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ABSTRACT

A summary is provided of the status of Phase I of the three-stage project, "Design of Training Systems" (DOTS). The purpose of the overall project is described as being to introduce the technologies of education, psychology, management and operations research into the management of Navy training. Phase I of the effort is designed to provide a functional description of the current Navy Education and Training Systems (NETS), and to recommend system improvements. Phase II is structured to select, design, develop and validate computer models to assist managers in planning and decision-making, and Phase III to field test the models developed in the previous stage. This report lists the major goals of the project, provides background information on its organization, and discusses the project's management and control. Specific details on the project are provided in the two volumes of the Training Analysis and Evaluation Group (TAEG) Report 12-1 (see documents IR 000 503 and IR 000 504). (PB)

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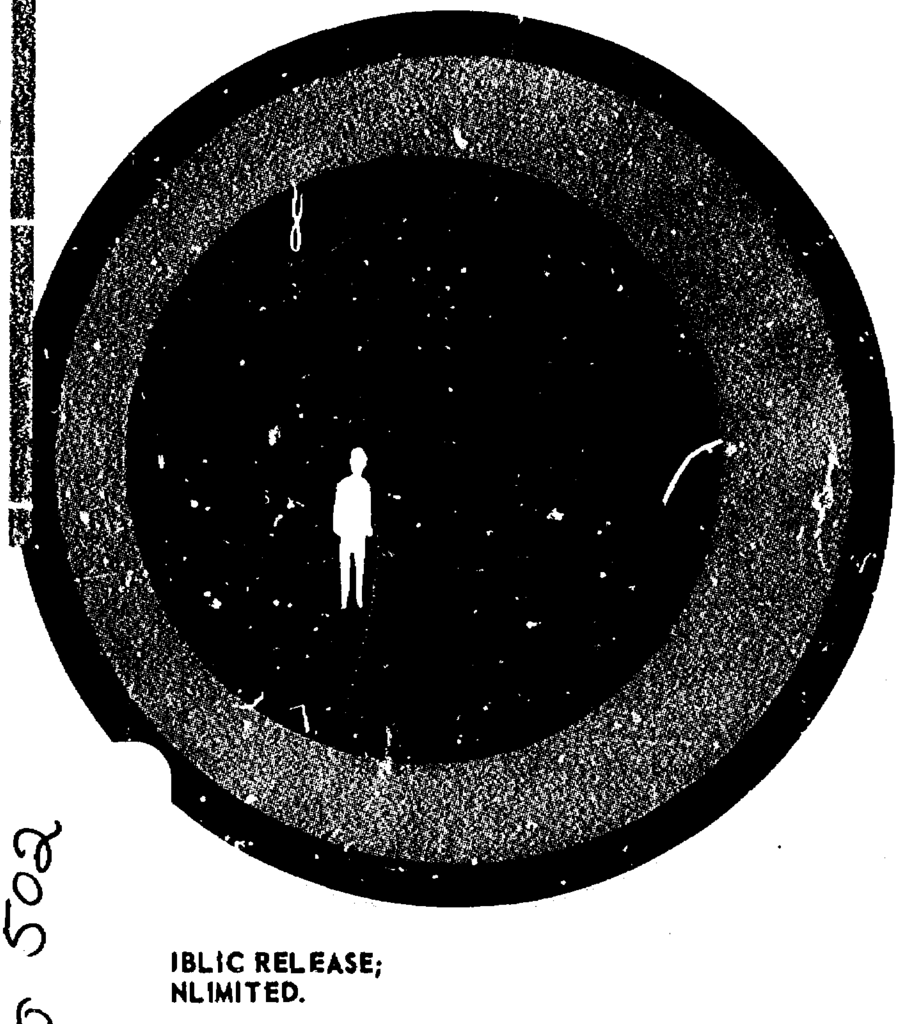
AND
EVALUATION
GROUP

TAEG REPORT NO. 11-1

DESIGN OF TRAINING SYSTEMS PHASE I
SUMMARY REPORT

ED 089777



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ORLANDO, FLORIDA 32813

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Technical Report: TAEG REPORT NO. 11-1

DESIGN OF TRAINING SYSTEMS
PHASE I SUMMARY REPORT

ABSTRACT

This report is the first in a series of reports concerned with the "Design of Training Systems" (DOTS) project. This report provides a summary of the status of the first phase of a three phase study.

A summary of observations and action items relative to the Phase I effort is also presented.

The appendices contain a broad overview of the project office efforts in describing: (1) the Navy Education and Training System, (2) educational technology innovations, and (3) existing modeling and simulation efforts.

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NAVTRAEQUIPCEN TAEG REPORT NO. 11-1

DESIGN OF TRAINING SYSTEMS
PHASE I SUMMARY REPORT

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December 1973

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FOREWORD

This report is the first in a series of planned reports concerned with the Training Analysis and Evaluation Group's (TAEG's) effort undertaken in partial fulfillment of the requirements of the Technical Development Plan (TDP) for Advanced Development Objective (ADO) 43-03X, "Education and Training," Part 01A, "Design of Training Systems."

A summary of the status of the project through Phase I is presented. The purpose of the report is to describe the goals of this three phase advanced development effort and to outline the manner in which the goals are being achieved.

An interdisciplinary project team from the TAEG of the Naval Training Equipment Center (NAVTRAEQUIPCEN) prepared the report. The team consisted of Mr. W. Lindahl, Operations Research Specialist; Mr. T. McNaney, Education Specialist; Mr. H. Okraski, Project Team Leader; and Dr. W. Rankin, Psychologist.

Appreciation is expressed to the members of the Project Working Group who provided guidance and served as input/output interfaces between the project personnel, the Naval Education and Training Command, and other organizations.

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INTRODUCTION

PURPOSE

This report provides a summary of the status of the advanced development project, "Design of Training Systems" (DOTS) Phase I. The project is Part 01A of the Technical Development Plan (TDP) for Advanced Development Objective (ADO) 43-03X.

The purpose of the report is to describe the goals of this three-phase advanced development effort and to outline the manner in which the goals are being achieved. In addition, background information pertinent to the organization and development of this project is presented which describes the impetus for change in Navy training.

The Phase I report places emphasis on the management and control of the project. Specific findings of the study are not presented since they are reported in TAEG Report No. 12-1 (1973),[1] prepared by the International Business Machines Corporation (IBM) under contract to the Naval Training Equipment Center (NAVTRAEQUIPCEN).

