Initiation of Preparation Cycle

(1) The Army Materiel Plan preparation cycle begins with the establishment of new basic premises and guidelines underlying materiel programs, as they are reflected in three types of documents: the Force Basis for Materiel Programing; the tables of equipment authorizations; and the Procurement of Equipment and Missiles, Army, Policy and Guidance.

(2) The Force Basis for Materiel Programing is developed by the Assistant Chief of Staff for Force Development. This document describes the structure and detailed composition of the Army year by year over the midrange time span (the next 5 years). It contains the force approved by the Secretary of Defense for materiel acquisition, and portrays unit activation and deployment schedules both in future peacetime periods and in a hypothetical wartime period beginning on an assumed day (called M-day). This twofold projection recognizes the basic role of military planning—to build and sustain a force capable of waging war. Recent editions of the Force Basis have departed from the former practice of projecting the authorized force in terms of generic types of units, in favor of making a detailed statement in terms of individual units identified by specific name and place designations. This change makes this document a more dependable basis for plans and actions affecting the purchase and distribution of major items of equipment.

(3) Each entry in the Force Basis references a numbered table of equipment authorization. The cross-reference from force units to tables of equipment authorization is the pivotal element. By this means, projections given in terms of force elements are translated into terms of initial equipment authorizations. The current and updated tables of equipment authorization are collectively, therefore, a second major input to the materiel planning process.

(4) *The Procurement of Equipment and Missiles, Army, Policy and Guidance* is published yearly by the Department of the Army. This is the medium by which the Deputy Chief of Staff for Logistics transmits the strategic concepts behind computation policy and instructions, which he receives from the Secretary of Defense, to the Commanding General, Army Materiel Command. Changes in computation guidelines, reflecting changes in the strategic assessment of the Army's role, can have as profound an impact on materiel planning as changes in force and equipment structure can. This is seen from the following partial list of considerations that are treated as planning parameters, subject to the control of defense policymakers:

(*a*) The level of full authorization strength to which various segments of the authorized force are to be equipped.

(*b*) The time phasing by which older equipment is to be replaced by later models.

(*c*) The applicability of post-M-day production capability to force requirements and/or item requirements.

(*d*) Planning constraints relative to requirements, procurement, and production schedules of certain controlled items.

(*e*) The designation of M-day and of the intensity and duration of combat.

c. Gross Requirements. The next step is the computation of gross requirements by the

Army Materiel Command's Major Item Data Agency. Elements involved in this computation for the Procurement of Equipment and Missiles, Army, category of items are discussed below.

(1) Initial (Table of Organization and Equipment and Table of Allowances) requirements refer to the quantities required to equip the M-day authorized force and to meet the needs of additive type operational projects.

(2) Replacement requirements are losses due to the wear-out of equipment during peacetime operations. Such losses are treated in the Army Materiel Plan as a drawdown of the year-end inventory position.

(3) Maintenance float requirements refer to a stock level of assemblies or end items from which complete units are made available for immediate exchange against unserviceable items turned in for repair.

(4) Combat consumption/replacements requirements refer to the losses sustained after M-day by the M-day authorized force. They break into the training requirements of mobilized but inactive forces, and the combat requirements of the active fighting forces.

(5) Pipeline requirements are the additional inventories needed in the worldwide supply system to maintain an uninterrupted materiel replacement flow.

d. Assets and Objective Levels.

(1) *Source of Assets.* Assets to meet peacetime and mobilization requirements include consideration of the following sources: those quantities currently in the hands of users and stock points; future receipts scheduled in from peacetime purchases or by transfer action; and the estimated capacity of the mobilization production base. In this step of Army Materiel Plan preparation, elements of assets and gross requirements are assembled in four key objective levels, each of which is discussed below.

(2) *The Mobilization Production Quantity.* This is the part of wartime consumption that can be met from the post-M-day production of planned mobilization producers. The resulting quantity reflects an interaction among three factors: wartime consumption, the predicted level of peacetime production activity on M-day, and mobilization production capability schedules backed up by planning agreements between the Government and industry. It can be assumed that mobilization production will not be built up as quickly from an inactive, or cold, peacetime production base as it could from an active base. The dynamic nature of the relationship between the peacetime base and mobilization production planning is gone into more deeply in chapter 15.

(3) *M-day Force Materiel Requirement.* This is the quantity required on M-day to equip the authorized peacetime United States Forces, both active and reserve.

(4) *The Mobilization Support Level.* This level represents the difference between wartime, post-M-day consumption and the mobilization production quantity. It is the quantity, over and above the M-day Force Materiel Requirement that is required in stock on M-day to provide the required level of support for U.S. Forces.

(5) *The Authorized Acquisition Objective.* This is the quantity of an item required to be in the military system on M-day in order to equip and provide the prescribed level of support for United States Forces. It is the sum of the M-day Force Materiel Requirement and the Mobilization Support Level.

e. Losses and the Peacetime Procurement Plan. Once these levels have been determined,

a peacetime procurement plan is drawn up to provide an orderly buildup of inventory to meet the Authorized Acquisition Objective as nearly as possible on M-day. The procurement planner (or project manager) first considers assets on hand and on order from prior year funds, as well as peacetime losses of all types; then he determines the extent to which the materiel fails to meet the objective. In this step, therefore, losses due to modernization, the washout of old materiel, and sales to other-than-Army customers (including foreign nations) are added to the year-by-year replacement losses. The deficiency so developed is designated the unfunded objective. In computational terms—

Unfunded Objective = Authorized Acquisition Objective *minus* Assets On Hand and Due In from Prior Funding Periods *plus* Losses to M-day.

The procurement plan finally arrived at must set forth an integrated program that meets the new unfunded objective as well as prior commitments. It must also make allowance for many types of purchasing considerations, such as available industrial capacity, continuity of production, and economic production quantities.

f. Program Cost and Production Base Support. In this step, the cost to meet the deficiency designated as the unfunded objective is developed in two parts—

(1) Program costs are the direct and indirect costs of units of production. The direct portion is broken down into several components, including the hardware, direct engineering, and testing costs. The indirect portion is broken down into the costs of tooling, quality assurance, and support documentation.

(2) Production base support costs are those related to several measures by which the Government supports the production of military systems. They include furnishing production facilities and special tools, the layaway of facilities and equipment for contingency use, and the support of production engineering efforts.

g. The Completed Army Materiel Plan. When all elements of requirements, assets, capabilities, and costs are in balance, the plan is complete. In spite of this, the planning itself, although necessarily analyzed as a sequence of steps, is essentially a dynamic process. The outcome of certain steps may affect others, and be affected by them in turn. Thus an analysis of program costs may produce reasons for amending a prior procurement plan; and the new plan may then change the mobilization support level, which, in turn, changes the Authorized Acquisition Objective on which program costs are predicated. In addition, many item interdependencies, which connect end items to their components and members of a mission system to each other, greatly complicate the task of producing a balanced plan within reasonable work-load and time constraints. The procedural difficulties have been such that measures are now under way to automate certain time-consuming steps, and, by speeding up the Army Materiel Plan preparation cycle, to provide a more timely and responsive product. Whereas the Army Materiel Plan was reissued only annually in the past, the automated system will be capable of producing at least quarterly revisions. Since the dynamic nature of the planning implies that any plan can, at best, approach a perfect balance of so many interrelated factors, the more frequent updating is also a refining process.

Section II. PERFORMANCE REQUIREMENTS AND QUANTITATIVE REQUIREMENTS

14–4. General

This section looks back upon the elements of quantitative requirements that were defined above, and examines the areas of trade-off between them and related performance objectives. Quantitative requirements can, of course, al-

ways be translated through the Army Materiel Plan planning methodology into terms of cost benefits or penalties. Interestingly, it turns out that some of the performance requirements can be expressed in the same terms. In other cases, the areas of trade-off will involve a more or less complex exchange of cost for effectiveness benefits.

14–5. Trade-Offs

a. Initial Requirements and Performance Characteristics. Performance characteristics that have an impact on initial equipment requirements are not difficult to find. The number of vehicles required to accomplish a given transport mission is a function of the weight and space capacity per vehicle. The number of weapons required to destroy a military objective is, similarly, a function of firepower per weapon. In more complex examples, a development may permit one model of equipment to integrate the functions otherwise performed by several special-purpose models. An outstanding example of equipment versatility and its effect on Tables of Organization and Equipment is the Army's Armored Reconnaissance Airborne Assault Vehicle, virtually an all-purpose tank. Thanks to the development of lightweight armor and other features, the new tank combines air-droppable, amphibious, and high-speed characterstics with missile firing and conventional ordnance capabilities. It provides the capabilities of the antitank, light tank, medium tank, and airborne artillery weapons, with amphibious capabilities added. It actually does more than replace these specialized equipments on a one-for-one basis. Beyond this, it permits a far greater number of options in structuring and restructuring the Army's force composition, and greater flexibility in adapting a given force to changeable combat situations.

b. Replacement Requirements and Durability Characteristics. Under certain criteria, the Army will restore an unserviceable asset by repairing it as long as the cost of repair is less than the cost of replacing it. When the asset is worn to the point where it can no longer be repaired economically, a replacement requirement is created. Several systems have been adopted by the Army to determine whether or not an unserviceable asset is economically repairable. A basic consideration in all of these systems is a comparison of the estimated costs to repair an item with the costs to replace it and, even more important, a judgment as to the value (in terms of service life) that will be restored to the item if it is repaired or overhauled. Equipment durability, as a factor in generating replacement requirements, encompasses not only ruggedness qualities that tend to lengthen the time between equipment failures, but maintainability characteristics that affect the cost of repair and the ability of the equipment to withstand the effects of repeated repair action. Replacement requirements can be defined another way by the formula:

$$A = B - BC = B\ (1 - C),$$

and

A = replacements required,
B = number of unserviceables turned in,
C = decimal equivalent of percentage of unserviceables that can be economically repaired and put back in service.

So if the number of unserviceables turned in within 1 year is 100 and 5 percent can be economically repaired, we let $B = 100$ and $C = .05$. Then annual replacement requirements, A, are determined by letting $A = 100\ (1 - .05) = 100 \times .95 = 95$. Developments that lengthen the time between equipment failures reduce term B (unserviceables turned in) and thereby reduce terms BC (unserviceables repaired) and A (replacements required), as well. Consequently, such developments have the effect over time of lowering both repair and replacement costs. Developments that reduce repair costs, on the other hand, have a more complex set of consequences. By increasing the benefits of repair, as opposed to replacement, they make term C (percentage of unserviceables economical to repair) a larger fraction, but leave term B (unserviceables turned in) unchanged. Consequently, there will be fewer replacements over time, and the cost to replace will be less than before. On the other hand, there will be more repair actions (term BC) over time, which tends to increase repair costs. However, the

cost of each repair action is less, and this tends to lower repair costs.

c. Maintenance Float Requirements and Reliability-Maintainability Characteristics. The maintenance float requirement answers the need for a stock level of serviceable units exchangeable on a moment's notice for those turned in for repair. This requirement becomes larger with increases in either the equipment failure rate or the time required to return an unserviceable asset to good condition. This requirement is, therefore, determined by an interaction between reliability and maintainability characteristics. In mathematical terms:

$$P = Q \times R,$$

where

P = the maintenance float quantity,
Q = the number of failures in a given time period,
R = the time required to return an unserviceable asset to good condition, expressed as a fraction of the same time period that enters into the definition of Q.

For example, if the failure rate is 120 per year and the maintenance turnaround time is 1 month, then $Q = 120$, $R = 1/12$, and $P = 120 \times 1/12 = 10$. Obviously, an increase or decrease in either Q (the number of failures) or R (the maintenance turnaround time) will have a direct, proportionate effect on P (the maintenance float quantity). This area of trade-off provides a good example of one where in many cases the terms on both sides of the trade-off equation are alike expressible in dollar terms.

d. Combat Consumption Requirements and Vulnerability Characteristics. The combat consumption requirements represent the equipment losses expected in case of war. The first aspect of these losses to be considered for trade-off analysis is their contingent nature. Such requirements are not additive in the usual sense to peacetime budgets and procurement plans. Instead, they are figured in as additive requirements by means of the methodology outlined in paragraph 14–3*d*, and described in greater detail in paragraphs 15–5 and 15–6. Essentially, only a part of the combat requirement is actually purchased for stock—specifically, the part that makes up the difference between the total requirement and what can be produced and delivered after M-day. There is obviously an area of exchange between the combat consumption of equipment and certain endurance and vulnerability characteristics that are developed to permit the equipment to stand up under combat punishment. Nevertheless, to draw a direct link between the cost of such developments and the cost benefits derived from lesser requirements for either mobilization production or inventory support would be an overly simplified approach. This is because the ability of equipment to survive in combat is an essential part of its total effectiveness as a weapon of war.

e. Pipeline Requirements and Weight-Cube Characteristics. The pipeline quantity is required to be in position in combat theaters on M-day, in order to bridge the delay between the end of production and the delivery there of materiel destined to replace combat losses. If this in-transit delay is 30 days, then the pipeline requirement is a 30-day supply measured in terms of the combat consumption rate. In mathematical terms:

$$U = V \times W,$$

where

U = the pipeline quantity,
V = the number of losses in a given time period,
W = the time in transit from the source of production to the combat theaters, expressed as a multiple of the same time period that enters into the definition of V.

For example, assume that combat losses in combat theaters are 50 per month, and the time lost in delivering units of production to the theaters is 2.5 months. Then $V = 50$, $W = 2.5$, and U, the pipeline quantity, is equal to 50×2.5, or 125. This shows that the pipeline requirement is a function of both the combat consumption rate and transit time. The latter factor is affected, in turn, by developments that either improve the capabilities or transportation media, or modify the equipment weight-

cube constraints that influence media selection. Improvements in the capabilities of transportation media provide another example of a direct trade-off between the cost of the development and savings in the form of a reduced investment in pipeline inventory.

Section III. EQUIPMENT DISTRIBUTION AND MODERNIZATION

14–6. Equipment Distribution Planning Studies

a. Equipment distribution planning is the next logical step once the Army Materiel Plan is complete. While the Army Materiel Plan furnishes the means of establishing equipment programs and budgets, the equipment distribution plan stands between the approved programs and a number of followup actions required to carry them out. It leads to decisions affecting the distribution and allocation of equipment assets to selected force elements; and such decisions, in turn, signal a need to coordinate actions involved in provisioning the spare parts, tools, documentation, and personal skills that are required to back up the planned equipment distributions.

b. Like the Army Materiel Plan, the distribution plan is also a collection of item studies called Equipment Distribution Planning Studies, which are prepared in a standard format (DA Form 2793) under guidelines spelled out in AR 700–16. But whereas the Army Materiel Plan represents a balance, worldwide, of requirements and assets, the distribution plan is a more detailed statement of equipment capabilities by theater of operation and other specialized force groupings. And whereas the Army Materiel Plan is oriented to a fixed future planning objective (M-day), the orientation of the distribution plan is poised between this objective and the status of current forces. It describes the period-by-period build-up of programed forces from their present status to the M-day authorization objective.

14–7. Modernization and Distribution

a. The Equipment Distribution Planning Studies describe all phases in the life history of individual equipments, from their first appearance in the Army Materiel Plan to the time when they are phased out of the Army system. There are two categories of studies—detailed, time-phased studies (Category I) and special studies (Category II).

b. Category I studies are prepared about 1 year ahead of deliveries from production. They present a time-phased comparison of equipment authorizations against assets by geographic area and force type, and identify local imbalances to be corrected by redistribution actions and shortages to be filled from production. If systemwide assets are in short supply, the plan will make an allocation of the available assets on the basis of force priorities. If there are system excesses beyond the quantity to be retained in the Army for contingencies, these studies direct their disposal by transfer to another Government agency or a friendly foreign power, or by sale or donation.

c. In Category II are special studies prepared for newly adopted items that have no counterpart in the present inventory, and for modernization items that are direct replacements for older, less efficient counterpart items currently on hand. Such studies are prepared upon the first appearance of a new item in the Army Materiel Plan. They provide a distribution plan for the initial production order, and are used to highlight related tasks having to do with both the support of the new equipment and the redistribution and phase-out of the old.

Section IV. SYSTEM CONCEPT FOR PROCUREMENT OF EQUIPMENT AND MISSILES, ARMY, ITEMS

14–8. The System Concept

a. General. This section describes a proposed system approach to the management of principal and secondary items funded under the Procurement of Equipment and Missiles, Army, appropriation. By grouping a number of de-

pendent items into a complete weapon system, the approach stresses the concept of balanced requirements and capability among functionally related items of equipment. The concept described here is not yet a fully developed, operational Army system. When fully operational, it will not do away with the item-oriented methods that were described earlier. Rather, it will lean on and extend these basic systems. Working with item data contributed by such systems, it will prepare summary reports intended to highlight relationships of the greatest significance to defense analysts and planners.

b. Definition of a Mission Item System. The definition of a mission item system is equipment-oriented. Thus a mission item system is comprised of an end item (the control or mission item) and the related items necessary for it to function effectively in combat. These are four major categories of control and related items, corresponding to the four basic functions of war: to shoot, to move, to communicate, and to support. For example, the 105-mm howitzer system description might list the 105-mm howitzer as the control item, and the following as related items:

(1) Shoot	Ammunition	105-mm Cartridge, various types
	Fire Control	Computer M-18
		Theodolite
		Aiming Circle
		Periscope, Battery Command
(2) Move		Truck, Cargo, 2½ Ton with Winch
(3) Communicate	Radio	AN/VRC-12
		PRC-25
	Wire	Field Telephone TA-312
		Switchboard SB-22
		Wire and Cable
(4) Support		Tool kit, Artillery Mechanic, Ammunition Trailer, 1½ Ton, and Mover, 2½ Ton Truck

c. System Summaries. Once mission item systems are defined and identified, it is necessary to summarize system requirements and to measure asset and procurement data for each system element so that the balance within a system can be determined and a basis provided for capability analysis and planning. System summaries are of necessity based on data on individual items, some of them peculiar to one system and others common to several. Accordingly, the items in a system are coded to indicate how they are handled in the display of system summary data (that is, dollar requirements, assets, and procurement summaries). Items peculiar to a given system are included in that system's summary display. Items common to several systems, on the other hand, are included in the summary of only one system. For related items not included in the system summary display, an analysis can be made of the individual item capability study to determine whether it limits the effectiveness of the mission system.