ORGANIZATION OF PROJECT

This study was conceived in an effort to introduce the technologies of education, psychology, management, and operations research into the management of Navy training. Because of the magnitude and diversity of the project, it was necessary to contract for a significant portion of the work. It was vital that the contract be awarded to a firm having

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[1] Design of Training Systems Phase I Report. Vols. 1 and 2. TAEG Report No. 12-1. December 1973. Naval Training Equipment Center, Orlando, FL.

a demonstrated capability in each of the technical areas mentioned, plus a familiarity with some aspects of military training. The offerors submitted proposals for a three-phase effort to span a time period of approximately three years. The successful bidder was the IBM Corporation.

The study is managed by the Training Analysis and Evaluation Group (TAEG) of the NAVTRAEQUIPCEN, Orlando, Florida. The TAEG is the Project Office for the DOTS project. The Federal Systems Division of IBM was responsible for the Phase I effort and conducted the study primarily at their Cape Canaveral, Florida, facility. Relationships were established between the contractor and the Project Office and, additionally, a management structure consisting of all cognizant organizations was established. The project management structure is described in detail in section II of this status report.

SECTION II

PROJECT MANAGEMENT

APPROACH

The project is divided into three phases, with the major milestones shown in figure 1. The purpose of Phase I was to provide a data base which reflects the current Navy Education and Training System (NETS). Phase I also includes recommendations for system improvement and a list of recommended computer based models to be developed in Phase II. A functional description of the NETS was derived through literature searches and personal interviews made at various education and training sites. The activities visited in Phase I are depicted in figure 2. Phase II entails the selection, design, development, and validation of computer models. The models will assist managers at various levels in planning and decision-making processes. Phase III is primarily a test and evaluation phase. The models developed during Phase II will be further validated and verified at a field site(s) using real-world data.

DATE	MILESTONE
16 MARCH 1972	SUB-PROJECT ASSIGNED TO NAVTRAEQUIPCEN
1 FEBRUARY 1973	CONTRACT AWARDED FOR PHASE I
29 JUNE 1973	COMMENCE PHASE II
1 DECEMBER 1973	END PHASE I
29 SEPTEMBER 1974	END PHASE II
1 OCTOBER 1974	START PHASE III
1 OCTOBER 1975	END PHASE III

Figure 1. TDP 43-03X PO1A Milestones

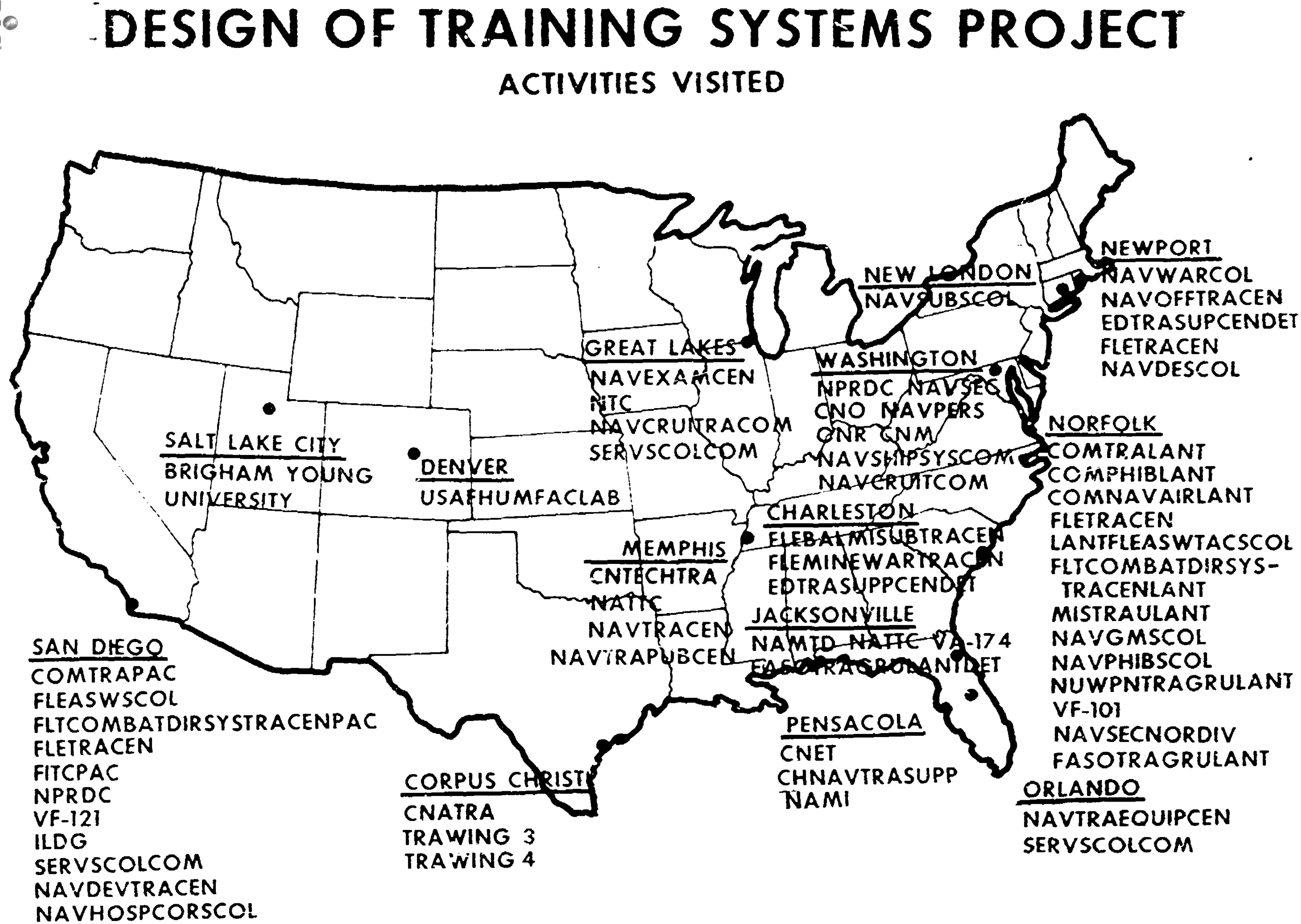

Figure 2. Activities Visited

PROJECT STRUCTURE

Very early in the project a team composed of many organizational entities was established by the Project Office to assist in developing the program. The resultant project structure is indicated in figure 3.

The Working Group members represent the Chief of Naval Education and Training (CNET) Functional Commands and the CNET staff. The Working Group functions are to:

a. Provide guidance to the Project Office.

b. Serve as input/output interfaces between their organizations and other project individuals.

c. Participate in test and evaluation.

d. Oversee system implementation.

The Advisory Committee consists of members from the various codes within the Chief of Naval Operations (CNO), representatives from Echelon II command organizations, and the Principal Development Agency (PDA) which is the Navy Personnel Research and Development Center (NPRDC). The functions of this committee are to:

a. Insure that the goals and progress of the project are in harmony with advanced development criteria.

b. Direct project personnel to appropriate organizations/ individuals.

c. Serve as input/output interfaces for their organization.

d. Outline potential pitfalls that might confront project personnel in their efforts.

e. Assist in promulgating instructions/directives for system implementation.

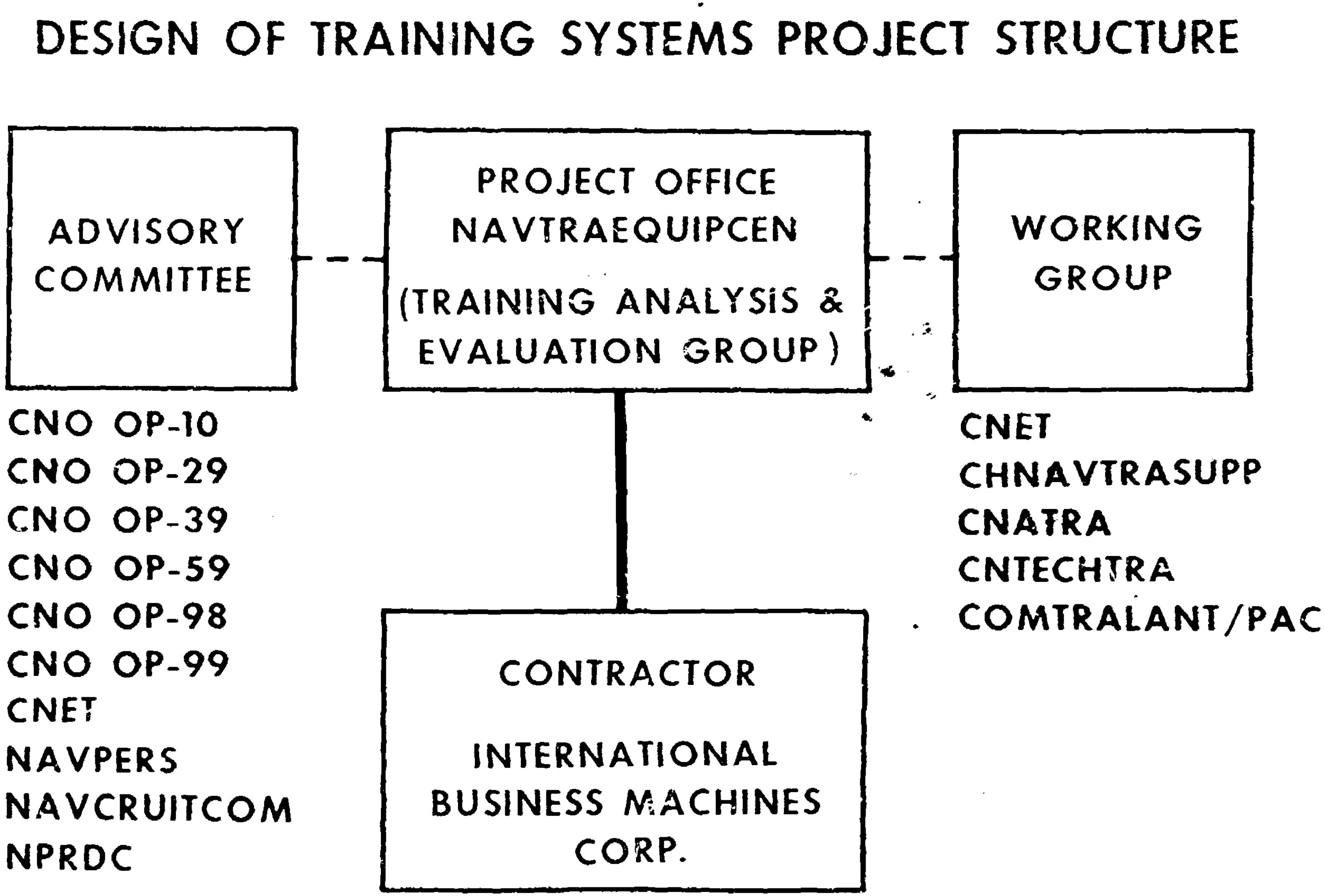

Figure 3. Design of Training Systems Project Structure

During Phase I the Working Group and Advisory Committee were utilized extensively.

The IBM study team, presented in figure 4, is comprised of experts in the disciplines required for the task. In addition, the contractor established and exercised an Advisory Group comprised of high-level corporate executives and consultants in the fields of education and training. This group was especially effective in developing the broad strategic assumptions and providing consultation in such areas as task analysis. The mission of IBM was to perform in accordance with a detailed statement of work contained in the contract.

Shortly after contract award, the contractor was required to submit a Management Support Plan which outlined specific plans for conducting the project. This plan is updated monthly and furnished to members of the Working Group. Similar plans will be required for Phases II and III. Contractor Progress Reports are also provided on a monthly basis. The IBM Report for Phase I is identified as TAEG Report No. 12-1. The contractor will also publish a report at the conclusion of Phase II.

The representatives of the disciplines were selected by the Project Office to manage the project and mirror those of the contractor. The TAEG team, presented in figure 5, managed and controlled the project by providing data and guidance to the contractor, establishing points of contact within CNET and the Fleet, and serving as a resource to the contractor.

In addition, the Project Office (1) described the NETS as a collection of subsets, (2) conducted a survey of existing and proposed training systems and educational technology innovations, and (3) conducted a