14-9. Objectives

a. A primary objective of the system concept is to develop summary data displays for mission item systems that identify system costs, present the current balance among items within the system, and show the changes in balance resulting from program procurement. A second objective is to provide a basis for assessing balance in areas of functional capabilities (by using combinations of mission item systems) and for developing cost/effectiveness studies of alternate systems, including those under development.

b. Another objective of the concept is to devise techniques for displaying and analyzing Procurement of Equipment and Missiles, Army, programs and budgets in terms of systems capable of performing a primary function of war. The present method of presentation, with the possible exception of missile and aircraft activities, is by individual line item. Although the present method does convey a great deal of information concerning the individual items to be purchased, it does not provide a way of relating the items to other items or to end pur-

poses. Furthermore, the present method of presentation does not facilitate evaluation of cost versus combat-needs. Because of these shortcomings, the presentation of items as individual lines can often frustrate decision-makers in their efforts to arrive at sound decisions. Summary displays for mission item systems are designed to minimize these difficulties.

CHAPTER 15

PROCUREMENT AND PRODUCTION

Section I. THE PROCUREMENT PROCESS

15–1. Main Steps in the Procurement Process

a. General. The procurement process for production items breaks down into two distinct phases: the advance planning phase that precedes the preparation of a Purchase Request, and the solicitation phase that precedes the award of a production contract. Each of these phases is discussed briefly in this paragraph. In paragraph 15–2 the factor of competition is singled out as an area of special concern to procurement and development managers during the planning phase.

b. Advance Planning for Procurement.

(1) Planning for procurement must start well in advance of the preparation of a Purchase Request and its receipt by the contracting office. Many financial legal, and business aspects of procurement should be considered during the Research and Development phase, since decisions made in Development may either foster or inhibit the procurement manager's freedom of action in any of the following areas:

(*a*) Choice of procurement method and type of contract.

(*b*) Choice of measures to encourage competition.

(*c*) Choice of production support measures.

(*d*) Source selection.

(2) The broad planning may proceed as soon as there is an approved program and target completion schedule. Planning early in the Research and Development phase can contribute a great deal toward overall program success if it highlights the following problem areas and sets them down as program milestones alongside the technical tasks:

(*a*) Will the technical data be available when needed to obtain competition in the initial and later purchases of equipment and repair parts?

(*b*) Can the Army make use of advanced contract types with incentive features designed to obtain the contractor's best efforts in improving performance, delivery, or cost?

(*c*) Have design specifications been reviewed to determine whether proprietary items can be eliminated and standard items used in their place?

(*d*) At what point in the development-production cycle can competition be sought without jeopardizing overall program objectives?

(3) As Research and Development near completion, there is still a need for the contribution of the Development manager in procurement planning. He may, for example, help to resolve questions that concern performance or design variations, component substitutions, testing and quality control measures, and contractor qualifications.

(4) Advance planning saves time by laying the groundwork for procurement action. By anticipating many types of procurement requirements and pre-

paring source lists and documentation beforehand, a minimum of time is lost between the receipt of the Purchase Request and the preparation of the solicitation package. Then contractor and Army contract specialists have the greatest amount of time to devote to the development of effective agreements.

c. The Solicitation Phase.

(1) The procurement process is formally under way when a Purchase Request, prepared by an activity with a requirement to be met, is sent to the contracting office. The Purchase Request, duly prepared and approved, grants to the contracting officer authority to proceed with contract action. The Request itself incorporates all of the results of prior planning. If this planning has been thorough, the step from Purchase Request to a definitive solicitation package involves a minimum of complications and delay.

(2) In formal advertising the solicitation package is called the Invitation for Bid. In negotiation it is either a Request for Proposals or a Request for Quotations. All of these include or reference all the documents and information that a firm needs to prepare its reply. They set forth the terms and conditions of the proposed contract and the rules for submission of bids or proposals.

(3) Ordinarily the entire package is mailed directly to all sources who are invited to compete. However, a preliminary notice is sometimes sent out or advertised to determine a firm's interest before it is included on the solicitation list.

(4) Interested firms then submit their bids or proposals in response to the solicitation. In formally advertised procurements, their bids remain sealed until the appointed time when they are opened in public. Then the bids are examined and award is made to the lowest responsive and responsible bidder, with allowance for only the most minor irregularities in the form or content of bidders' replies.

(5) A somewhat different procedure may also be followed under formal advertising. In this variation, called two-step formal advertising, technical proposals are solicited and examined first. Price bids are then sought only from firms whose technical proposals were found acceptable. The competition from this point on is based strictly on price just as it is in straight formal advertising.

(6) Formal advertising is characterized by set procedures and controls designed to offer the largest number of firms an opportunity to compete, and to provide an objective standard—that is, the lowest price—as the basis for award. The negotiation process, on the other hand, gives the Army greater latitude in selecting sources and contract type. Although competition is still sought, under negotiation, the evaluation of proposals is not conducted in public, and awards are not always made to firms that offer the lowest price alone. Negotiation permits separate discussions and bargaining with one or more firms that have submitted the most promising proposals. In such discussions, changes may be made in price, contract type, pricing arrangements, and other aspects of the original solicitation and submission.

15–2. Hi-Dollar Breakout and the Factor of Competition

a. The Department of Defense Hi-Dollar Breakout Program is a procedure for increasing the use of competitive methods in the purchase of end-item components and repair parts. Correspondingly, the program encourages making less use of the end-item manufacturer or its vendors as the sole source of supply. Since its basic aim is not competition for its own sake,

but, rather, the dollar savings obtained by competition, the program places the greatest emphasis on items of sufficient value to repay the cost and effort involved in obtaining the legal and technical data needed to support competition.

b. The program includes two important administrative routines. The first is the early, selective screening, or breakout, of high-value components for competitive purchase consideration. The second is a decision process through which the selected items pass. Items are then categorized as either competitive purchase items or validated proprietary and sole-source items. The full decision process breaks down into the following steps:

(1) Assembly of available data, including basic supply, procurement, and engineering data.

(2) Initial evaluation of data, reflecting both the Government's and the contractor's rights in data, as far as can be determined from the available documentation.

(3) Completion of data evaluation and determination of rights in data or of further efforts required to obtain missing data elements.

(4) Technical assessment of the item's development status and design stability.

(5) Assessment of certain types of costs of obtaining competition, as opposed to expected savings. These types of costs are the additional costs of qualification and approval tests, for quality control and inspection, and for tools and production support. Also assessed are the costs of rights in data or licensing agreements.

(6) Determination that the item's lead time or stock status will permit the delay involved in seeking competition.

c. Although items may be submitted to the breakout-decision process at any time in their life cycle, many advantages are gained when the breakout decision is made early, preferably in the Development phase. An early breakout and selective acquisition of data (and rights) permits competitive benefits in the purchase of equipment spares in the initial provisioning phase. When considered early, such questions as the following may materially influence the contract specification and thereby the total program's success: Should certain data and rights provisions be written into the contract, to protect the Army's competitive position in follow-on procurements? Can standard replacements be found for specific proprietary components? Should critical components be developed to Military Standards or Specifications and furnished by the Government, rather than by the contractor under contractor specifications?

Section II. PRODUCTION

15–3. Contractor Performance and Engineering Changes

a. Once a contract has been let, the production phase begins, and responsibility for contract administration passes in most cases into the hands of the Defense Contracts Administration Service, a central agency set up to furnish standard contract administration services to all Department of Defense agencies. The Government's role in managing program execution at this time changes radically. The signed contract becomes the prime point of reference in all matters related to performance. Although Government contract administrators can direct, advise, and monitor progress, they cannot unilaterally alter contract terms. In some cases, particularly when performance and pricing terms are firmly fixed in the contract, it is better to limit Government intervention in the production process and to place maximum reliance on the judgment and responsibility of the contractor. In other cases, the national interest requires more active participation by the contract administrator and his representatives. This may be because of the Army's involvement in production through various technical assistance and production measures. Or it may be because of the relative flexibility of

the contract's performance and pricing provisions. In all cases, however, the contract administrator must keep watch on the contractor's progress in meeting the stated requirements, and he must approve or disapprove contractor-suggested changes, whether these were inspired by a desire to lessen production difficulties or to make improvements in the final product.

b. In concept, development precedes and governs the planning for production and support. In practice, however, development and production for many items are telescoped into a concurrent process, so that support planning is a problem of continual evolution and change. The greatest incentive to continued development in the production phase comes from the desire of equipment designers and engineers to keep pace with the ever-advancing state of the technology. However worthy of consideration such opportunities to upgrade equipment quality and stave off early obsolescence may be, their benefits should be weighed against additional costs and, in particular, against the problems they will add to support planning.

c. A product improvement introduced early in production may involve only the cost and effort required to amend the contract and the design specification. In general, however, the consequences of product improvements introduced later in the production phase are far more extensive, and their offsetting costs are far greater. If the improvement is introduced after production materiel orders have been released, then some materiel already purchased or fabricated will become worthless and will have to be replaced. If it is introduced after some units of production have been completed, the improvement will incur an added cost to modify or retrofit the already completed units. If it is introduced after some units of production have been delivered to the field, the cost of retrofit will be even greater, because these equipments will have to be returned to a central location for modification or else must be modified in the field. Even more costs will be incurred if the change affects repair parts already provisioned, warehoused, and catalogued —then the new parts must be stocked, the old ones disposed of, and catalogs, stock lists, and technical manuals amended to reflect the latest changes.

d. In the light of these considerations, AR 700–35 places certain constraints on actions involved in improving and diversifying Army materiel. For instance, the bulk of available funds must be spent on items that provide real strides forward in terms of combat effectiveness, with emphasis on mobility, firepower, and communications. Conversely, no substantial sums of money may be spent for relatively small increases in terms of combat effectiveness. Unnecessary technical features, overrefinement, and excessive durability must be eliminated. Only features and characteristics that contribute directly to operational capabilities should survive the developmental process. Incorporation of "nice-to-have" but nonessential features must be avoided. Finally, the costs of new items and modifications to existing ones must be carefully weighed against the expected improvement in operational capability. Marginal improvements in the name of modernization must be eliminated.

e. The Army value engineering program is designed to eliminate unnecessary features in the design of systems, equipment, and supplies. As defined by AR 11–26, value engineering is an organized effort aimed at analyzing the intended function of Army materiel and accomplishing this function at the lowest cost consistent with performance requirements. It is obviously most effective when implemented during the early phases of development, procurement, and production.

15–4. Quality Assurance

a. Army Materiel Command Regulation 700–6 defines quality as the composite of a product's material attributes, including its performance, configuration, logistics, and physical characteristics. This regulation defines quality assurance as the function of product management that attempts to assess and satisfy user requirements, both during the product's development and production and later, during its service life.

b. Consequently, the Army's quality assurance program extends and applies throughout

the product's entire life cycle. In the Development phase, it helps to define product qualities in terms most conducive to their measurement and objective evaluation in later phases. During development, it also helps bring to light unusual product characteristics that justify exceptional quality control measures. It may then be decided that certain products should be added to the list of qualified products, so that manufacturers will be required to demonstrate their ability to produce them by passing a qualification test before they can receive a contract. Or it may be decided, either because of critical performance requirements or, as in the case of missiles, because of an inability to submit each unit of production to a realistic operational test, that a reliability program should be undertaken. A reliability program integrates the planning, testing, and evaluation of all factors that have a measurable relationship to successful performance. ("Reliability" means a measure of the probability that materiel and equipment will perform its intended function for a specified period under stated conditions.) Reliability considerations permeate every phase of the product's life cycle. In development, a program of this kind is concerned with specifying reliability criteria, including the levels of reliability and their associated costs. The contract must then incorporate these criteria and provide the means, by laboratory or service test, of establishing whether they have been satisfied by the contractor's production.

c. In the production phase, the Army develops quality assurance standards and procedures to be implemented and enforced by the contract administrator. In this phase, therefore, the function of quality assurance falls within the scope of responsibilities of the Defense Contracts Administration Service, the integrated agency mentioned above. The contractor will be required either to comply with the established standards and procedures or obtain a waiver from the contract administrator. Since the contract administrator is normally only responsible for enforcing the provisions of the quality standards, he must submit the request for waiver to the Army technical staff for approval. The actual performance of the required tests and inspections is, of course, the contractor's responsibility. Nevertheless, in some instances where the contractor lacks the necessary testing facilities, the Army may elect to perform quality assurance testing in its own facilities. The normal sequence of events is as follows: In a preaward survey, Army representatives review and accept the contractor's quality control program as meeting Army standards. After award, these representatives must be satisfied that acceptable quality control methods and systems are being employed and maintained. Ultimately, they must inspect materiel to be delivered under the contract and accept it if it meets the stated requirements. Final inspection and acceptance, however, does not relieve the contractor of his responsibility to conduct in-process tests and to apply such quality control measures as are dictated by sound manufacturing practice.

d. Quality assurance programs reach into the Operational phase through the medium of warranty clauses that extend the contractor's liability for product performance for a designated period (usually, 6 months or 1 year) beyond formal acceptance by the Army. Under such provisions, the contractor is required to replace or repair components that fail and to correct defects in materials and workmanship at no cost to the Army.

e. Although warranty clauses are used, they are costly and cumbersome to administer and have no effect beyond the designated coverage period. Therefore, greater reliance is placed on user reporting systems, such as The Army Equipment Reporting System (TAERS). As part of this system, units submit Equipment Improvement Reports on materiel in use. Army quality assurance activities review these reports and make sure that the suggestions of equipment users are followed up.

Section III. THE MOBILIZATION PRODUCTION BASE

15–5. M-Day and P-Day Planning

a. Mobilization planning assumes the outbreak of a limited or general war at some time in the future. The target date toward which this planning is oriented is called M-day, or mobilization day (D-day coinciding). On this day, two sets of programs are set in motion: First, the military forces in combat theaters will begin to consume materiel at intensified combat consumption rates. Second, the mobilization production base will be activated and will begin to produce the additional materiel required to replace combat losses.

b. M-day cannot be a fixed date. It changes with each successive plan. Ordinarily set about 2 years from the study preparation date, it establishes a practical goal for materiel planning, near enough for realism, yet far enough in the future to allow the time required for budgetary and procurement lead time.

c. The Army has two methods of providing for future wartime requirements. It can take measures to build up the capacity of the mobilization production base, or it can prestock supplies and equipment that the M-day force will need to implement war plans. Ordinarily a combination of these two measures is relied upon, and the quantities required in mobilization reserve are limited to the amounts that cannot be obtained from post-M-day production.

d. Once a post-M-day production base is established, the actual extent of mobilization reserve inventory requirements is also affected by strategic estimates and war planning strategy. In some cases, it is decided that selected items or forces will be supported for only a limited period after M-day, and then mobilization inventory must make up the difference between production and combat consumption only through this period. In other cases, it is decided that selected items or forces will be supported indefinitely after M-day, and then mobilization inventory must make up the difference between production and combat consumption through the day when production will equal consumption. That day is called P-day. From P-day to an indefinite point in the future, it is assumed that all combat requirements can be furnished from the production base.

15–6. The Production Base

a. General. Realistic war plans must include a careful consideration of the availability of adequate logistic support, and this support depends on the nation's industrial potential. Since industry is not geared in peacetime to satisfy the needs of war, it becomes necessary to make positive plans for converting the nation's industrial output from civilian goods to military goods. To accomplish this planning and to provide for an orderly conversion of the industrial complex from peace to war, the Army has developed an industrial readiness program.

b. Industrial Readiness Program.

(1) *Production-Base Support.* When a new item is to be procured in great quantity, it may be necessary for the Army to take certain actions designed to enable industry to respond to peacetime and emergency requirements. The three kinds of projects classified as production-base support include the furnishing of plant and/or facilities, support of production engineering measures, and layaway of production equipment and facilities.

(2) *Layaway of Production Equipment and Facilities.* The term "layaway" refers to the act of placing in reserve status items of production equipment, or even complete industrial facilities, that are essential for mobilization production but are not needed for current requirements. Layaway can take several forms. The equipment can be maintained in a constant state of readiness to be put into operation. It can be laid away on the site in preserved storage, or in place but under wraps and needing only to be deprocessed, hooked up, and turned on. Equipment can be removed from its

place in the production line to nearby storage or to a central storage point at some distance. Combinations of these means of layaway are also possible.

(3) *Planned Mobilization Producers.* Coordinated planning assures an orderly allocation of industrial capacity among the three military departments and provides for peacetime development of mobilization production schedules with planned producers for items to be produced in the event of mobilization. The agreements with planned producers pertain to specific essential items and set forth mobilization production schedules, showing the buildup in production month by month after M-day. The assets furnished by this planned production capacity are then considered in the preparation of the Army Materiel Plan.

(4) *Integration of Current Procurement and Mobilization Production Planning.* The placement of current procurement contracts with the planned producers serve to establish, maintain, and improve their ability to produce under mobilization conditions. A production base is classified as hot, warm, or cold according to its active level of production. Thus a base operating at or near full capacity is said to be in a hot status; one operating at the minimum sustaining rate is in a warm or in-between status; and an inactive base is said to be cold. The projected M-day status of the production base will, it is argued, determine the ability of this base to respond to emergency demands. This interaction between the peacetime production level and mobilization production capacity adds still another element to the complex balancing of mobilization inventory and production factors. Thus the decision to stretch out peacetime deliveries and maintain an active, or hot, base will lessen the need for mobilization inventory in reserve against slack in the response of the mobilization base to an emergency. The decision to buy out future requirements and close down peacetime production lines will have, on the other hand, the reverse effect.

CHAPTER 16

SUPPORT

Section I. TRAINING, MATERIEL, AND MAINTENANCE SUPPORT

16–1. General

Equipments in operation require three categories of support: the trained personnel to operate and maintain them; support materiel, including special supplies for operation, ancillary equipment, and repair parts; and a maintenance concept to integrate the various elements of support into a total support plan. Planning for each of these categories of support should begin early in the equipment development and production phases. This planning provides for the normal lead time involved in acquiring support skills and materiel. It also does something even more important: it provides the developer with the information he needs if he is to build preferred operation and maintenance characteristics into the basic equipment design.