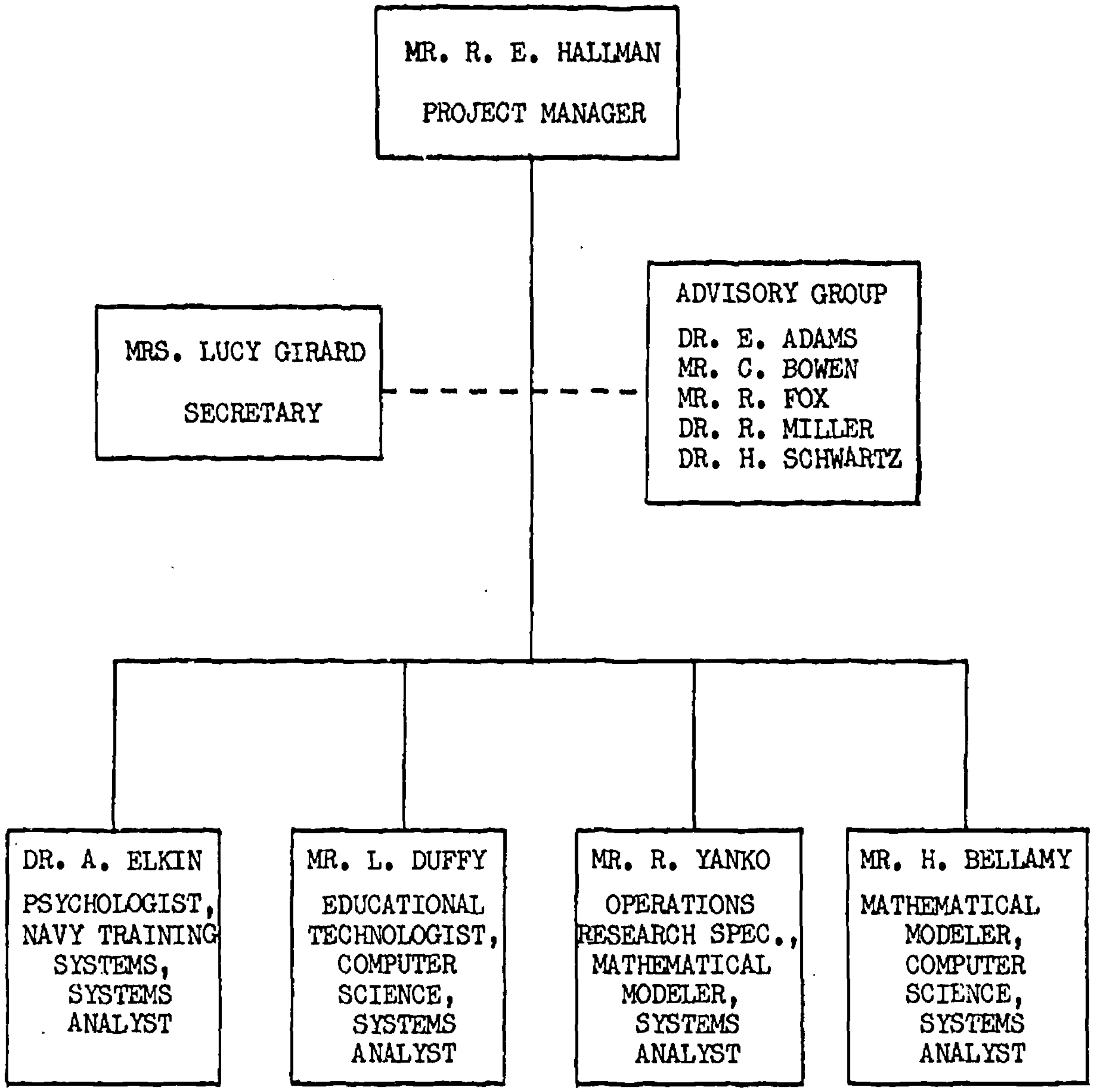

Figure 4. IBM Study Team

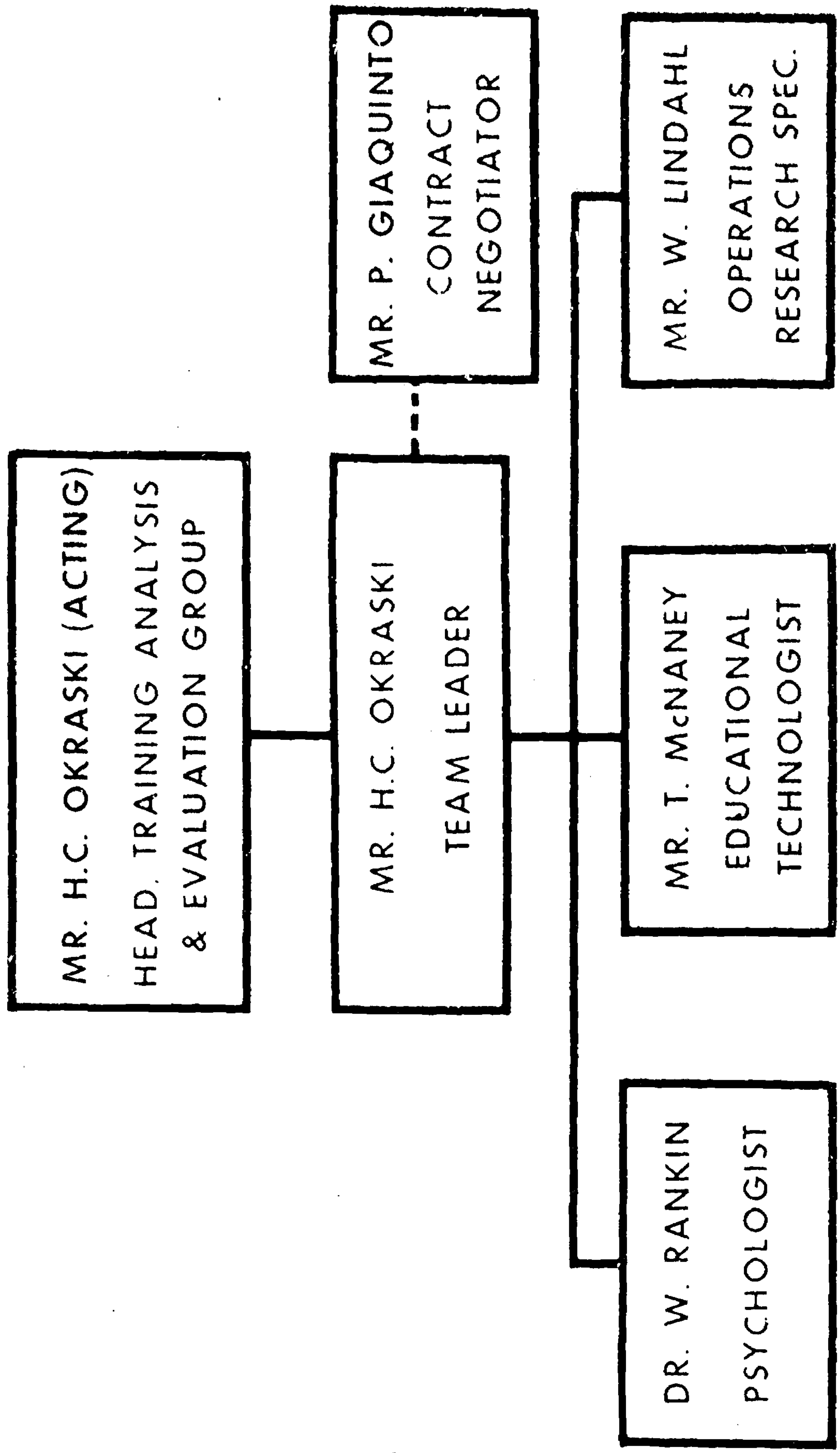

Figure 5. Project Office Team

survey of existing models and developed a computerized simulation model of a proposed individualized, self-paced training system, utilizing the General Purpose Simulation System (GPSS). A broad overview of the "in-house" efforts is presented in the appendices. An in-depth report on the simulation system will be the subject of a future report.