16–2. Training Support

a. The New Equipment Training Program. This program encompasses those training activities required to insure that all new or modified equipment issued to a unit is married up with the operator and maintenance personnel necessary to achieve the units assigned readiness capability. New equipment training is often considered to terminate when the normal training function can be taken over by Army schools, training centers or parent organizations. The New Equipment Training Program, of necessity, is much broader than training in its normal connotation of the teaching of skills. It includes, for example: the development of qualitative and quantitative personnel data, i.e., necessary skills, MOS decisions and quantitative requirements; decisions affecting composition of units Table of Organization and Equipment (TOE), Table of Distribution and Allowances (TDA); requirements and allocation of equipment for the training base; development of training aids and training devices (these in themselves may be major equipment items and require a separate developmental cycle); preparation of training literature; development of training allowances (as for ammunition); orientation of personnel engaged in staff planning and budgeting; training of service test and key instructor personnel and integration of these initially trained personnel into the training base.

b. Program Management. The most distinguishing feature of the New Equipment Training Program is the diversity of input required from various command and staff elements on a timely basis in order to achieve the program goals of an effective training base and an on-schedule operational capability. Personnel and training milestones at Department of the Army and major command levels provide the vehicle for overall system management. These personnel and training milestones are intertwined with and dependent on other approved milestones scheduled throughout the life cycle of an equipment item. A primary management tool in the New Equipment Training Program is the series of equipment studies prepared within the commodity commands of Army Materiel Command to provide a detailed account of the training programs required to support specific equipment systems and subsystems. The U.S. Continental Army Command Training Plans and Equipment Distribution Planning Studies for selected major items of equipment also consolidate data and requirements fo ease of review. While the New Equipment Training Program is equipment dependent, it

is also personnel-oriented and requires timely decisions and close attention throughout.

16–3. Materiel Support

a. Initial Provisioning.

(1) *General.* Initial provisioning, as the process is described in TM 38–715–1, involves a number of decisions vital to the support mission. It encompasses all supply actions necessary to support new end items during an initial period (normally, 1 year) in their service life and to assure a smooth transition between initial and follow-on support functions. Although the actions that will best accomplish the provisioning objective may vary for different equipments and in different circumstances, the provisioning process must include two groups of supply decisions that focus on the individual parts and assemblies of which new end items are composed. The first group is concerned with the documentation required for initial provisioning, while the second is concerned with the materiel involved in such provisioning. These two types of requirements are closely related and, together, form the immediate objectives of initial provisioning actions.

(2) *Documentation Requirements.*

(*a*) *General.* Initial provisioning requires certain kinds of information that may be furnished by contractors or provided by internal reporting systems. Such documentation and data fulfill three purposes. First, they must identify the components of new equipment with sufficient precision so that these items can be correlated with existing items in the Federal and Army supply systems. If the components themselves are new to these systems, then item identification and descriptive data are required to enter them into catalogs, and data files are initially established. Second, data are required to support the initial provisioning materiel decisions discussed below. Third, data are needed to support follow-on materiel decisions and various continuing supply control and distribution functions. For new items these include initial unit price, lead time, and failure estimates; future source and purchase reference data; and the identification of any exceptional characteristics that limit shelf life or require special handling, storage, or control. For all items entering service in increased numbers, data requirements include information on component applications and the applicable equipment programs. Some types of these support data are discussed below.

(*b*) *Parts breakdown lists.* Parts breakdown lists, furnished by the contractor during the production phase, are a highly useful means of identifying equipment component and support items. Such lists are a way of reducing, in progressive steps, the entire materiel content of end items to the limited number of constituent assemblies and parts that are required as replacement items. Complete breakdown lists may be required at the beginning of this selection process, but more specialized lists of high mortality, long-lead-time, and unique application items are often used as the process proceeds.

(*c*) *Federal item identifications.* Before a new item can be brought into the Army inventory, it must be identified and described as a unique item of supply under the procedures of the Federal Catalog System. The procedures for completing item descriptions according to Federal standards is spelled out in Federal catalog publications. The narrative or coded Federal descriptions are usually furnished by the end-item contractors, who have the specifications

and drawings required for this purpose. The actual determination of uniqueness and final assignment of a Federal stock number are, however, functions of the Defense Logistics Service Center, the central cataloging agency of the Government.

(*d*) *Purchase and repair specifications.* Initial provisioning should provide the data needed for the follow-on repair or repurchase of selected equipment spares. In some cases, the Army will have to obtain manufacturing blueprints and detailed specifications from the equipment developer if it expects to have competition in the reprocurement or contractual repair of expensive components. In other cases, however, the standard catalog files (which include item descriptions and manufacturing reference data) will provide all the necessary information. Since assembling and maintaining technical data files involves costs, the only data that should be acquired are those justified in terms of both need and economy.

(*e*) *Repair parts and special tools lists included in technical manuals.* In addition to narrative portions, all technical manuals include repair parts and special tools lists, which are derived from basic provisioning breakdown lists. Since these lists are used by field personnel to identify the names and numbers of repair parts and special tools, they furnish an essential communication link between the supply and user systems.

(3) *Materiel Decisions Required for Initial Provisioning.*

(*a*) *Item selection.* First, the components that are to be carried as items in the Army supply system are selected by maintenance and supply specialists. However, adding and maintaining new items in the Army inventory catalog, and disposing of them when necessary, can be expensive. It is not possible, therefore, to bring all applicable components into stock when each new equipment enters service. The objective of careful screening and selection procedures is to meet support requirements, within limits set by cost, mortality, and mission considerations. This aim is met by not stocking in advance any more components than are justified by a balancing of cost and effectiveness objectives.

(*b*) *Repair parts source, maintenance, recoverability and supply status codes.* The next decision involves a comprehensive economic analysis that compares alternative ways of procuring, stocking, and maintaining each part during its service life. Such questions as the following are considered: When parts fail, should they be replaced by new parts, or should they be repaired for future use? Should parts be stocked and issued as individual line items, as complete assemblies, or with groups of other maintenance-related items in repair kits? And, finally, because of their value or natural characteristics, should parts be stored and handled by exceptional procedures? Each preferred treatment has a specially designated code that appears in published catalogs and serves to inform all handlers and users of the item of its established management classification. Examples of such codes, from AR 700–18 and AR 700–1, are as follows:

1. *The source codes*, indicating whether the normal source of resupply is by central purchase, local purchase, fabrication, assembly, or other methods.
2. *The maintenance codes*, indicating the lowest maintenance echelon authorized to install the repair part.

3. *The recoverability codes*, indicating whether the part is economically repairable, whether it is to be furnished by supply on an exchange basis, and also whether the part is salvageable by reclamation of precious materials or parts.

4. *Perishability codes*, indicating whether the part is likely to deteriorate with the passage of time, and if so, whether it has predetermined shelf-life beyond which it cannot be issued from stock without reinspection.

(*c*) *Distribution of supply.* After selection and repair and supply status coding have been accomplished, the next major decision is where items are to be carried in routine stock in the Army's distribution system. In the Army there are many possible distribution patterns, including stockage at national depots only, stockage at national and oversea depots only, or stockage at depots and various maintenance echelons through the user level.

(*d*) *Requirements computation.* Initial provisioning requirements are developed from a basic replacement or failure factor combined with time period elements. Among the time periods that must be taken into consideration here are the supply distribution pipeline, stock replenishment lead time, and the initial period set as the target period of initial provisioning actions.

(*e*) *Source selection.* The source and method of obtaining initial supplies is then selected. Among the possibilities here are obtaining the supplies from Army or other Government agency surplus stocks on hand; purchasing by competition among several commercial suppliers; and purchasing from the end-equipment manufacturer or directly from his vendor.

b. Follow-On Support.

(1) *General Characteristics of Stock Funded Secondary Items.* Stock funded secondary items, including repair parts, are all the items that do not fall into the principal or PEMA financed secondary item categories (para 13–2). Generally, stock funded secondary items are characterized by short lead times, low value, and ease of procurement. It is interesting to note that although stock funded secondary items and repair parts constitute the bulk of the items in the Army Supply System, they account for only about 20 percent of the procurement dollars spent by the Army. On the other hand, they account for 80 percent to 90 percent of the entire work load and costs of the distribution system.

(2) *Planning to Meet Future Demands for PEMA and Stock Funded Secondary Items.*

(*a*) *Data requirements.* The inventory control point plans to keep stock available on a worldwide basis by directing newly procured stocks to Army depots on the basis of anticipated demand. To assist the inventory control point in performing this task, all supply transaction documents, including user requisitions, are submitted to the inventory control point where they are processed against a central file of stock status and other inventory information. The central file records the stock status, receipt, and issue activity of individual depots within the system complex. Since the central files are updated as transactions occur, the inventory manager makes purchase and distribution decisions on the basis of perpetually current demand and availability information.

(*b*) *Management of secondary items.* Each of the Army commodity commands exercises worldwide supply

management of secondary items, including repair parts, from a closely supervised central inventory control point. At one time, all secondary items received approximately the same degree of attention in the determination of requirements. Studies showed, however, that a relatively small number of items accounted for most of the dollar value of issues; therefore, varying degrees of control are now authorized on the basis of annual dollar demand. Items are stratified according to value of annual demands upon the central depot system as low dollar value items ($0 to $5,000 in annual demand), medium dollar value items (over $5,000 but not exceeding $25,000 in annual demand), and high dollar value items (in excess of $25,000 in annual demand). Within the high-dollar category, there is also a super-high dollar stratum of items. These are selected by the Army Materiel Command for worldwide asset reporting and comprehensive study. Depots are allowed to carry more stock of the low annual dollar demand items. A standard method for computing requirements for secondary items is established for use by all inventory control points (AR 710-45).

(3) *Steps in Determining Secondary Item Requirements.* The following simplified procedures are used to determine requirements for the low-dollar-value items. The procedures for other categories are more detailed but are governed by the same general principles of supply control. The most important figure in supply control is the Average Quarterly Demand. This figure is computed by accumulating and averaging total demands (both recurring and nonrecurring) for some representative historic period. Then the Reorder Point is computed by considering lead time, safety level, and mobilization reserve factors together with the rate of demand. The Reorder Point is the minimum quantity of assets that must be maintained on hand and on order to avoid supply failures. When the Reorder Point is reached, a new order is placed so that assets will be brought up to the Requirements Objective. The Requirements Objective is therefore the maximum quantity of materiel to be maintained on hand and on order to sustain current operations and satisfy reserve objectives. It is the sum of the mobilization reserve, procurement lead time, safety level, and reorder cycle quantities. In the case of low-dollar items, the actual computation and analysis is done by computer, and only exceptional cases are checked by hand.

(4) *Relationship of Principal to Secondary Item Requirements.*

(a) *Programing change factor.* Forecasts of principal item requirements form an important element in the computation of requirements for allied secondary items. A single item, such as a tractor of a certain make and model, may have hundreds of repair parts and accessories whose supply depends to a large extent upon the future use and distribution of the end item. This relationship is particularly important when changes in the Army program affect requirements for any principal item. A "programing change factor" is computed by the commodity analyst to express the ratio between the current and projected in-use end-item population. Programing change factors for secondary items are projected for the balance of the current fiscal year and succeeding fiscal years.

(*b*) *Implementation of programing change factors.* The programing change factor cannot always be applied directly. In many cases a repair part or accessory is used for more than one principal item, and program changes may affect different items in different ways. Generally, both program changes and the requirements forecast that results from them are plans and estimates, subject to variations and errors. Program changes will not take place immediately. Equipment will be turned in over a period of time, and it is very possible that those items remaining in the field will receive harder usage, resulting in a higher demand for spare parts and maintenance materials. In projecting repair parts requirements, the commodity analyst interprets the programing change factor as a trend, along with other elements of data, such as demand experience and troop deployment.

16–4. Maintenance Support

a. Maintenance Planning and Materiel Development for Maintainability. The most potent weapon system can become a logistics nightmare without sound planning. The necessity of early and continued consideration of maintenance during the development of new materiel is fully recognized. Two maintenance objectives must be met before an item is issued to the ultimate user. First, the item must be designed and engineered for the maximum reliability and maintainability that is consistent with operational requirements. Maintainability is assured through review by maintenance engineers at specific in-process review points in the development process. Second, materiel development must be accompanied by a maintenance support plan. This plan fixes the responsibility for maintenance operations on appropriate maintenance echelons and insures that each item will be supported by the proper technical skills, repair parts, tools and test equipment, handling equipment, and technical publications, and by effective training and technical assistance programs.

b. In-Process Review.

(1) *General.* The review of maintenance considerations arrived at during the various development phases of an item constitutes a critical step in maintenance planning. It is the means by which an item can be developed with optimum maintainability features and supported logistically upon issuance to the field. In-process reviews, discussed in chapters 9 and 10, are conducted as an integral part of the materiel development review program set forth in AR 705–5.

(2) *Factors Emphasized.* The in-process review procedures provide that maintenance considerations be given proper weight in relation to other item characteristics and operational considerations. Specifically, the following support objectives are to be given the maximum possible emphasis at various stages of materiel development:

(*a*) Reliability.
(*b*) Reduction in technical skills (quantity and complexity) for maintenance of equipment.
(*c*) Use of standard parts, components, modules, tools, and test equipment.
(*d*) Interchangeability of parts, components, and modules.
(*e*) Accessibility for adjustment and repair.
(*f*) Reduction of frequency of repair.
(*g*) Use of throwaway components.
(*h*) Speed in fault isolation.
(*i*) Reduction of repair time.

c. Maintenance Support Planning.

(1) *Purpose.* The purpose of maintenance support planning, and the guidance for preparing detailed maintenance and logistic support plans and schedules therefor, for the designated supportable end items, are found in AR 750–6. The purpose of this planning is to integrate all elements of support

and to assure their availability before or at the time of equipment distribution. Maintenance support planning begins with the development of the maintenance concept portion of the Qualitative Materiel Requirement. The planning then becomes more detailed and concrete as the equipment development progresses. Thus, at appropriate stages, it includes the review and evaluation of the equipment maintainability and reliability characteristics, review of draft technical manuals, the conduct and evaluation of the maintenance portion of equipment service tests, and ultimately the coordination of all training, technical assistance, and supply actions that are required to support equipment deliveries. Important vehicles of this planning are the maintenance support and logistic support plans, discussed below.

(2) *Maintenance Support Plans.* This plan is a continuously updated plan. The initial plan may be prepared at the outset of development in the case of a military item, or in the procurement phase in the case of a commercial item. The plan contains narrative sections that describe the item, its uses, and general construction, and that set forth the framework of overall program objectives. It then records in detail the tasks and actions necessary to support equipment programs properly at each phase of the development, production, and support life cycle. The plan for an end item, assemblage, or system will list major components and/or support equipments, and will include detailed plans for the various component and support items as annexes to the basic plan. The agencies with commodity responsibility for the various components and/or support equipments prepare these annexes and submit them to the agency responsible for the end item. The end-item manager coordinates the actions of participating agencies, and guides the preparation of the total plan. The detailed sections of the plan deal with the following areas:

(*a*) Trained military and civilian maintenance personnel.
(*b*) Requirements for new or changed military and civilian skills.
(*c*) Military and civilian instructor and operator personnel.
(*d*) Repair parts.
(*e*) Special and common tools and test equipment.
(*f*) Support and ground handling equipment.
(*g*) Technical manuals.
(*h*) Technical assistance.
(*i*) Maintenance float.
(*j*) Modification work orders.
(*k*) Calibration.

(3) *Logistic Support Plans.* Logistic support plans are prepared as required by the Deputy Chief of Staff for Logistics for specific end items. These plans must be completed at least 1 year before the equipment is initially deployed to the field. It contains planning data of interest to all participants in logistic support. However, it is particularly designed to assist field commanders in assuring the orderly deployment and support of new and complex systems, such as missile, fire distribution, combat surveillance, and aircraft systems.

Section II. TOTAL LIFE CYCLE COSTS

16–5. General

This section considers some difficult evaluation problems that arise from the fact that equipment reliability, maintainability, and other qualitative characteristics largely control subsequent support actions and costs. Under the present programing and budget structure, equipments costs in general are divided between

two distinct categories. There are, on the one hand, the investment costs supported by the Research, Development, Test, and Evaluation, Army, appropriation and by the Procurement of Equipment and Missiles, Army, appropriation. On the other hand, there are the operating costs supported by the Operations and Maintenance, Army, appropriation. Despite many significant areas of trade-off between costs borne in development, production, and support, the traditional structure makes it difficult to assess the total costs—both investment and operating—of specific systems, and ultimately to choose the best weapon in terms of cost and effectiveness from many alternatives.

16–6. Goal of Total Life Cycle Cost Analysis

a. The Concept. The goal of the total life cycle cost concept is fairly straightforward: to determine the total out-of-pocket expenditures that will result from the choice of one manufacturer's equipment as opposed to that of another. If two equipment configurations are interchangeable, but one is offered at a lower unit price, a total analysis will indicate which of these two offerings is the less expensive in terms of total system costs. The analysis proceeds by assessing the impact of the two designs on total internal Army expense, as well as the money paid to the ultimate supplier, to determine which design results in the least overall cost to the Government.

b. Developing a Comprehensive Control System. If equipment selections are made without an analysis of total life cycle costs, contractors may develop a design that is highly competitive with other sources on a unit price basis but increases parts cost per overhaul, labor cost per overhaul, and component condemnations, and decreases the mean time between overhauls. Any of these factors represents an adverse trade-off to the Government. This situation can be avoided by developing a system for comprehensive control of total life cycle costs in component selection decisions. In order to develop such a system, it is necessary to begin by amassing information on internal system costs that will be affected by the selection decision. Then an analytic model must be developed, one that takes into consideration all costs associated with alternative supplier offerings over the complete life cycle of the equipment. Each of these requirements is discussed more fully below.

16–7. Research of Cost Elements

a. General Requirements. The total life cycle cost concept attempts to determine the lowest level of total cost (including investment and operating expenses) associated with alternative manufacturer offerings. Effective application of this principle depends upon adequate determination of these internal expenses, and also imposes certain requirements on the methods and criteria used in cost determination. First, it requires application of appropriate units of measure—in the case of operating and similar costs, the single line item; in the case of obsolescence and associated expenses, the average dollar value of inventory on hand over a given period. Second, the total cost system requires the inclusion of variable costs only; that is, costs that change in direct proportion to changes in the unit of measurement, whether the change is in the number of new parts cataloged or the dollars of inventory on hand.

b. Specific Elements. Some of the specific cost elements requiring study include the expense that can be avoided if original equipment is purchased, rather than a new design developed. These costs include research and development expenses (if paid for by the Government), plus a number of operating expenses, such as technical data and other associated "software" costs, training costs, provisioning costs, costs of cataloging new parts added to the inventory, and allied data management and inventory management costs. Another group of costs that require study varies with the procurement and requisitioning activity that alternative equipment designs would involve. These costs include both initial and reprocurement expenses of equipment, and parts purchases. A third group of costs varies with the reparable or consumable nature of the equipment, and the other applications of the parts if the equipment is reparable. In most cases, parts that have many uses are not sub-

ject to as high an obsolescence risk as those that have few uses. The significant cost of this risk requires its inclusion in the overall analysis.

c. Costs Over Time. In addition to differences in internal operating expenses, cost research should consider the cost implications of the possibility that choice between equipments may result in considerable differences in the length of the operating life cycle. In addition, the concept of present value (the time value of money) should be explored as it relates to the timing of both operating and investment expenditures.

16-8. Development of a Total Cost System Formula

Once the internal costs of operations are known, a formula (or analytic model) must be developed that allows for examination of these costs as they relate to alternative manufacturer offerings. The major requirement for an effective formulation of the problem is its completeness: the model must allow for consideration of all possible inputs, including maintenance plans, support plans, supply plans, life of type data, parts consumption, labor costs, and cataloging expenses. These costs must be developed for both the equipment and the parts (common and peculiar) required in its support. In addition, the model must allow for answers in operational terms as well as in dollars, so that various elements of the calculation can be employed to develop inputs into equipment performance requirements, such as the minimum acceptable time between overhaul or cost per overhaul. Finally, the model must also allow for consideration of alternative support plans: repair by the manufacturer, warranty of the equipment with all repair done by the manufacturer, or in-house repair.

PART SIX

OTHER AGENCIES WITH INTEREST IN RESEARCH AND DEVELOPMENT

CHAPTER 17

OTHER DEPARTMENT OF DEFENSE AGENCIES

Section I. DEPARTMENT OF THE NAVY

17–1. General

This chapter and the two following discuss briefly organizations outside the Army that engage in research and development. The organization of the Navy and Air Force, as related to materiel development, will be described in this chapter. Chapter 18 deals with other Government agencies and chapter 19 with nongovernmental organizations that may contribute to the Army's materiel development programs.

17–2. Organization for Materiel Development

a. Organization of the Department of the Navy is shown in figure 17–1. The Secretary of the Navy is responsible for the organization, operation, and administration of the Navy, including the development of materiel and equipment for the operating forces. The Assistant Secretary for Research and Development is responsible for development and implementation of Navy policies and procedures for research and development. He manages the appropriation for the budgeting category Research, Development, Test, and Evaluation, Navy, and is chairman of the Navy's Research and Development Committee. Through his subordinate, the Chief of Naval Research, he manages the Office of Naval Research, and he is responsible for liaison between the Navy and the Director of Defense Research and Engineering.

b. The Chief of Naval Operations has prime responsibility for the Navy's operating forces. His staff, as a part of its planning and policy functions, develops materiel requirements for the operating forces and monitors the progress of materiel development.

c. The development of Navy materiel is the responsibility of the Chief of Naval Materiel. He directs the activities of the Naval Materiel Support Establishment, which is comprised of four bureaus involved in research, development, production, and support of Navy materiel. Both the Chief of Naval Materiel and the Chief of Naval Operations report to the Secretary. Their activities in materiel development are discussed more fully in the following paragraphs.

17–3. Chief of Naval Operations

a. The Office of the Chief of Naval Operations includes a number of Deputy Chiefs whose functions correspond closely to those of the Army's General Staff. They conduct the Navy's planning and develop operating concepts and materiel requirements. The Deputy Chief of Naval Operations for Development is directly concerned with Navy research, development, test, and evaluation programs, including the coordination and direction of weapons development.

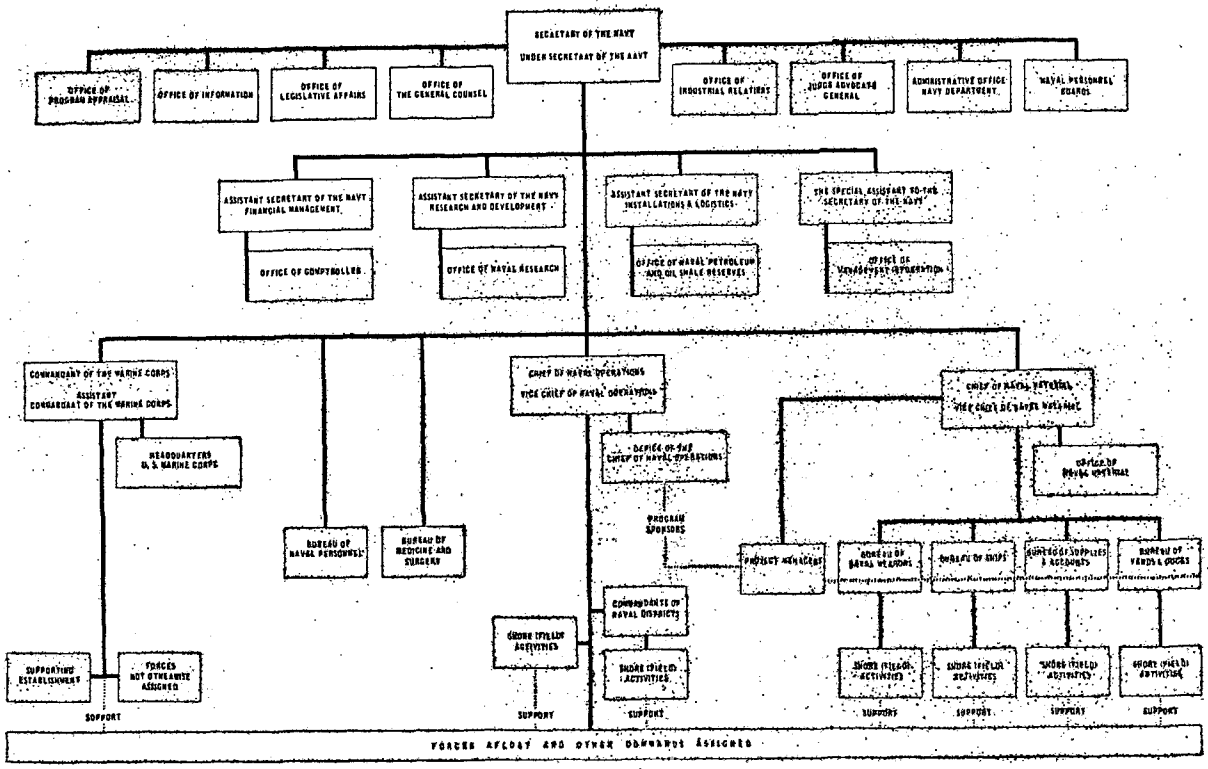


Figure 17-1. Department of the Navy.

b. For major development programs, Program Sponsors are designated in the Office of the Chief of Naval Operations to maintain coordination with the developing agency. The role of the Program Sponsor is the same as that of the Department of the Army Systems Staff Officer—to develop requirements and monitor project plans and progress, and serve as a central point of information within the Navy and between the Navy and the Office of the Secretary of Defense.

17-4. Chief of Naval Material

a. The Chief of Naval Material heads the Naval Material Support Establishment, established in 1963. The responsibilities and functions of the Naval Material Support Establishment are similar to those of the Army Materiel Command. It is comprised of the Office of Naval Material and the four materiel bureaus of the Navy: the Bureau of Naval Weapons, the Bureau of Ships, the Bureau of Yards and Docks, and the Bureau of Supplies and Accounts. The organization of the Naval Material Support Establishment is shown in figure 17-2.

b. The Office of Naval Material is the headquarters staff organization of the Chief of Naval Material. It includes four Deputy Chiefs —for Programs and Financial Management, Material and Facilities, Development, and Management and Organization. They develop plans, policies, and procedures for the Naval Material Support Establishment as a whole.

c. The Bureau of Naval Weapons has the responsibility for research, development, acquisition, and support of naval aircraft and ordnance, as well as certain associated items such as photographic and meteorological equipment. Functional responsibility for materiel development rests with the Research, Development,

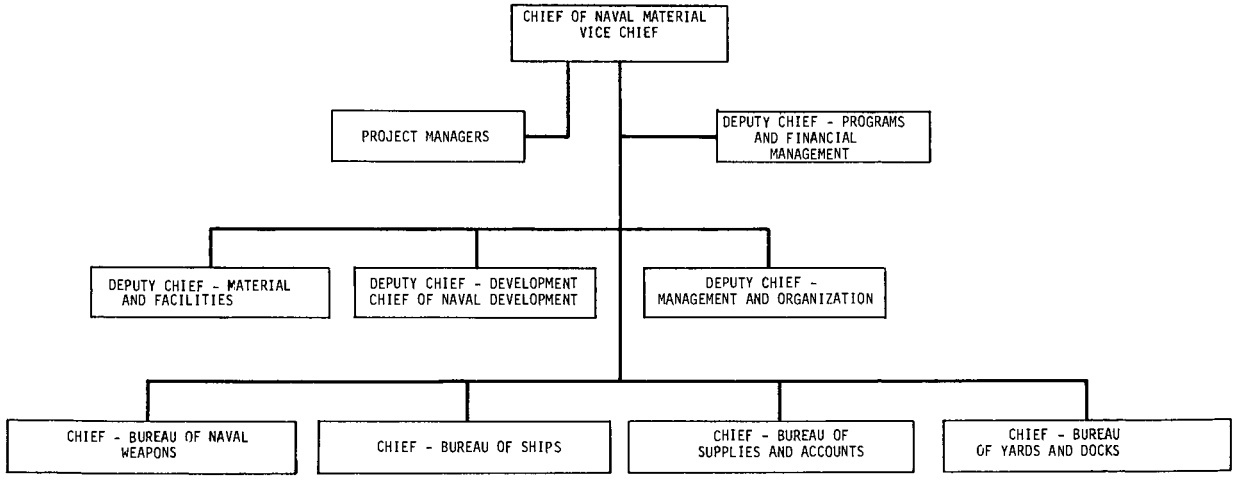


Figure 17–2. Organization of the Naval Material Support Establishment.

Test, and Evaluation group of the Bureau, headed by an Assistant Chief. Coordination of Bureau activities and project management for designated systems is the responsibility of the Assistant Chief for Plans and Programs. The Bureau operates a number of laboratories and test facilities in support of its materiel development activities. Among these are the Naval Air Engineering Laboratory near Philadelphia, the Patuxent River Naval Air Test Center in Maryland, and the Naval Ordnance Test Station in California.

d. The Bureau of Ships has the responsibility for research, development, acquisition, and support of naval vessels and associated equipment, including propulsion systems and search, surveillance, and communications equipment. Materiel development activities are carried on under three Assistant Chiefs—for Research and Development; Technical Logistics; and Design, Shipbuilding, and Fleet Maintenance. Planning and coordination of Bureau-wide activities are the responsibility of the Assistant Chief for Plans, Programs, and Financial Management. Like the Bureau of Naval Weapons, the Bureau of Ships operates laboratories and test facilities in support of materiel development. It also operates naval shipyards and other industrial facilities.

e. The other two bureaus in the Naval Material Support Establishment—the Bureau of Yards and Docks and the Bureau of Supplies and Accounts—are less directly associated with the Navy's materiel development activities. The Bureau of Yards and Docks is responsible for construction of naval facilities, and in this capacity is actively engaged in the planning, design, and construction of special facilities for new materiel, such as training and test installations. The Bureau of Supplies and Accounts is responsible for supply support, and thus is involved in determining quantitative requirements for items entering the Navy supply system.

f. Project management in the Naval Material Support Establishment involves designation of projects at two levels. Designation at the Chief of Naval Material level is required when it is determined that critical interfaces will exist in the project with other military services or other Government agencies, or between materiel bureaus; or that there are major technical complexities or other special circumstances. Project managers are established at the bureau level when it is determined that the proposed project is for the most part wholly under the cognizance of the materiel bureau.

17-5. Office of Naval Research

The Office of Naval Research is headed by the Chief of Naval Research, who reports to the Assistant Secretary for Research and Development. The Office conducts research and exploratory development programs through branch offices and field installations, such as the Naval Research Laboratory in Washington, D.C., and the Naval Biological Laboratory in California. It is also active in the planning and coordination of research and exploratory development programs throughout the Navy, in collaboration with the Chief of Naval Operations, the Chief of Naval Material, and the Commandant of the Marine Corps.

17-6. The United States Marine Corps

Although the Marine Corps has no materiel development organization of its own, it has a substantial requirement for the development of combat equipment. For the most part, this requirement is satisfied through the Navy's bureaus, particularly the Bureau of Naval Weapons. The Corps' responsibility for amphibious and land operations, however, involves a high degree of cooperation and coordination with the Army and Air Force as well as with the Navy. Much of its materiel is developed by the Army.

Section II. DEPARTMENT OF THE AIR FORCE

17-7. Organization for Materiel Development

a. The organization of the Department of the Air Force is shown in figure 17-3. The Secretary of the Air Force is responsible for the organization, operation, and administration of the Air Force, including the development of materiel and equipment for the operating forces. The Assistant Secretary for Research and Development is responsible for the development and implementation of Air Force policies and procedures for research and development. His duties are essentially the same as those of his counterparts in the Army and Navy.

b. The Chief of Staff of the Air Force is responsible to the Secretary for the full range of Air Force activities, including materiel development. The Air Staff is the Air Force counterpart of the Army General Staff, with responsibility for planning and policy formulation. It is the primary focal point for the development of materiel requirements in the Air Force.

c. The Air Force Systems Command has the responsibility for development and acquisition of new weapon systems and the conduct of related research and development activities. When new items enter the Air Force inventory, logistics support is provided by the Air Force Logistics Command.

17-8. The Air Staff

a. The Air Staff is the headquarters organization of the Air Force Chief of Staff. The Deputy Chiefs and Assistant Chiefs develop plans, policies, and programs for implementation of the field organization. The Deputy Chief of Staff for Research and Development has primary responsibility for the planning and direction of Air Force research and development activities. The Air Staff also includes the United States Air Force Scientific Advisory Board, which reviews research and technological developments for their application to the Air Force mission, and reviews and evaluates Air Force long-range plans for research and development; the Chief Scientist, who serves as chief scientific adviser to the Chief of Staff; and the Operations Analysis Office, which studies and evaluates weapons and tactics, strategy, logistics, and other subjects to which the methods of operations research are applicable.

b. Like the Army and Navy, the Air Force headquarters organization designates officers to oversee the planning and implementation of major development programs. Called Program Element Monitors, they perform the same function as the Army's Department of the Army Systems Staff Officers.

17-9. Air Force Systems Command

a. The Air Force Systems Command, estab-

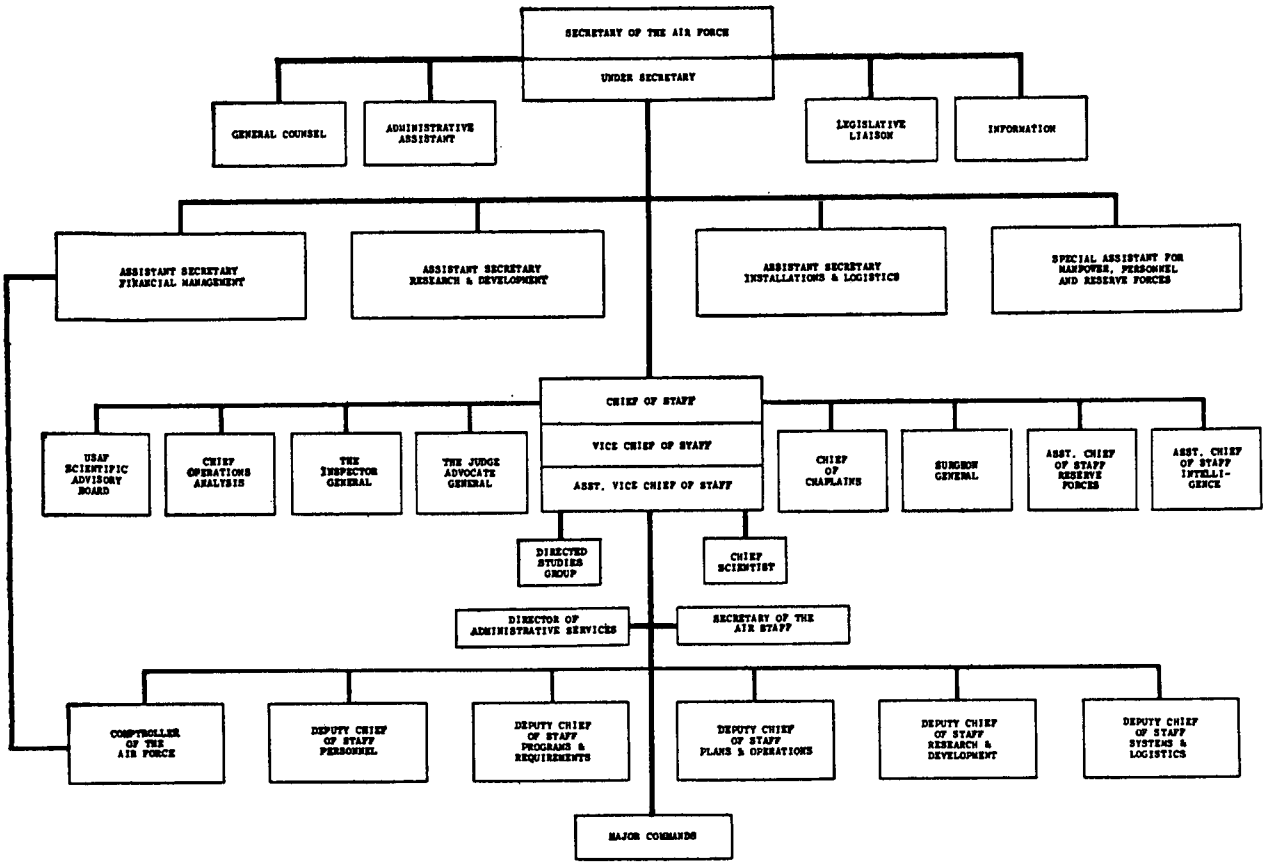


Figure 17–3. Department of the Air Force.