SECTION III

BACKGROUND

ADVANCED DEVELOPMENT OBJECTIVE 43-03X

In 1966, the ADO 43-03X, "Education and Training Development," was promulgated by the Chief of Naval Operations (CNO). The ADO recognized that operational readiness is a function of the Navy's education and training programs and that training policies, plans, and programs were not fully capable of meeting current or future training requirements with reasonable levels of effectiveness or efficiency. The costs of providing necessary training were excessive for achieving and maintaining proficiency. Exploratory development programs, meanwhile, had yielded techniques that were candidates for advanced development and were ready for exploitation. Among these were modeling analyses, use of computer-aided instructional procedures, and procedures for developing training objectives and training quality control programs.

The ADO stated that available simulation and modeling technologies were to be integrated and tested for the purpose of achieving training goals which have Fleet-wide implications. Specific projects were identified which would consider approaches for relating Navy training systems' capabilities to fleet readiness capabilities, for predicting future Navy-wide training requirements, and for planning supporting peacetime and mobilization programs for achieving both mid-range and long-range training goals. In the ADO, 22 training areas were identified as "test beds" for assessing the new technologies. Many of the areas outlined are of concern to CNET since most of the Navy training responsibilities are now under the cognizance of the Naval Education and Training Command and its functional commands.

Subsequently, the TDP 43-03X, "Education and Training Development," was prepared by the Bureau of Naval Personnel (BUPERS) in response to the broad objectives stated in the ADO. Funding was provided by CNO. The TDP identified several technological areas that were to be examined and tested in an effort to improve Navy training. Part 01A of the TDP, entitled, "Design of Training Systems," addressed the total universe of Navy training management, i.e., recognized that advances in operations research, system analysis, management science, and educational technology have yet to be considered in the management of training within the Navy. The TDP goal was to provide training managers, at all levels, with an effective decision-making capability and to provide alternate paths and strategies in the decision-making process. In addition, the need for a capability to simulate the effects and outcomes of these decisions was articulated.

The task of implementing the DOTS Sub-project (Part 01A of the TDP) was assigned to TAEG. The NPRDC, San Diego, California, is the Principal Development Agency for TDP 43-03X.

DESIGN OF TRAINING SYSTEMS

The objective of the "Design of Training Systems" (Part 01A of the TDP) is to improve the management of the Navy's training system by providing an expanded decision-making capability for all levels of training management. The achievement of the capability will be manifest in the form of mathematically-derived, predictive, analytic models. These models, if adequately supported and properly executed, can serve to increase the effectiveness of the educational and training program. The models provide the training manager with tools capable of dealing with the various social and economic factors and with the technological advances that will impinge on Navy training through the 1980 decade.

In order to accomplish this objective, a broad conceptual framework for the total NETS was constructed. This was used as a base from which to develop a series of interrelated mathematical models which will serve as aids in the solution of various management problems associated with functional components of the system. It will be necessary to develop ways for achieving interactions between and among these models and for interfacing with existing models, utilizing current and to-be-developed data bases. The focus of the effort for achieving the stated objective is CNET.

IMPETUS FOR CHANGE IN NAVY TRAINING

a. Establishment of the Naval Training Command. On 8 February 1971, the Naval Training Command Board was convened for the purpose of developing a plan for the establishment of a single Naval Training Command. This action was taken as a result of a letter directive addressed to Rear Admiral M. W. Cagle from Vice Admiral D. H. Guinn, Deputy Chief of Naval Operations (M&NR). The five-month study conducted by the Board confirmed the fact that the management of training was fragmented and lacked central control and that a strong focal point for Navy training was not established in CNO. In summary, the recommendations of the Board were:

(1) Establish a Director of Naval Education and Training (DNET) at the CNO Staff level.

(2) Establish strong training divisions in CNO (OP-02, 03, 05).

(3) Retain medical education and training under the Chief, Bureau of Medicine and Surgery.

(4) Establish the Chief of Naval Training (CNT) based at Pensacola, Florida, upon the structure of the Chief of Naval Air Training (CNATRA) staff.

(5) Place education institution and programs then under the BUPERS under DNET.

In August 1971, the offices of Chief of Naval Training and Director of Naval Education and Training were established in Pensacola, Florida, and Washington, D. C., respectively. The consolidation of training management is taking place at the Navy Education and Training Command (NETC). At the NETC, training is being examined and developed on a more systematic basis. The techniques of task and training analyses are being applied in the design and the utilization of training systems. Individualized instruction, computer aided instruction, and the expanded use of audio-visual/multi-media instructional packages are being considered for integration into training systems.

The issue that emerges concerns the ability of a newly formed organization to assume a role of leardership and formulate policy. For this organization to be effective, a premium must be placed upon providing officers/managers with decision-making tools necessary to make valid decisions and on training the officers responsible for manning the organization. Hopefully, the output(s) of the current project will partially fill these requirements and augment the professionalism required of training management.

b. The Climate of Today. The current trend in society of focusing on the individual is also pertinent to the Navy training community. Meeting the needs of the individual and simultaneously achieving the job requirements is the goal of the future Navy. However, this can only come about by restructuring the work environment to accommodate both objectives.

The human input to the training system is also changing as a function of the zero-draft condition of an all-volunteer force. Holding all other things constant, the change in the characteristics and quantity of input population will require a modification of training methods. The success of the volunteer force will be largely a function of society's attitude toward the military, in general, and the ability to retain those individuals who can contribute effectively during a Naval career.

c. Technological Advances Impacting Navy Training. When new technologies are developed, they are quickly recognized as innovations. However, forecasting the impact of these technologies is not easy. For example, who could foresee the tremendous impact of television not just on training but on our daily lives? Thus, the problem of preparing for new technologies in the Navy training system is a complex one.