lished in 1961, is responsible for virtually all research and development activities in the Air Force. It includes seven divisions and ten field activities, in addition to the headquarters organization. The organization of the Air Force Systems Command is shown in figure 17–4.

b. The headquarters organization of the Air Force Systems Command includes eight Deputy Chiefs of Staff. Principal responsibility for materiel development lies with the Deputy Chief of Staff, Systems, whose duties include the development of management systems and procedures as well as the planning and development of weapon systems.

c. The seven divisions of the Systems Command include for systems development divisions and three divisions with specialized functional responsibility. The systems development divisions are the Aeronautical Systems Division at Wright-Patterson Air Force Base, Ohio (aircraft, manned aerospace craft, and associated ordnance and supporting systems); the Ballistic Systems Division at Norton Air Force Base, California (ballistic missile systems); the Electronic Systems Division at Hanscom Field, Massachusetts (command and control systems); and the Space Systems Division at Inglewood, California (space programs). Each

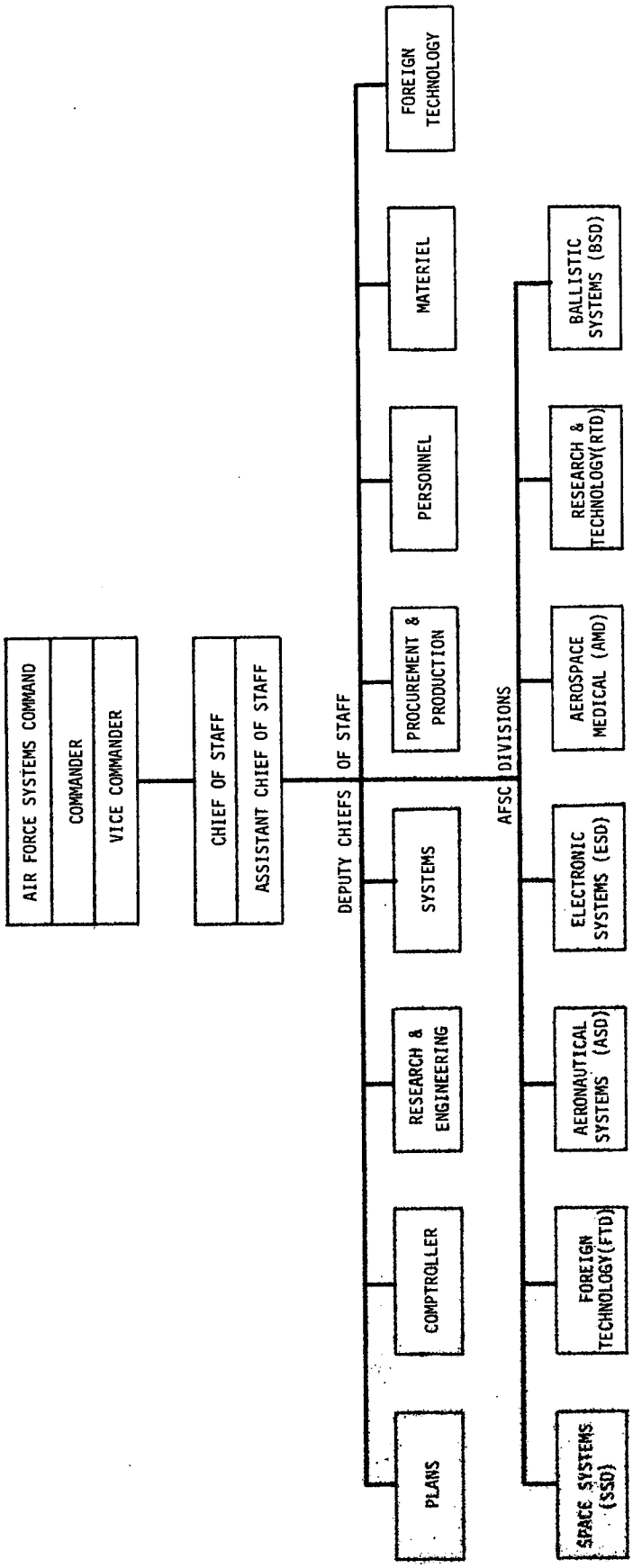


Figure 17-4. The Air Force Systems Command.

of these divisions operates laboratory and test facilities, as well as managing system development projects. The three functional divisions are the Aerospace Medical Division at Brooks Air Force Base, Tex. (life sciences and medical research); the Foreign Technology Division at Wright-Patterson Air Force Base (aerospace technical intelligence); and the Research and Technology Division at Washington, D.C. (applied research and advanced technology).

d. In addition to the divisions, the Systems Command operates seven field centers for research, development, and testing in support of the Command's materiel development program. They include development and test centers for aircraft, missiles, nuclear weapons, and command and control systems.

e. Project management in the Air Force is conducted at the systems divisions, each of which has several System Program Offices headed by System Program Directors. For major, high-priority projects the System Program Director reports to the Division Commander, with "redline" authority to communicate directly to Systems Command headquarters in emergencies. Other System Program Directors report to the division's Deputy Commander for Systems Management. "Designated" systems are those which have been singled out for special management attention, whether the Director reports to the Division Commander or the Deputy Commander.

17–10. Air Force Logistics Command

The Air Force Logistics Command is responsible for the logistics support of systems and equipment that have entered the Air Force inventory. In order to plan adequately for this activity and to facilitate the transfer of responsibility from the Systems Command at the point of acceptance for operational use, the Logistics Command works closely with the Systems Command during the development phase, maintaining a liaison staff in the System Program Office for planning purposes.

CHAPTER 18

OTHER GOVERNMENT AGENCIES

Section I. EXECUTIVE OFFICE OF THE PRESIDENT

18–1. Introduction

a. In addition to the Department of Defense agencies that play a role in materiel development, a number of other activities of the Federal Government may also contribute to the process because of the nature of their responsibilities. The most predominant of these are the scientific and technological agencies of the Government. A knowledge and understanding of their functions and capabilities is important to a person engaged in any facet of Army research and development. They represent valuable resources for information and evaluation, and from time to time actually perform studies, tests, and development to fill Army needs. Army personnel frequently participate on panels and committees with representatives of these agencies, and have ready access to their capabilities. This chapter will examine the functions and responsibilities of these agencies, and will describe the role—actual or potential —that they may play in the process of materiel development.

b. Many other governmental agencies and bodies not specifically mentioned in paragraphs 18–5 through 18–15 also play important roles in, and have impact on materiel development. For example, to some extent, there must be cooperation and coordination between the military and the Departments of Agriculture and Health, Education, and Welfare in the development of Chemical, Biological and Radiological (CBR) materiel and medical service materiel. As another, but most important example, Congress also impacts on the process by their committees' and subcommittees' method of reviewing the status of specific materiel development programs which require justification.

18–2. Office of Science and Technology

a. The Office of Science and Technology was established in the Executive Office of the President in 1962. Its purpose is to advise and assist the President in developing policies and evaluating and coordinating programs, with the ultimate aim of assuring that science and technology are used most effectively in the interests of national security and the general welfare.

b. This Office is charged with evaluating the major scientific and technological policies, plans, and programs of the various agencies of the Federal Government; harmonizing science and technology with national security and foreign policy; and furthering science and technology in the nation. It assesses the impact of scientific and technical developments and programs on national policies. It reviews, integrates, and coordinates major Federal activities in science and technology, taking into consideration similar activities being conducted by non-Federal resources and institutions. Finally, it is responsible for achieving close and harmonious relations with the scientific and engineering communities of the nation. By gaining their maximum contribution, the Office helps to strengthen science and technology in the United States and the free world.

c. Clearly, the functions and responsibilities assigned to the Office of Science and Technology place it in the position of a guide to the entire national storehouse of scientific and technical knowledge. It serves as the medium for determining whether (and where) the know-how is available to permit the development of equipment to meet Army-conceived requirements. It

also suggests possible uses for the results of basic research in application to anticipated Army needs.

18–3. The Federal Council for Science and Technology

a. This Council, of which the Director of the Office of Science and Technology is chairman, was established in 1959 to promote closer cooperation among Federal agencies, to assist in the resolution of common problems, to improve planning and management in science and technology, and to assist the President with Federal programs that affect more than one agency. Like the Office of Science and Technology, the Federal Council for Science and Technology is a clearinghouse for existing scientific and technical knowledge and a guide to the personnel and facilities that may be available for use in the development of materiel.

b. In addition to the Director of the Office of Science and Technology, the Council's membership includes officers of policy rank from eight departments and agencies of the Government. The Council has committees in various scientific and technological sectors, including materials research and development, scientific information, and scientific and technical personnel. It also has a standing committee that concerns itself with the operations of Federal laboratories. The Office of Science and Technology provides the secretariat for the Council.

18–4. President's Science Advisory Committee

The Committee was established by the President in 1951 within the Office of Defense Mobilization and reconstituted as the President's Science Advisory Committee and transferred to the White House in 1957. The membership was extended to 18 eminent scientists and engineers, drawn from private life. The Committee has the responsibility of providing answers to questions raised by the President, to undertake assignments for him of an advisory kind, to mobilize the best scientific advice of the country in behalf of the Federal Government, and to recommend ways by which United States science and technology can be advanced to best serve the nation's security and welfare.

Section II. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

18–5. Mission and Programs

a. The National Aeronautics and Space Administration was established in 1958. Its purpose is to carry out the national policy of insuring that activities in space are devoted to peaceful purposes for the benefit of all mankind. It is charged with conducting research to solve problems of flight within and outside the earth's atmosphere; with the development, construction, and testing of aeronautical and space vehicles; and with the exploration of space.

b. The programs of the National Aeronautics and Space Administration are planned and directed by a headquarters organization in Washington, D.C. The agency has three major program offices—for Manned Space Flight, Space Science and Applications, and Advanced Research and Technology. These programs are executed by the agency's field centers, which conduct research and development projects under guidance from the program offices.

18–6. Relation to Army Materiel Development

a. Although the charter of the National Aeronautics and Space Administration restricts the agency to the peaceful uses of aeronautics and space, many of its programs have significant implications for Army materiel development. For example, space operations require the development of vehicles, propulsion methods, and guidance systems that may have application to Army needs in the advancement of missile technology. The agency's responsibility for the development or aeronautical vehicles to operate within the atmospheric envelope produces scientific data and technical developments that have a bearing on the Army aviation program. Basic and applied research in electronics, materials, and other areas result in products and processes

designed to meet the rigorous conditions of operation in space, Many of these developments, yielding lighter, smaller, stronger components and materials, can be applied to Army materiel development.

b. In addition, technical personnel of the Army and the National Aeronautics and Space Administration work together on numerous projects and cooperate in the use of facilities. Thus the Army Aviation Laboratories at Fort Eustis, Va., use wind tunnels at the Langley Research Center, located a few miles away, for studies of aerodynamic shapes.

c. Finally, it should be noted that the National Aeronautics and Space Administration provides information of value to the Army not only through its research and hardware development activities, but also through the data acquired by scientific satellites and probes of the atmosphere and near-space environment. For example, weather observation satellites that are developed, launched, and monitored by the agency for the United States Weather Bureau are a continuous source of data that are useful both for research and operational purposes.

Section III. ATOMIC ENERGY COMMISSION

18–7. Mission and Programs

a. The Atomic Energy Commission was established by the Atomic Energy Act of 1946. It is the successor to the Manhattan Project, the Army operation that, during World War II, produced the first atomic bombs.

b. The function of the Atomic Energy Commission is to provide and administer all programs for the use of atomic energy, both for peaceful purposes and for defense and security. The Commission consists of five members, citizens of national stature, who advise the President on matters relating to atomic energy. Members also act as a board of directors to oversee the operational activities of the organization.

c. The activities of the Commission are divided into two parts—operating and regulatory. The General Manager controls all operating functions, including research and development, production, and information. The Director of Regulation concerns himself with licensing and regulatory and safety functions. The Commission operates a number of field offices and installations under the General Manager. These include both production facilities and research and development laboratories.

18–8. Relation to Army Materiel Development

a. The Atomic Energy Commission and the Department of Defense have complementary responsibilities for development of weapons, powerplants, and equipment using nuclear energy. Military requirements for weapons and equipment are developed by the services and are transmitted to the Commission through the Defense Atomic Support Agency and the Director of Defense Research and Engineering. Approved military characteristics are transmitted to the Commission through the Military Liaison Committee. This committee, an advisory body of the Atomic Energy Commission, consists of a civilian chairman and representatives of the three military departments.

b. The Atomic Energy Commission is responsible for the development and production of all nuclear warheads. However, the Army is responsible for the development of nuclear power reactor systems (exclusive of ship propulsion and aerospace applications) for all military departments. Atomic Energy Commission resources are used to develop the reactor components; Army resources are used to develop the power conversion equipment. The two agencies collaborate on complete reactor systems.

Section IV. DEPARTMENT OF COMMERCE

18–9. General

The Department of Commerce has several agencies of direct concern to Army research and development activity. The chief of these are the Bureau of Standards and the Weather Bureau. The Department has an Assistant Secretary for Science and Technology, who exercises supervision over the Bureau of Standards, the Weather Bureau, and the Coast and Geodetic Survey.

18–10. The National Bureau of Standards

a. This Bureau has been in existence since 1901 as the guardian of the nation's basic measurement standards. It is organized in four units, as follows:

(1) The Institute for Basic Standards provides the central basis for all standards of physical measurement, and conducts research and fundamental physical phenomena.

(2) The Institute for Materials Research studies the basic properties and behavior of materials.

(3) The Institute for Applied Technology provides a central clearinghouse for the collection and dissemination of scientific and technical information.

(4) The Central Radio Propagation Laboratory collects, analyzes, and disseminates data on the propagation of electromagnetic waves and the use of electromagnetic systems.

b. The activities of the Bureau of Standards in materials research, the collection of information, and radio propagation are all applicable to the Army's materiel development efforts.

18–11. The Weather Bureau

This Bureau is also an agency of great interest to the Army. Its research work in climatology and meteorology has direct application to Army needs, both in aviation and in ground operations. The Bureau chairs a National Coordinating Committee on Aviation Meteorology, composed of members from all Government agencies interested in aviation, including the Army.

Section V. NATIONAL SCIENCE FOUNDATION

18–12. Mission and Programs

The principal purpose of the National Science Foundation, which was formed in 1950, is to strengthen basic research. It awards grants and contracts to universities and other nonprofit institutions in support of basic research, and also awards graduate fellowships in the sciences. It supports (through contracts) national centers where large facilities are made available for the use of qualified scientists (for instance, the National Radio Astronomy Observatory). It also conducts research and evaluation in weather modification. It is concerned with programs for improving scientific education through increasing the competence of teachers, modernizing teaching materials, and providing science students who demonstrate unusual ability with the opportunity to obtain additional experience. Finally, the National Science Foundation is responsible for developing and disseminating information about scientific resources, and for a program for coordination of scientific information in the Federal Government.

18–13. Relation to Army Materiel Development

The National Science Foundation fills a role somewhat similar to those of the Office of Science and Technology and the Federal Council for Science and Technology as a possible source of information for the Army concerning scientific and technical knowledge and its possessors and practitioners. The Foundation is becoming increasingly important as the sponsor of fundamental research in colleges and universities. The Army frequently works through the National Science Foundation in securing basic

research efforts that cannot be directly related to an Army Equipment need. The Foundation also provides scientific guidance and consultation to other Government agencies. For example, it has conducted reviews of Army materials research programs.

Section VI. NATIONAL ACADEMY OF SCIENCES

18–14. Mission and Programs

a. The National Academy of Sciences is a quasi-governmental agency that dates back to the Lincoln Administration. It is an organization of distinguished scientists and engineers, dedicated to the furtherance of science and its use for the general welfare. It operates under congressional charter, but is not, strictly speaking, a Government agency.

b. At the request of President Wilson in 1916, the Academy organized the National Research Council as a measure of national preparedness. The purpose of the National Research Council is to stimulate research in the mathematical, physical, and biological sciences and in their application to engineering, medicine, and other useful arts, so that the national defense and the general welfare will be served.

c. Both the Academy and the Research Council are organized in sections according to scientific disciplines (for example, mathematics, chemistry, physics, engineering, and so on). In these sections the Academy and Research Council bring together the most competent scientists and engineers in the country to consider problems and to exchange information in furtherance of research.

d. The Academy and the Research Council maintain no laboratories, but they do stimulate and support the work of individual scientists and coordinate investigations into broad problems in research. Under their sponsorship conferences are held, technical committees meet, and surveys are made. Data are collected and collated. These organizations also sponsor scientific publications and research organizations, and administer public and private funds for research projects and fellowships. The Academy and the Research Council administer several million dollars a year—funds that are provided by contributions, grants, contracts from Federal and state agencies, private industries, foundations, scientific societies, and individuals.

18–15. Relation to Army Materiel Development

a. The Academy and its Research Council make up the national association of the country's best scientific and technical brains. The Research Council, in particular, charged as it is with contributing to the strengthening of national defense, is an appropriate medium for the Army to consult in seeking solutions to problems in the development of basic scientific and technological capability that will permit the development of materiel to meet a foreseen need.

b. The National Academy and the Research Council respond to the Army's requests for reviews of scientific studies. They can gather panels composed of the ablest men in particular disciplines to evaluate proposals for research or concept developments, or to suggest possible avenues for the solution of a problem. The Academy and the Council have recently reviewed programs for oceanography and astronomy to provide guidance for the national effort in these fields. They have also completed a review on research management for the Congress.

CHAPTER 19

NONGOVERNMENTAL ORGANIZATIONS

Section I. GENERAL

19–1. Introduction

At various times a great many nongovernmental agencies have participated in the research and development cycle for items of Army materiel. In fact, the Army relies heavily on such organizations in every phase of the cycle, from fundamental and applied research (which may be far in advance of any weapon idea) to feasibility studies, exploratory development that establishes the practicality of radically new ideas, and the design of the item.

19–2. Basic Categories

Two distinct kinds of such research and development organizations can be identified: commercial companies that are operated for profit, and agencies that do not have a profit objective. Within these broad categories many subdivisions can be made. For example, colleges and universities, institutions and foundations, and scientific societies all fall into the noncommercial category. Similarly, commercial companies may be production-oriented or research-oriented. The role of each of these kinds of nongovernmental organizations will be discussed in this chapter.

19–3. Funding Arrangements

The Army can employ nongovernmental agencies in the research and development process in two ways: by contract and by grant. A contract is appropriate when an end product can be described and its delivery can be specified. Contracts, therefore, are most appropriate in applied research and development, where the product to be paid for may be a study defined by detailed parameters, or an actual item of equipment. Where the specification of an end item is unforeseeable (and may also be undesirable) funds can be made available to support the research of an individual or a group into a broad area, without defining an expected result. For example, an Army grant supported a university investigation into the inhibition of enzymatic activity in foodstuffs. Although such research has an obvious relationship to the eventual production of preserved rations, specifying an end product and a delivery date might very well interfere with a thoroughly scientific investigation of the area under study.

Section II. COLLEGES AND UNIVERSITIES

19–4. Universities as a Repository of Talent

The nation's colleges and universities possess much of the scientific talent that is essential to technological advances in materiel. Because of this talent, the Army looked early to the academic world for assistance, and particularly for assistance at the basic research end of the research and development spectrum.

19–5. The Balance Between Teaching and Research

Universities, anxious to preserve the appropriate balance between education and research, regard research both as a teaching tool and as a contributor to the general fund of scientific knowledge. Therefore, they prefer to confine their efforts to fundamental investigations that

can be integrated into their educational programs. In cases where the demands of national defense have compelled universities to study applications, they have often opened laboratories (operated separately from the universities) which employ people to work solely on the applications contracts.

19-6. Contractual Arrangements with Academic Institutions

Colleges and universities constitute the nonprofit sector of the noncommercial scientific and technological agencies. Contracts for their services are negotiated to include reimbursement for costs, but no fee.

19-7. Scope of Academic Involvement

More than one hundred educational institutions have participated in military research and development work. Among them are such institutions as Massachusetts Institute of Technology, Johns Hopkins University, the University of California, Harvard University, the University of Michigan, the University of Chicago, Carnegie Institute of Technology, and Princeton University.

19-8. Kinds of Work Performed

The work done in university laboratories has been of almost endless variety. The Massachusetts Institute of Technology, for example, recently conducted Army studies on the behavior of materials. Dartmouth College has done research in solid propellant combustion instability. Mississippi State's investigations into viscous flows have contributed to applied aerodynamics. Princeton, Georgia Institute of Technology, Virginia and Texas Universities have all done research for Army Aviation.

19-9. Grants

Grants are usually made on the initiative of the institution. When a university wishes financial support for a research effort in which it believes the Army may be interested, it submits a proposal to the Army research activity having primary interest. The grant, when made, will specify the area of investigation and the person or group to be supported, but it will not lay down performance specifications. This system allows the researcher to follow wherever the trail leads him for as long as the funding permits.

19-10. The Importance of These Organizations to the Army

The academic world will continue to be of great importance to Army research and development. The services of many of the country's leading scientists will be most readily obtainable through the medium of the universities, and many embryonic scientists and engineers will be afforded educational opportunity through work on Army projects. Not only are the universities important for their direct participation in Army research and development; they are also the source of the fundamental scientific and technological advances that provide the basis for progress in materiel development.

Section III. INSTITUTIONS AND FOUNDATIONS

19-11. Categories of Laboratories and Research Institutes

A variety of agencies other than universities and colleges are also essentially nonprofit in orientation and are available for military research and development. These laboratories and research institutes are of three kinds: those established by private foundations; those that grew out of university research and development activity; and those created at the instance of military departments to meet specific research needs.

19-12. Their Establishment and Role

Some of the first research institutes in this country were established by funds donated by wealthy individuals or groups of people interested in the furtherance of scientific research. For instance, Battelle Memorial Institute in Columbus, Ohio, was founded by the Gordon

Battelle Foundation. The Mellon Institute is an activity of the Mellon Foundation. Franklin Institute in Philadelphia was established by a group of citizens who felt a need for an organization to pursue scientific research. Older institutes of this kind originally had few demands made on them by the military. In recent years, however, they have become increasingly active in military research and development work. For example, the Flight Safety Foundation, which is supported in part by the Rockefeller Foundation, does a great deal of study of crash effects for Army Aviation, and its findings have led to improvements in the design of seats, safety belts, and helmets. Another example is the Franklin Institute, which has performed tasks for the Army in airborne fire control and artillery design.

19–13. University-Affiliated Research Institutions

The second category of interest to the Army consists of laboratories and research institutions that grew out of the rapid expansion of university work for the Government. In some cases these organizations were established as entities separate from their parent institutions when it became apparent that the demands of military research and development were creating imbalances between research and teaching. In other cases, universities established separate laboratories at the request of the military. Among these university-sponsored laboratories are the following:

a. Jet Propulsion Laboratory. The California Institute of Technology originally operated this facility for the Army, but now does so for the National Aeronautics and Space Administration. It developed the experimental design for the Corporal missile.

b. Argonne National Laboratory. This laboratory at the University of Chicago, now an agency of the Atomic Energy Commission, is widely known for its role in the development of the atomic fission process.

c. Brookhaven Laboratories. Organized by an association of nine eastern universities, this institution, located in New York, is now an element of the Atomic Energy Commission.

d. Los Alamos Laboratory. This facility was established by the University of California to do atomic research. It too is now part of the Atomic Energy Commission.

e. The Radiation Laboratory. This research facility at the Massachusetts Institute of Technology was headquarters for much of the research and development of radar.

f. Cornell Aeronautical Laboratory. This agency of Cornell University performed advanced concept development of the LaCrosse missile, and continues to do aerodynamics research work for the Army.

19–14. Other Noncommercial Research Institutes

The third category of noncommercial institutes includes those created at the specific request of the military departments to perform research and development tasks. Some of these are managed by universities, some by commercial companies, and others by self-contained managements. The chief characteristic that they have in common is that their programs and funding all derive from a military department. Some of the laboratories mentioned in the preceding paragraph began as integral activities of universities, but have since shifted over into this category. A number of the new organizations in the category are oriented primarily toward operations research. However, they also do feasibility and concept studies for proposed weapon systems.

19–15. Typical Organizations

Typical organizations are the RAND Corporation, which has carried on research for the Air Force for a number of years, and the Special Operations Research Office of American University, which performs a similar role for the Army. Newer creations are the Institute for Defense Analysis (the research arm of the Weapons Systems Evaluation Group of the Office of the Secretary of Defense) and Research Analysis Corporation, now a principal research and development agent of the Army.

19–16. Research Analysis Corporation

This Corporation devotes the greater part of its effort to its contract with the Department

of the Army. General staff supervision over this contract is exercised by the Chief of Research and Development. Requests or proposals for projects or research studies are submitted by Army agencies to the Chief of Research and Development, and the research program to be performed for the Army is worked out in coordination with the Corporation. Examples of studies undertaken by Research Analysis Corporation are the construction of a mathematical model to aid decision-making in research and development management, and a study of the Army's need for a manned surveillance Vertical Take-Off and Landing aircraft.

19–17. Contractual Arrangements

The laboratories and research institutes considered in this section usually operate on a not-for-profit basis. In other words, they are permitted to charge the Government fees (customarily smaller than those allowed commercial contractors) in addition to being reimbursed for costs. These fees are generally used to improve the physical plant, to provide working capital, or to finance research not supported by outside funds.

Section IV. SCIENTIFIC SOCIETIES

19–18. Introduction

Scientific societies and associations play a vital role in the dissemination of scientific and technological information among the practitioners in the field. Every scientific discipline has at least one society devoted to its interest. The functions of these societies are to bring their members together in conventions, conferences, seminars, and symposia to discuss advances in their fields, and to publish journals that disseminate information on the advancement of science.

19–19. The Army and Learned Societies

Army scientific and technical people are usually active members of the societies in their disciplines. They attend society meetings and receive society journals. Their active role is supplemented by the cooperation of the learned societies, many of which are willing to convene panels at the Army's request to consider research problems or to evaluate proposals for new systems.

19–20. The Interdisciplinary Approach

Solutions to Army problems frequently emerge from research in disciplines other than those to which the problem appears most directly related. Because of this, it has become necessary for Army scientists to hold membership not only in the society of their own discipline, but also in those of related specialties. Army Research and Development staff members are able to monitor forthcoming meetings through schedules that are published in technical magazines. This helps insure their attendance at meetings of interest to the Army.

19–21. Exchange of Information

The Army scientific community is keenly aware of how essential the exchange of information is to technological advancement. It is generally conceded that highly automated cataloging and indexing methods are needed to reduce the flood of information to manageable proportions and to insure that pertinent new information is available to specialists in a timely manner. Society membership is useful, but the amount of time that Army personnel may devote to meetings of interest is limited. Various information-retrieval systems are now under development to supplement the exchange of ideas made possible through the learned societies.

Section V. INDUSTRIAL RESEARCH DEPARTMENTS

19–22. The Role of Industry in Research

Profit-making firms that engage in Army research and development are of two kinds: companies whose major interest is in large-scale production; and companies that engage only in research and development, and are not

interested in production contracts. Most major manufacturing firms have found it necessary to establish elaborate research facilities in order to remain competitive in both commercial and Government markets. They seek development contracts in order to gain know-how for application to the production run of the completed weapon or system. Commercial industry is capable of handling a great many of the Army's research and development problems. Its efforts are primarily devoted to the later stages of the research and development cycle, but there are many cases in which commercial firms have done applied research, feasibility studies, concept studies, and advance design.

19–23. Participation in Research and Development

a. In some cases commercial firms have operated not-for-profit laboratories or have performed not-for-profit contracts for the Army. For example, Rohm & Haas established a not-for-profit laboratory at Redstone Arsenal to do advanced research on solid propellants. In another instance, United Shoe Machinery Corporation conducted development on tank gun-loading devices, first on a cost reimbursement basis, and later with a small fee to compensate for disallowed costs.

b. Commercial firms have also contributed, through their own initiative, to the development of Army systems and equipment. One example is the development of three generations of Nike air defense missiles. The idea for the first of these, the Nike Ajax, was conceived by a Bell Telephone Laboratories' engineer, who proposed the substitution of a controllable missile with a missile-tracking radar for the antiaircraft projectile then in use. Bell Telephone Laboratories proceeded to determine the feasibility of such a system and to carry through its development. When small atomic warheads became available, Bell developed the longer-range, more sophisticated Nike Hercules, with atomic capability. When the need for an antimissile weapon was realized, this company conducted feasibility and design studies that resulted in the Nike Zeus. Another example is the development of the HAWK low-altitude air defense missile. The Army invited two firms to bid on the development of this system. A third firm, Raytheon, submitted an unsolicited proposal, and eventually received the contract. While Raytheon was developing the primary system, an alternative type of seeker system was also under development by Sanders Associates of Nashua, N.H. Still another example is the special-purpose individual weapon on which simultaneous independent development was conducted by Harrington and Richardson Company; Springfield Armory; Aircraft Armaments; and Olin Mathieson.

c. Commercial firms are also engaged in more fundamental work. For example, the Arthur D. Little Company, which is solely a research organization and has no manufacturing facilities, performed studies relating to area saturation for various munitions. Similarly, Whittaker Corporation of San Diego has done research on matrixes of fiber glass for Army Aviation.

d. A large number of weapon system contractors now maintain operations research groups to study the possibilities of new weapons. They frequently develop ideas that can lead to radical advances in weapons technology. For instance, LAW, the light antitank weapon, was developed without a contract by Flightex Fabrics as a follow-on effort to a development contract on shaped charges.

19–24. Army Exploitation of Industrial Research

In summary, industry has an enormous range of capabilities, from fundamental research in the physical properties of materials to the development of complete weapon systems. It is often advantageous to place contracts for feasibility and concept studies simultaneously with industry and with nonprofit or not-for-profit organizations to insure that all of the most promising approaches are considered. Industry's efforts in the more fundamental aspects of research, undertaken at its own expense for the purpose of enhancing competitiveness, will also yield contributions of importance to the military. The Army must be alert to this potential in order to exploit discoveries made by industry, which give promise of contributing to the advancement of weapons technology.

APPENDIX A

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4120.3	Defense Standardization Program
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70-31	Standards for Technical Reporting
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70-41	Cooperation with Allies in Research and Development of Defense Equipment
70-45	Scientific and Technical Information Program
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17	Project Management

A–9. Army Materiel Command Regulations

11–4	Army Materiel Command Program System Volume 4: Research, Development, Test, and Evaluation Volume 13: Command Objectives
11–16	Volume II: Planning and Decision-Making Techniques for Project Management Volume III: Master Plans and Reports for Project Management

11–26	Configuration Management
11–27	AMC Milestones
11– (draft)	Commodity Management
70–7	Test and Evaluation of Materiel
70–25	Research and Technology Reporting System (RCS–CSCRD–103)
350–6	Education and Training, New or Modified Equipment and Materiel
700–6	AMC Quality Assurance System
700–15	Reliability Program for AMC Materiel
705–5	Preliminary Operation and Maintenance Manuals
750–15	Maintenance Support Planning

A–10. Army Materiel Command Pamphlets

1–1	Directory of United States Army Materiel Command Installations and Activities
11–2	Guide to Life Cycle of U.S. Army Materiel
705–1	Research and Development of Materiel, Volumes 1–4 Volume 1: Philosophy Volume 2: Objectives for Technology Volume 3: Long-Range Technical Planning Volume 4: Qualitative Materiel Development Objective Planning Guide

A–11. Army Materiel Command–Other

Qualitative Development Requirements Information (QDRI), Volume 1, QDRI Managers Guide

A–12. Test and Evaulation Command Pamphlet

700–700	Materiel Test Procedures, Volume I

APPENDIX B

PERT/COST METHODOLOGY AND OUTPUT REPORTS

B–1. Network Methodology

a. Definitions. To understand the fundamentals of the PERT networking technique, three important terms must be defined:

(1) *Event.* A specific, definable accomplishment in a project plan, recognizable at a particular instant in time. Events do not consume time or resources. They are represented in the network by a circle.

(2) *Activity.* A work effort of a project that is represented on a network by an arrow. An activity may also simply represent a connection or interdependency between two events in the network. An activity cannot be started until the event preceding it has occurred.

(3) *Dummy activity.* A dummy activity shows restraints between events on the network, and does not represent the expenditure of resources or time. It may be represented on the network as if it were an activity with zero time, or it may be drawn as a dotted line.

b. Estimating Time. After a network has been constructed, showing all events and activities and their relationships, the next step is to estimate the elapsed time for each activity. There are two generally accepted approaches for establishing time estimates for each activity on the network. One approach calls for establishing a single time estimate, the other for establishing three estimates, which are then converted to a single time by a statistical approximation for a stated resource allocation. With both methods, the time values are estimates of the elapsed time needed for completion under normal operating conditions and without regard to calendar dates. Estimates can be made in terms of months, weeks, tenths of a week, and so on. The single-time-estimate approach establishes one time value for each activity on the network. This estimate represents the expected time (t_e) for the completion of the activity. The three-time-estimate method requires the planners or the engineering supervisors to make an optimistic time estimate (a), a most likely time estimate (m), and a pessimistic time estimate (b), for each activity. These estimates are defined as follows:

(1) *Optimistic Time Estimate* (a)—the time in which the activity can be completed if everything goes exceptionally well. It is estimated that an activity would have no more than one chance in a hundred of being completed within this time.

(2) *Most Likely Time Estimate* (m)—the most realistic estimate of the time an activity might consume. This time would be expected to occur most often if the activity could be repeated a number of times under similar circumstances.