There are new technologies continually coming into being whose immediate impact on Navy training is hardly discernible. What is important is not merely the recognition of these new technologies but also the recognition of their impact on training and how to prepare for that impact. For example, TAEG Report No. 12-1 (1973) attempts to identify potential technologies and describes how to prepare for their impact on Navy training. An appendix to that report presents strategic assumptions relevant to training through the 1980's. Included are assumptions directly related to the development and implementation of new technologies, e.g., satellites used for Electronic Counter-Counter Measures (ECCM). The list is not exhaustive but provides the best projections of a representative sample of training planners. The important feature is the need for adequate preparation for technologies once their usefulness and expected impact are recognized.

The training system continues to be reactive in character because it must respond to requirements imposed by the "driving force" of new weapons systems. Weapons systems hardware complexity and tactical employment are challenging those responsible for maintaining and operating newly developed systems. The "delta" between the skills and knowledges available and those necessary for the maintenance and operation of a new sophisticated weapons system must be provided by modifying the existing training system.

Efforts are being made toward standardizing hardware components, establishing remove and replace maintenance concepts, incorporating built-in test features, and otherwise simplifying operator tasks. However, these measures in themselves do not balance out the need for increased training. For that matter, they may even add to the training required. In some instances, the full capability of a weapons system is not determined until after the system has been delivered, tested, and evaluated. This contributes greatly to the "lag" experienced between the training requirements and the training actually provided. Consequently, one should not expect, as a rule, to have the development of the training system in phase with the weapons system when new technologies or operational concepts are employed in the development of a new weapons system.

Over the last few years, a rapidly expanding training technology has led to such training media developments as programmed instruction, computer assisted instruction, audio-visual instructional carrels, and many more. These developments reflect a growing learner-centered approach to instruction, emphasizing an active approach to learning by "doing" at a pace tailored to the individual's capability. This newer approach to instruction places (1) a decreasing reliance upon intervention by any individual acting in the traditional role of the instructor, and (2) an emphasis on the content of what is to be learned in terms of "need to know," coupled with attention to strategies for sequencing the material to be learned.

In short, previous training has not always been responsive to the needs of the individual or of the job. Characteristically, people received the same training, at the same rate, whether needed or not, in a lock-step fashion. New concepts recognize the role of individual differences and that these differences are magnified by individual learning rates, experience levels, motivation, and individual abilities. Further, only job-relevant subject matter is emphasized, presented in a "learning by doing" fashion. This orientation to job requirements and responsiveness to individual differences has produced enough evidence that maximum levels of competence can be attained in signficantly shorter time periods when compared to traditional instruction. This basic philosophy is appropriate to Navy training of the future.

SECTION IV

SUMMARY

A purpose of the Phase I effort of this project is to establish a foundation for developing a set of predictive tools for use by training managers in the NETS of the near future. A summary of observations and action items relative to the Phase I effort of this program is presented below:

a. It is imperative that those responsible for implementing the models to be developed in Phase II lend their total support to this effort. It is expected that once the candidate models are identified, a great deal of coordination will be required among the Navy training activities, Project Office, and contractor. The technical problems of data base availability, hardware and software capabilities, and personnel and training requirements will have to be addressed. These items will require the cooperation of the Navy organization responsible for each model selected and developed.

b. The Chief of Naval Education and Training (CNET) Functional Commands, with the assistance of the Project Office should consider the support of these models in terms of total resources needed to implement the models. Early identification of these resources will allow better planning in terms of FY 1976 budget requirements.

c. A career-enhancing pattern for education and training management should be set up for both officers and enlisted personnel. In this regard, it is further recommended that training managers receive formal training in both the subject matter they are held responsible and accountable for and in the science of management.

d. Some form of training should be provided to training managers which will acquaint them with decision-making models, their use, and utility. This training should be made available on a trial basis prior to implementing the models developed in Phase II of this project.

e. Personnel, manpower, training and planning overlap and complement each other. The functions of these planning areas must be integrated if the NETS is to become a viable dynamic entity which is responsive to the training needs of the Fleet. The models which will be developed in Phase II of this project could provide the initial integration of these planning functions.

f. There may appear to be some overlap between this project and other ongoing education research projects such as AIS, CTS, and GENTRAS. This apparent overlap is superficial. These projects are concerned with particular aspects of training and do not approach the broad managerial scope of the DOTS project.

APPENDIX A

NAVY EDUCATION AND TRAINING SYSTEM

As a system the NETS should be amenable to levels of description and analysis. In comparison to physical and organizational systems, NETS might not be recognizable in any but the most abstract sense. Nevertheless, the whole of NETS can be decomposed into a more analytically manageable collection of subsets for description and analysis. These smaller components have the principal virtue of greater stability, for NETS has been typified by tremendous organizational volatility in staff, structure, and goals with little indication of altering such dynamic properties.

UNIVERSE OF NAVY TRAINING. All behavior required of Navy personnel that is not a part of their immediate repertoire must be acquired via human learning. Whether the management of this enterprise has as its goal formal or informal training, does not change the inclusion rule for defining this universe. It would be desirable to state that the organizational agent for NETS and this defined universe is CNET; however, there is not a complete intersection/union of the universe and CNET. Since the exceptions are few, it is parsimonious to describe the domain of CNET relative to the universe by enumerating these exceptions:

Bureau of Medicine & Surgery: Medical Education & Training

Special Projects: Submarine Weapon Systems Training
- Polaris/Poseidon
- Nuclear Power

Some Fleet Training

a. Major Dimensions of Navy Training. For some years it has been useful to classify training into three broad categories which account for human behavior relative to machinery and software or even to other humans. The fact that these three categories are self-explanatory attests to their validity and durability as useful descriptors. While the categories are distinct, it is highly unlikely that Navy personnel receive training in just one. The three categories are: (a) maintenance training; (b) operator training and (c) team training.

b. What Drives Navy Training? Another version of this question might be, "What Produces a Behavioral Deficiency in the Personnel Inventory?" Now the responses to the question come more easily: (a) Loss of trained personnel (attrition of skill), (b) Impoverished basic skill input (recruit characteristic), and (c) Technological change (hardware/software acquisition). It is clear that the human resources impact (items a. & b.) on Navy training, while non-trivial, has much less influence than item c. This is supported by the fact that human capabilities have remained relatively constant. Therefore, by deduction, it is equipment and changes in its technology that have and are likely to continue to be the driving influence on Navy training.

c. Training vs. Education. It is futile to elaborate in great detail on the definitions, similarities, and differences between training and education, since the universe of human learning encompasses both. However, the equipment impact on Navy training, alluded to above, highlights one of the major distinctions. Learning about a specific piece of gear, whether to operate or maintain it, can be considered the product of training. Learning the physics of propulsion systems (which govern a number of hardware systems) can be considered a product of education. Clearly, no planned array of learning experiences will be completely devoid of either educational or training elements. But, speaking in broader terms, most of the learning experiences one encounters in the Navy can be classed as "educational" (Naval Academy, Post-Graduate School) or "training" (MK 48 Torpedo Maintenance Course, etc).