(3) *Pessimistic Time Estimate* (b)—the time required for an activity under adverse conditions. It is estimated that an activity would have no more than one chance in a hundred of exceeding this amount of time.

c. Computing Time Estimates. The three time estimates are converted to an expected (t_e) for each activity by means of a formula which is an approximation for estimating the mean of a special probability distribution known as the beta distribution. The formula is:

$$t_e = \frac{a + 4m + b}{6}$$

where:

t_e = expected time in weeks
a = optimistic time in weeks
m = most likely time in weeks
b = pessimistic time in weeks

The results of the computations for t_e for a simplified network are shown in figure B–1. The values below the activity line are the three time estimates. Once the time estimates have been made, they can be put into a computer to calculate the earliest expected time for an event (T_E), the latest allowable time for an event (T_L), the critical path, and slack (t'). For large networks, it is certainly much easier and faster to use a computer if one is available with the necessary program. However, these computations can be done manually, and for smaller networks, or where computer facilities are not readily available, manual computations may be preferred. The computations presented here are similar to those performed by the computer. They may be used by the technician as a guide for performing the calculations manually or as an explanation of the calculations performed by the computer.

d. The Critical Path. The critical path consists of those sequential activities, each of which must be completed before the next one can begin. Delay in completing any activity on the critical path will cause an equivalent delay in succeeding activities. Thus the critical path is the longest time path through the network diagram and, as such, controls the schedule for the entire project. Determination of the critical path alerts the manager to the activities that are the most critical in terms of meeting schedules. When the manager knows which activities are on the critical path, he is able to utilize critical resources more effectively. Slack paths are sequences of activities having excess time in comparison to the critical path. These slack paths indicate to the manager where excess resources may exist. Thus, when the manager knows the critical path and the slack paths, he is in a better position to make time-cost-performance trade-offs.

e. Earliest Time (T_E). The first step in determining the critical path is to determine the earliest possible time (called earliest times) for the completion of each event. In calculating earliest times, start with the first event on the extreme left of the network, and proceed from left to right across the network, determining the earliest times for each event. The symbol that represents the earliest times is T_E, and should be shown on the diagram with its associated time value. This is determined by adding, to the value obtained at the last event, the time for the activity from the last event to this event (fig. B–2). As an illustration, the earliest time (T_E) at event No. 3 is the T_E value at event No. 1 (in this case 0) plus the activity time for activity 1–3 (in this case 6), which gives an earliest time for event No. 3 of 6. When an event is a merger point, all paths leading to that event must be considered; the one with the longest time value should be selected. For example, the earliest time (T_E) for event No. 8 is 67, following the path from 7 to 8. Following path 3 to 8 would give a T_E of 26 at No. 8, and path 4 to 8 would give a T_E of 60 at No. 8, so path 7 to 8 is selected and the earliest time for event No. 8 is shown as 67. The earliest time for the completion of the entire project is 91 weeks.

f. Latest Time (T_L). The second step is to determine the latest possible time (called latest times) for completion of each event. The latest time is when an event should be completed if the final event is to be completed at a specified time. In calculating latest times, start with the final event on the network diagram, and move across the network from right to left, determining the latest times for each event. The symbol that represents the latest times is T_L; it should be shown on the diagram with its associated time value. To start determining the latest times for all events on the network, the latest time for the final event must be fixed at some point—usually at the same time as T_E for the final event. Starting with this value, the latest time for an event can be determined by subtracting the time for the activity from the succeeding event to this event from the latest time value of the succeeding event (fig. B–2). For instance, the latest time (T_L) for event No. 10

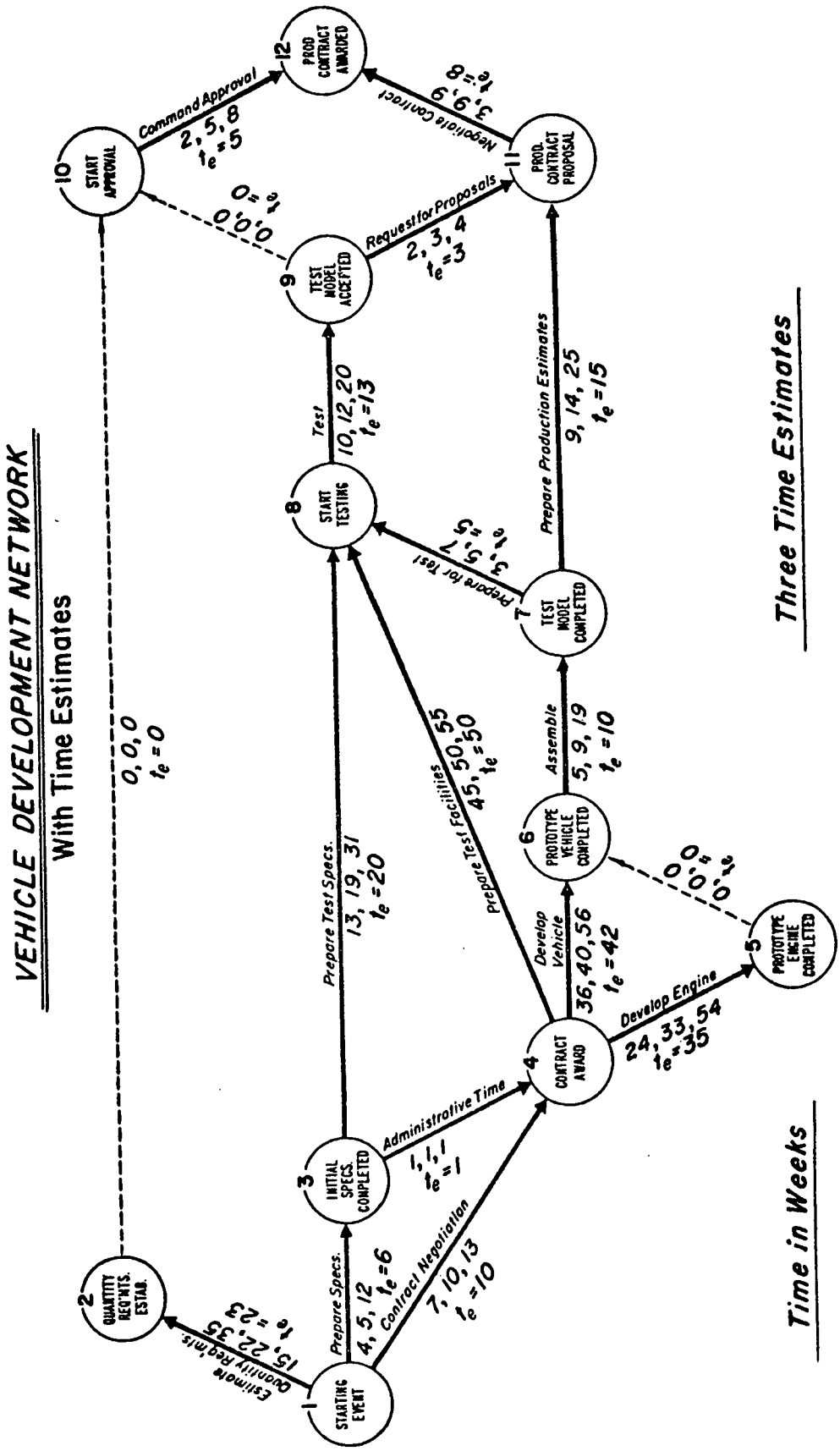

Figure B–1. Vehicle Development Network With Time Estimates.

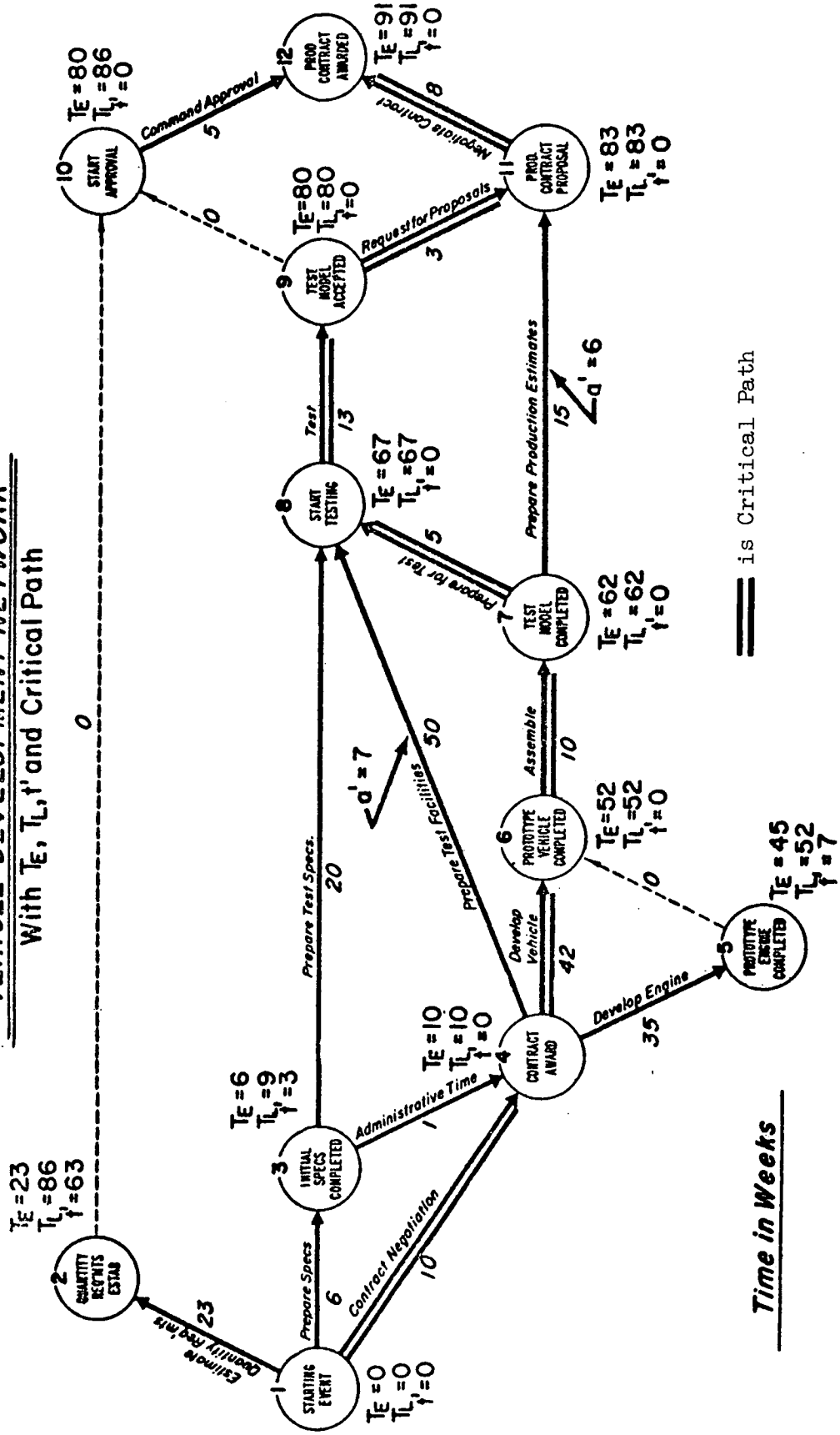

Figure B–2. Vehicle Development Network With T_E, T_L, t', and Critical Path.

PERT/COST
MANAGEMENT SUMMARY REPORT

	REPORTING ORGN.	CONTRACT NO.	REPORTS CONTROL SYMBOL: BOB 22-R-236
ABC - MISSILE AND GHE	XYZ - A&S DIVN	33(600)28369A	TERM (SPAN): TOTAL PROGRAM
LEVEL/SUMMARY ITEM: 3/BALLISTIC SHELL 22300			CUT OFF DATE: 30MAR63
			RELEASE DATE: 10APR63

ITEM	COST OF WORK $(000)						MOST CRIT SLACK (WKS)	COMPL DATE	SCHEDULE	REMARKS
	WORK PERFORMED TO DATE			TOTALS AT COMPLETION					S-SCHED COMPL DATE--TOTAL A-ACTUAL COMPL DATE-- ITEM E-EARLIEST COMPL DATE--CRITICAL L-LATEST COMPL DATE-- ITEM	
	VALUE	ACTUAL COST	(OVERRUN) UNDERRUN	PLANNED COST	LATEST REVISED EST	PROJECTED (OVERRUN) UNDERRUN			P YR 1963 J F M A M J J A S O N D 1964 J F M A M J J A S O N D 5 6 7 8 L YR	
BALLISTIC SHELL								10DEC64	S	See PROBLEM ANALYSIS RPT ITEMS 1-3
LEV 3			(.05)			(.13)		31DEC63	E	
22300	19,600	20,500	(900)	35,200	39,650	(4,450)	0.0	31DEC63	L	
NOSE FAIRING								10DEC64	S	ITEM 6
LEV 4			.07					10JUN63	E	
22310	27	25	2	175	175		8.6	10AUG63	L	
FIRST STAGE								30APR64	S	ITEMS 9-12
LEV 4			.04			(.05)		31DEC63	E	
22320	6,700	6,400	300	9,200	9,700	(500)	0.0	31DEC63	L	
SECOND STAGE								15JUN64	S	ITEM 15
LEV 4						(.02)		31DEC63	E	
22330	1,645	1,650	(5)	3,500	3,570	(70)	0.0	31DEC63	L	

TIME NOW

Figure B-3. PERT/Cost Management Summary Report.

is the T_L value at event No. 12 (in this case 91), minus the activity time for activity 10–12 (in this case 5), which gives a latest time for event No. 10 of 86. When an event is a burst point (comparable to a merger point for T_E calculations), all paths leading back to that event must be considered and the one with the lowest time value selected. For example, the latest time (T_L) for event No. 4 is 10, following the path from 6 to 4. Following path 8 to 4 would give a T_L of 17 at No. 4, and path 5 to 4 would give a T_L of 17 at No. 4. Path 6 to 4 gives the lowest value for T_L at No. 4, so path 6 to 4 is selected and the latest time for event No. 4 is 10.

g. Event Slack (t'). The third step is to determine the slack for each event on the network diagram. Event slack, represented by t', is the difference between the latest time value and the earliest time value at the particular event, or $t' = T_L - T_E$. The slack at each event on the network diagram is determined by making the calculation indicated above (fig. B–2). It can be noted that, for some events, a zero slack condition exists. This indicates that the earliest and latest times for these events are identical. These points of zero slack help to determine the critical path, as points of zero slack fall on the critical path.

h. Gross Scheduling. As a result of the above calculations to determine the critical path, basic information now exists for preparing gross schedules. The earliest time, T_E, for the final event is compared with the directed date. If the T_E date exceeds the directed date, reevaluation of the network is required to reconcile this difference. When this reconciliation has been made, estimates of the costs and resources for that particular plan are prepared.

B–2. PERT/Cost Reports

a. General. The basic information generated in the PERT/Cost technique may be summarized in several ways for reporting purposes. All PERT/Cost reports are interrelated in that they have a common foundation of network activities, Work Packages, and related time and cost data. However, each report emphasizes different levels, items, or aspects of the project. The PERT/Cost reports given below are among the most important, and will provide the manager with timely information on the time and cost status of his project.

b. Management Summary Report. The PERT/Cost Management Summary Report (fig. B–3) shows current and projected schedule and cost status of the total project and/or the individual contract and each of the major component items or elements within the project. The report is prepared at several levels of the Work Breakdown Structure. It may be prepared for all contracts or for a specified combination of contracts, depending upon the needs of management. The report may be machine-produced, but when it is manually prepared, the necessary information is derived from the Program/Project Status Report *c* below. The first line of each Management Summary Report shows (in the title block) significant information, such as contract number and reporting organization, for a summary item. Subsequent lines show each subdivision of that summary item at the next lower level of the Work Breakdown Structure. Thus, each page of the report is usually divided for distribution to appropriate Government and contractor managers.

c. Program/Project Status Report. The Program/Project Status Report (fig. B–4) is a comprehensive, computer-produced report. It is organized to reflect the end-item Work Breakdown Structure and provides time and cost information from the Work Package level up to the top of the Work Breakdown Structure. The first line of this report presents data for the summary item shown in the title block. Subsequent lines show all subdivisions of that item down to the Work Package levels (Work Packages may appear at different levels of the Work Breakdown Structure). The primary purpose of the Program/Project Status Report is as a backup for the Management Summary Report. The two reports contain similar information, but where the Management Summary Report highlights information for the manager, this report retains detail for the analyst.

d. Organization Status Report. The Organization Status Report (fig. B–5) provides operating-level contractor managers with a detailed

PERT/COST
PROGRAM/PROJECT STATUS REPORT

	REPORTING ORGN.	CONTRACT NO.	REPORTS CONTROL SYMBOL: BOB 22-R-236
ABC - MISSILE AND GHE	XYZ - A&S DIVN	33(600)28369A	TERM (SPAN): TOTAL PROGRAM
LEVEL/SUMMARY ITEM: 4/FIRST STAGE 22320			CUT OFF DATE: 30MAR63
			RELEASE DATE: 10APR63

IDENTIFICATION				TIME STATUS			COST OF WORK $(000)					
							WORK PERFORMED TO DATE			TOTALS AT COMPLETION		
CHARGE OR SUMMARY NUMBER	LEVEL	FIRST EVENT NO.	LAST EVENT NO.	SCHED OR ACT (A) COMPL DATE	EARLIEST & LATEST COMPL DATE	MOST CRIT SLACK (WKS)	VALUE	ACTUAL COST	(OVERRUN) UNDERRUN	PLANNED COST	LATEST REVISED ESTIMATE	PROJECTED (OVERRUN) UNDERRUN
FIRST STAGE 22320	4	12000999	12000199	30APR64	31DEC63 31DEC63	0.0 12000612	6,700	6,400	.04 300	9,200	9,700	(.05) (500)
INSTRUMENTATION 22322	5	12000700	12000400	10JAN64	31DEC63 31DEC63	0.0 12000612	165	172	(.04) (7)	415	430	(.04) (15)
POWER CABLE ASSY. 22323	5	12000899	12000800	15FEB64	15JUN63 15JUN63	0.0 12000783	270	200	.26 70	1,250	1,180	.06 70
ELECTRICAL DESIGN 32164	6	12000700	12000420	25JUL63	10JUN63 25JUN63	2.1 12000682	110	112	(.02) (2)	205	209	(.02) (4)
ELECTRICAL DESIGN 32165	6	12000869	12000860	12JAN64	15JUN63 15JUN63	0.0 12000783	22	20	.10 2	175	175	
MANUFACTURING 52073	6	12000690	12000410	22AUG63	10JUN63 25JUN63	2.1 12000682	55	60	(.11) (5)	125	137	(.10) (12)
TESTING 78340	6	12000622	12000400	10JAN64	31DEC63 31DEC63	0.0 12000612				85	84	.01 1

Figure B–4. PERT/Cost Program/Project Status Report.

PERT/COST
ORGANIZATION STATUS REPORT
BY RESP ORGN, CHARGE NUMBER, PERF ORGN, RES CODE

	REPORTING ORGN.	CONTRACT NO.	REPORTS CONTROL SYMBOL: BOB 22-R-236
ABC - MISSILE AND GHE	XYZ - A&S DIVN	33(600)28369A	TERM (SPAN): TOTAL PROGRAM
LEVEL/SUMMARY ITEM: 3/BALLISTIC SHELL 22300			CUT OFF DATE: 30MAR63
			RELEASE DATE: 10APR63

IDENTIFICATION				MANHOURS				DIRECT COSTS $(000)				TIME	
				WORK TO DATE	TOTALS AT COMPLETION			WORK TO DATE	TOTALS AT COMPLETION				
CHARGE NUMBER	RESP ORGN	PERF ORGN	RES CODE	ACTUAL	PLANNED	LATEST REVISED ESTIMATE	PROJECTED (OVERRUN) UNDERRUN	ACTUAL	PLANNED	LATEST REVISED ESTIMATE	PROJECTED (OVERRUN) UNDERRUN	MOST CRIT SLACK (WKS)	SCHED OR ACT(A) COMPL DATE
ELECTRICAL DESIGN, INSTRUMENTATION	2217												
32164		2217	E1	16,900	30,000	31,100	(1,100)	41	90	94	(4)	2.1	25JUL63
			E2	16,800	20,000	20,100	(100)	40	60	60			
		4422	A10	3,500	7,000	7,000		12	25	25			
			M60					5	5	5			
		5514	D1	1,200	5,000	5,000		5	15	15			
			[illegible]	2,800	3,300	3,300		9	10	10			
											(.02)		
TOTAL								112	205	209	(4)		
ELECTRICAL DESIGN, PWR CABLE ASSY													
32165		5514	D1	2,200	4,200	4,200		6	12	12		4.2	15JUL63
											.04		
	TOTAL							1,300	2,600	2,500	100		

Figure B-5. PERT/Cost Organization Status Report.

PERT/COST
FINANCIAL PLAN AND STATUS REPORT
BY MONTH, CHARGE NUMBER

	REPORTING ORGN.	CONTRACT NO.	REPORTS CONTROL SYMBOL: BOB 22-R-236
ABC - MISSILE AND GHE	XYZ - A&S DIVN	33(600)28369A	TERM (SPAN): TOTAL PROGRAM
LEVEL/SUMMARY ITEM: 4/FIRST STAGE, BALLISTIC SHELL 22300			CUT OFF DATE: 30MAR63
			RELEASE DATE: 10APR63

MONTH	CHARGE NUMBER	INCREMENTAL COST $(000) ACTUAL	PLANNED	LATEST REVISED ESTIMATE	(OVER) UNDER PLAN	CUMULATIVE COST $(000) ACTUAL	PLANNED	LATEST REVISED ESTIMATE	(OVER) UNDER PLAN	Remarks
PRIOR	32163					24	24	24		Value of Work Performed to date 1) CUM to CUT OFF $6,700,000 2) Latest Month $275,000
	32164					92	93	92	1	
	52072					12	12	12		
	52073					2	8	2	6	
	78339						2		2	
	TOTAL					6,150	6,200	6,150	50	(Over) under run for Work Performed to Date $300,000
MAR63	32163	1	1	1		25	25	25		
	32164	20	19	20	(1)	112	112	112		
	52072	3	2	3	(1)	15	14	15	(1)	
	78339	2	2	2		2	4	2	2	
	TOTAL	250	300	250	50	6,400	6,500	6,400	100	
APR63	32163		1	1			26	26		
	32164		2	6	(4)		16	21	(5)	
	TOTAL		98	140	(42)		6,598	6,540	58	
TOTAL PERIOD						6,400	9,200	9,700	(500)	

Figure B–6. PERT/Cost Financial Plan and Status Report.

PERT/COST

COST OF WORK REPORT

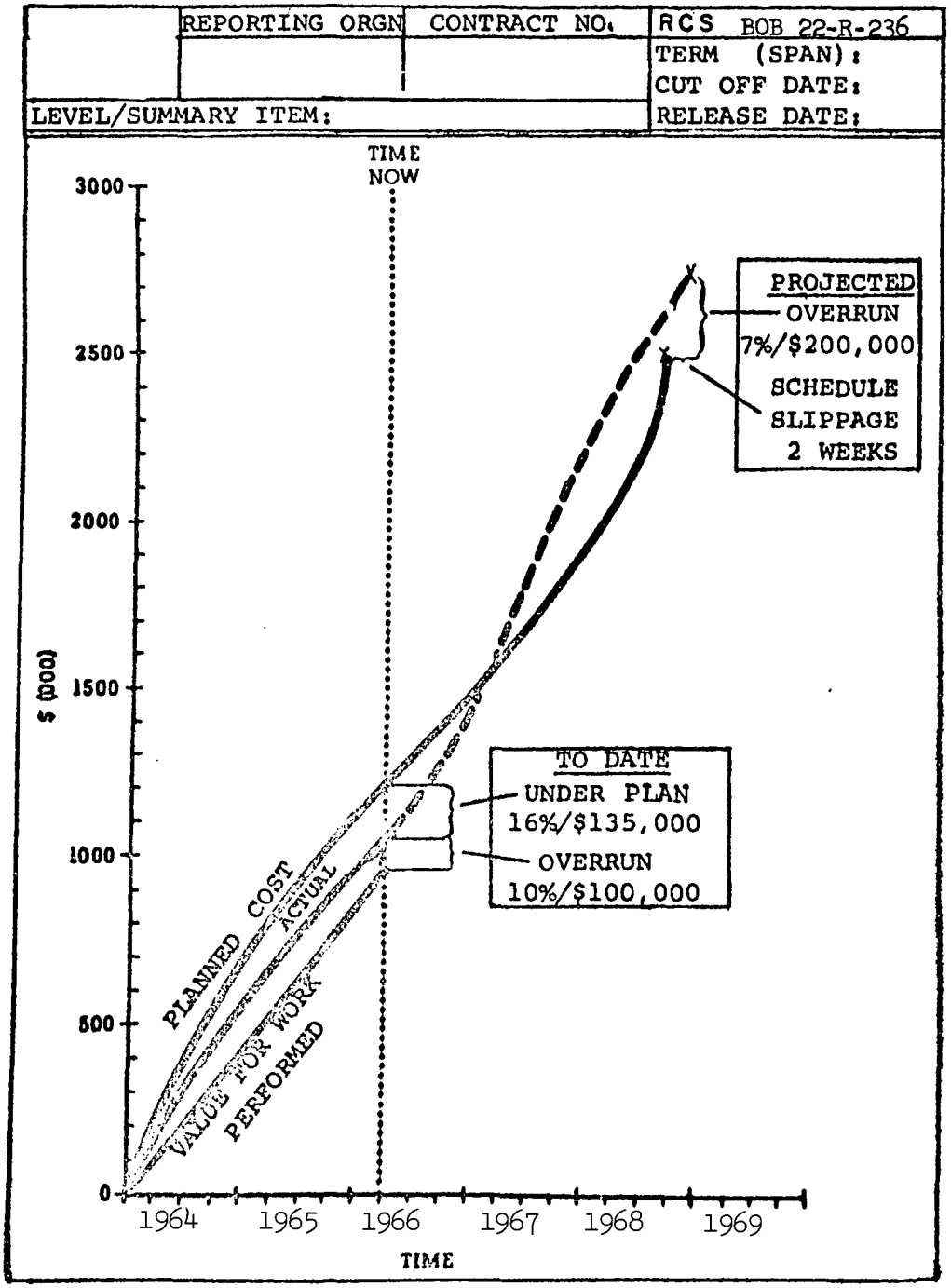

Figure B-7. PERT/Cost Cost of Work Reports.

PERT/COST
COST OUTLOOK REPORT

	REPORTING ORGN.	CONTRACT NO.	REPORTS CONTROL SYMBOL: BOB 22-R-236
			TERM (SPAN):
			CUT OFF DATE:
LEVEL/SUMMARY ITEM:			RELEASE DATE:

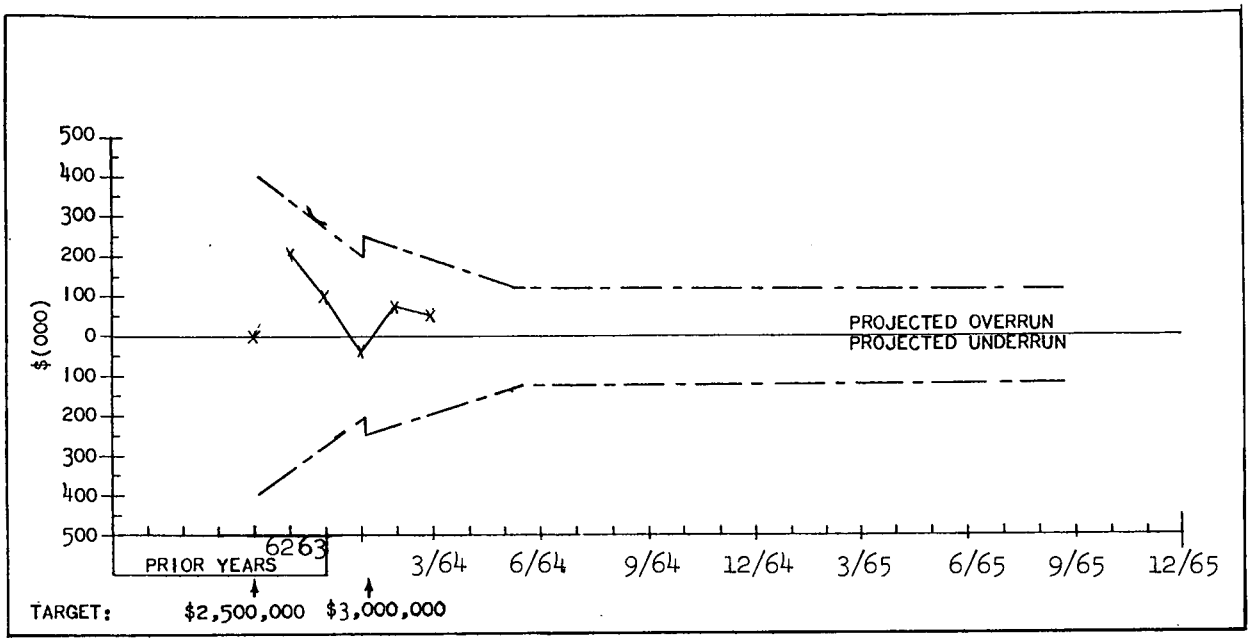

Figure B–8. PERT/Cost Cost Outlook Report.

breakdown of information from the store of data available in the PERT/Cost computer program. Several types of report may be produced within this format by changing the sorting sequence of "Charge Number," "Responsible Organization," "Performing Organization," and "Resource Code." A summary report by performing organization may be prepared for the manager's use.

e. Financial Plan and Status Report. The Financial Plan and Status Report (fig. B–6) provides data for a monthly comparison at any given level, of actual and/or latest revised estimates against planned costs, and thus serves as a tool for monitoring financial plans. Historical (prior-month) cumulative costs are shown for each charge number. Both incremental and cumulative costs by charge number are shown for each future month within the time period identified in the "Report Dates" block. The report is prepared for higher levels of management by printing only totals for each month.

f. Cost of Work Report. The Cost of Work Report (fig. B–7) is a graphic equivalent of the Financial Plan and Status Report. In addition, it shows the distribution of actual cost and the "Value for Work Performed" (see Army Materiel Command Regulation 11–16 for further explanation of Value for Work Performed). The Cost of Work Report is manually prepared each month from data contained in the Financial Plan and Status Report.

g. Cost Outlook Report. The Cost Outlook Report (fig. B–8) shows for any given level and summary item the projected cost status at work completion. It also shows what the projected cost was at every cycle previous to the current one, and thus provides for the recognition of trends. Every month new projections are obtained from the Management Summary

PERT/COST
SCHEDULE OUTLOOK REPORT

	REPORTING ORGN.	CONTRACT NO.	REPORTS CONTROL SYMBOL: BOB 22-R-236
			TERM (SPAN):
			CUT OFF DATE:
LEVEL/SUMMARY ITEM:			RELEASE DATE:

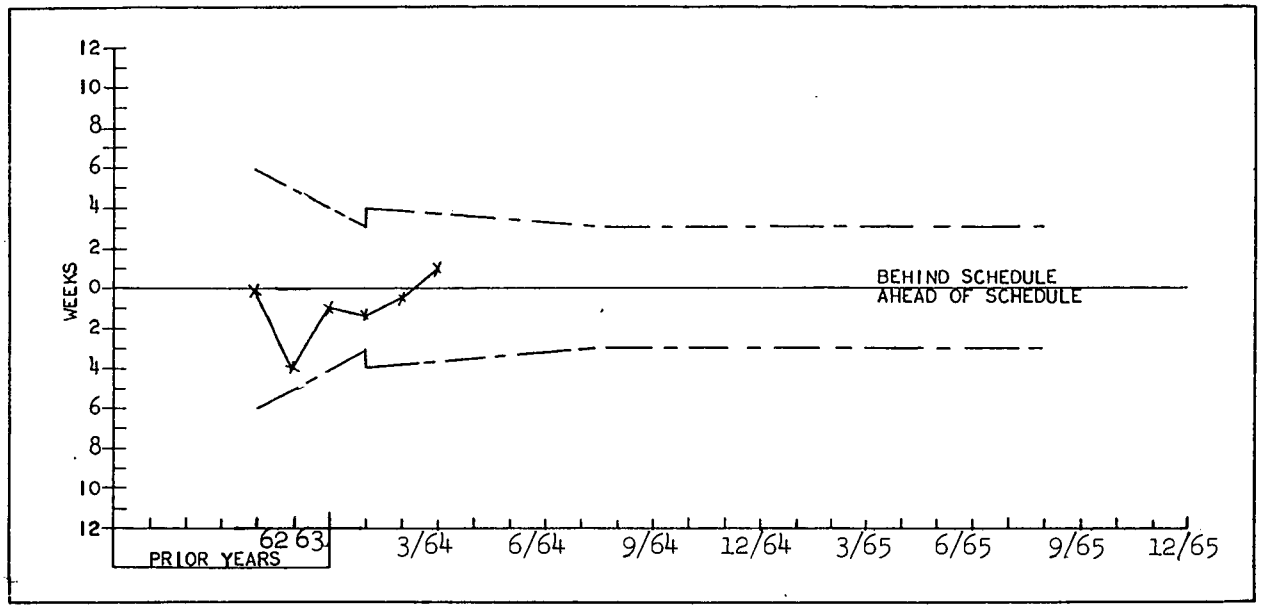

Figure B-9. PERT/Cost Schedule Outlook Report.

Report to provide new entries for the Cost Outlook Report. This report is manually prepared by periodically plotting the projections obtained. The projections may be plotted by month for 2 years, after which the report is redrawn to show previous projections condensed by year. Limit lines, established by the manager for each project, identify the values of overrun or underrun that require analysis to be submitted in narrative form.

h. Schedule Outlook Report. This report is similar in format to the Cost Outlook Report. It relates to project schedule status at work completion. An example of the Schedule Outlook Report is shown in figure B-9.

INDEX

By Order of the Secretary of the Army:

HAROLD K. JOHNSON,
General, United States Army,
Chief of Staff.

Official:

KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

Distribution:

To be distributed in accordance with DA Form 12–11 requirements for Logistics Materiel Management Requirements.

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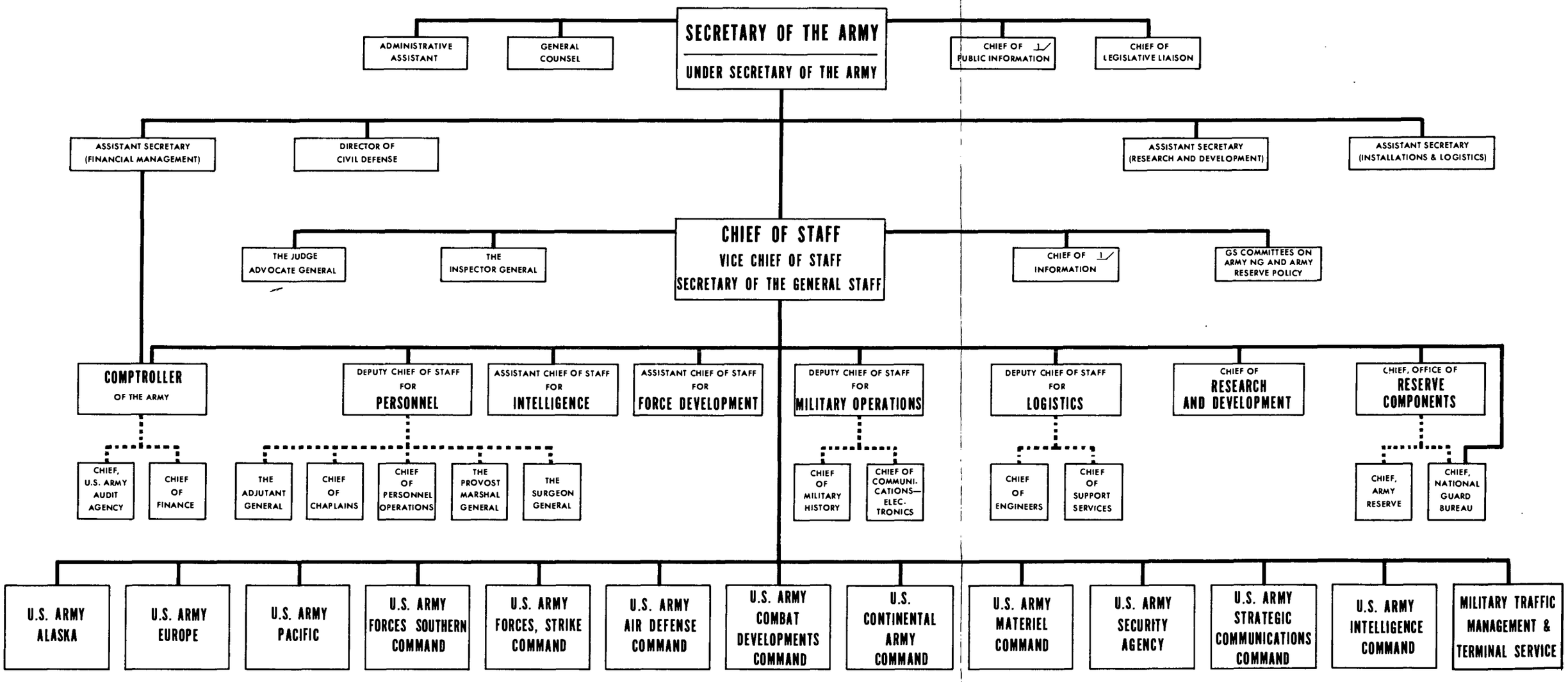
ORGANIZATION OF THE DEPARTMENT OF THE ARMY



1/ THE CHIEF OF PUBLIC INFORMATION ALSO SERVES AS CHIEF OF INFORMATION.

Figure 4–1. Organization of the Department of the Army.