ORGANIZATION TO MANAGE NAVY TRAINING

While it is customary to begin organizational analyses at the top of an organization "wiring diagram," this approach is extremely vulnerable to producing irrelevant results with the passage of time. A more prudent tack, yielding impressions of some endurance, is to begin at the loci of learning, be they formal, informal, school, or on-the-job settings. For this discussion, centered around management control, it is useful to regard the school house, fleet training center, or training squadron as the loci of learning environs. This approach yields the highly schematic picture of Navy Training Management depicted in figure 6. It is intended to be scrutinized from the bottom up.

THE SCHOOL. The Navy school is an organizational element subject to many of the same pressures as the public or civilian school. For example, non-military school organizations are influenced above and beyond their routine operation by political, fiscal, and social forces that are typically contravalent with respect to each other. A common instance of this is the collision of political/social goals with fiscal constraints. Autonomous planning at the school level is one approach to avoiding such collisions of external forces.

The Navy school may be directed by higher authority to create or add a new course to its curriculum without being given additional resources to accomplish such an undertaking. Consequently, the school must often

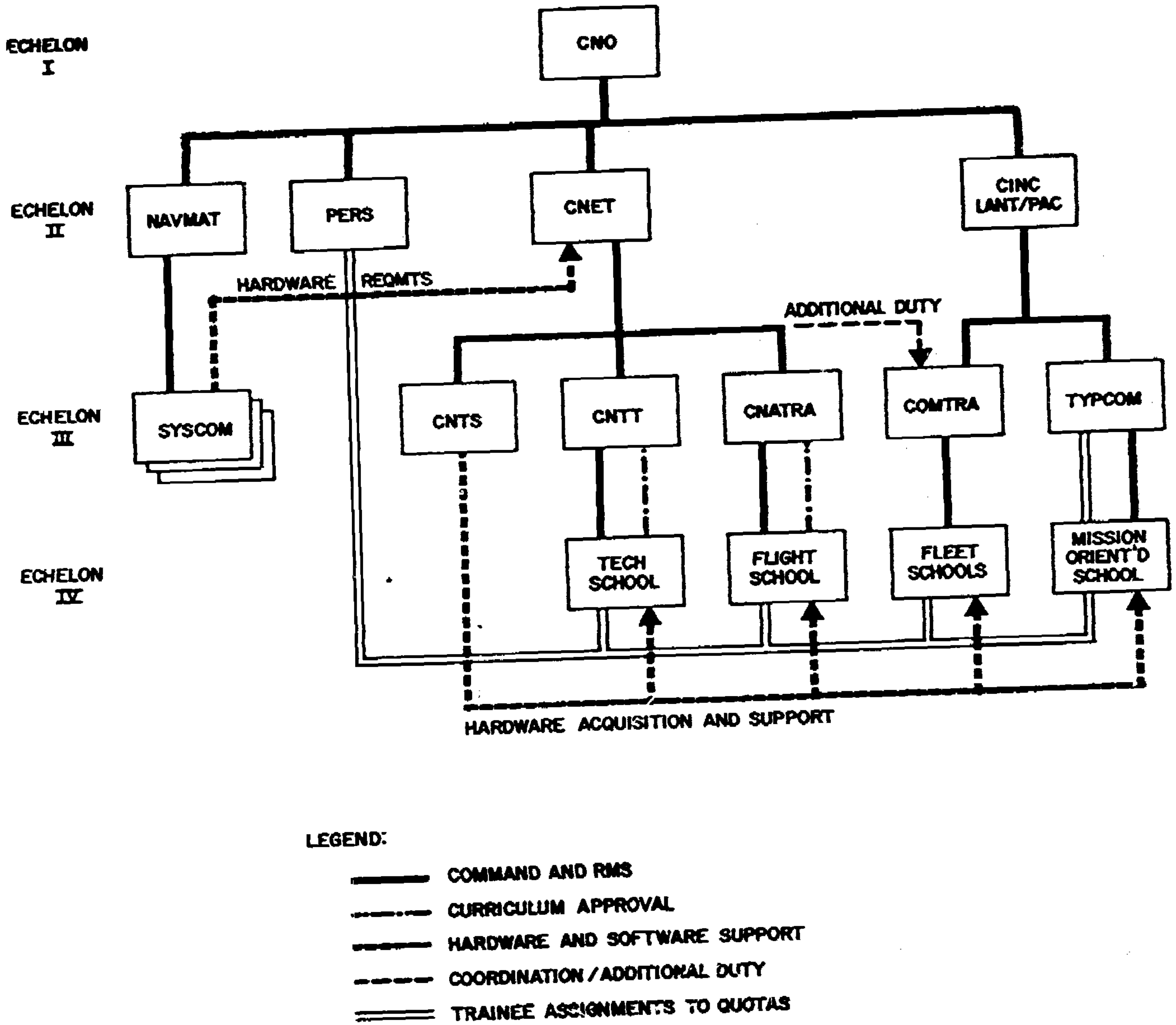

Figure 6. Navy Training Management

internally realign its priorities in order to achieve the externally imposed objective (the phrase, "take it out of your hide" is often used to describe such situations). Another example of external influence concerns the issue of quota control. Presumably, the school should have the authority to limit class size as well as establishment of entry level prerequisites, etc. to courses. At present, this is not completely true, particularly at fleet training centers where decisions to send a trainee to a short course are almost completely fleet determined.

THE FUNCTIONAL COMMANDS. At a higher level of managerial aggregation, there are a small number of commands that manage, via curriculum and/or fiscal control, a number of learning environments or provide support to them. At this level there are three major functional commands for the following:

(a) All surface/subsurface technical training.

(b) All air technical training.

(c) All basic, advanced flight training (except factory and replacement training).

(d) All training support.

In addition to what one might ordinarily expect to be derived from a management analysis of the functional commands, their relative position in the hierarchy becomes important. That is, they have a buffering and filtering influence on pressures, both internal and external, exerted downward on the learning environments. Additionally, they represent a focusing point for further amplification of the needs of those who actually operate and manage the learning place. The potential for highly complex interaction between the functional commands and other Navy commands is highlighted by virtue of their "middle-management position in Echelon III."

CNET, ET AL. Figure 6 reveals a layer at Echelon II of four vital inputs to the training community. It is important to realize that only one of these four (CNET) has a full-time 100 percent concern about all Naval training. However, the remaining three impose massive influences in some of the following:

(a) New system developments in the Chief of Naval Material (CHNAVMAT), through its systems commands, create skill deficits.

(b) Normal force structure attrition and recruitment create differences between required and available skilled personnel (tracked and planned by BUPERS).

(c) A continuing source of negative feedback is the fleet, the ultimate consumer of the product sent by the shore establishments by NAVMAT, BUPERS, and CNET.

As far as training is concerned, everyone wishes to get into the act; for all, according to the above, are vitally interested. This makes for great difficulty in the efficient management and coordination of procurements of prime systems and their support. An example of this comes from the roster below of organizations attending a training planning conference on a major weapon system, TRIDENT.

CNO (OP-01, OP-123, OP-99, OP-29)
CHNAVMAT (MAT 04)
BUMED (M&S 4)
BUPERS (Pers B2N1)
CNET
CNTECHTRA
NAVTRAEQUIPCEN
PM 1 (SP-15)

NAVSHIPS (SHIPS-08, -047, PMS-396, PMS-302)
NAVELEX (ELEX 04, PME 117)
NAVORD (ORD 5421, ORD 0453A, PMO 4025)
NAVFAC (OICC TRIDENT)
NAVSUP (SUP 0141B)
NAVSEC (6182F)
COMOPTEVFOR
COMTRAPAC
CINCLANTFLT
CINPACFLT
COMSUBLANT (N11)
COMSUBPAC
OCMM

Another example of the problem of sheer numbers of organizational interaction required to create new training, revise or abolish on-going training, and maintain and support existing training may be inferred from the following list of organizational attendees at a sonar system training plans conference.

CNO (OP-02, OP-29)
NAVSHIPS (SHIPS-047, PMS-302)
SUBLANT
SUBPAC
TRALANT
TRAPAC
SUBSCOL
FBM SUBSCOL, CHARLESTON
SUBTRACEN, PEARL HARBOR
NAVTRAEQUIPCEN
CNTT
CNET
SUBDEVGRUTWO, NEW LONDON
NUSC, NEW LONDON
ASW SCHOOL
NPRDC
BUPERS

Obviously, whether one examines the Navy as a whole system or just the subsystem associated with training, imperfections of operation are a way of life. But only through the effort of self-scrutinization and setting longer term goals for management optimization can the Navy in the world of training break out of its image of being reactive, slowly

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evolving, almost incapable of escaping its inertial attitudes, and unwilling to look beyond today's problems.

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APPENDIX B

INNOVATIONS IN EDUCATIONAL TECHNOLOGY

INTRODUCTION

Educational technology includes, but is not limited to, the development of instructional systems, the identification of existing resources, the delivery of resources to learners, and the management of these processes and the people who perform them. Its functions are shared in varying degrees by all who are concerned with its main purpose--the facilitation of human learning.

This view of educational technology is derived from the more general concept of technology which John Galbraith defines as "the systematic application of scientific and other organized knowledge to practical tasks." Educational technology has been directed toward expanding the range of resources used for the facilitation of learning, emphasizing the individual learner and his unique needs, and using a systematic approach to the development and control of learning resources.

The uniqueness of the technology of education, and therefore its reason for being, is revealed by three concepts that have shaped the development of the field during the past 50 years: (1) the use of a broad range of resources for learning, (2) the emphasis on individualized and personalized learning, and (3) the use of the systems analytic approach.

a. Developing a Broad Range of Resources.

In the early 1920's, an expanding state of the art in the technology of communications sparked the idea of "visual instruction." The outcome of this was to facilitate learning by raising the information level through the use of media in instruction rather than depending solely on an instructor, chalkboard, and written materials.

The total impact of the media movement was to create a philosophy and mode of operation in the field of educational technology that uses any resources--in the school or in the real world, especially designed or natural, mediated or interpersonal, print or audiovisual--to facilitate learning. The thrust to expand the range of available media and information sources for learning was and still is one of the more distinctive purposes of the educational technology field.

b. Emphasis on Individualized and Personalized Learning.

Until about 1960, educators tended to place emphasis on good teaching. It was teaching, therefore, that was emphasized, evaluated, and changed. The advent of programmed instruction helped place a new emphasis on the learning process and individual learner. This emphasis brought about the realization that learning is the goal of the instructional process and the criterion by which it must be judged. No longer was teaching enough; the student had to learn.

With the resources and techniques in use by the educational system before 1960, most learning experiences were group based. After the introduction of programmed learning, the individualization of learning became a focal point for instructional planners and developers operating in the technological frame of reference.

In the application of educational technology there must not only be a broad range of resources which can produce learning, but there must also be a means for allowing the learning to individualize and personalize the interaction with these resources.

c. The Systems Approach

When scientific and experimental methods are applied in an orderly and comprehensive way to the planning of instructional tasks, or to entire programs, this process is sometimes known as "systems design" or "systems approach." Implicit in the systems approach is the use of clearly stated objectives, experimentally derived data to evaluate the results of the system, and feedback loops which allow the system to improve itself based on evaluation.

A systematic approach usually involves: needs assessment (to determine what the problem really is), solution selection (to meet the needs), development of instructional objectives (if an instructional solution is required), analysis of tasks and content needed to meet the objectives, selection of instructional strategies; sequencing of instructional events, selection of media, developing or locating the necessary resources; tryout/ evaluation of the effectiveness of the resources, revision of the resources until they are effective, and recycling continuously through the process.

The systems approach is a basic tenet of educational technology. Individualized learning requires systematic planning because it may operate with little or no direct intervention by the teacher and because it must make available a range of resources. The purpose of systems analysis and procedures in the context of educational technology is to provide a rationale for developing, organizing and making available learning resources.

Educational technology's role in the DOTS Project is of utmost significance. This technology, some of which exists in current programs, must be refined and introduced into the Navy's operations to increase its awareness of current requirements and future conditions in the Navy of the 1980's.

An extensive literature search was conducted to determine what technologies are available, currently, and what technologies are being planned. After careful analysis of the state-of-the-art in educational technology, an examination will be made of the appropriateness of these technologies to Navy training.

The following are a few examples of advanced technologies being surveyed.

a. Advanced Instructional System (AIS).

This Air Force project, led by Dr. Marty Rockway, is being developed at Lowry Air Force Base. The overall objective of AIS is to demonstrate that an individualized, multimedia, computer-based training system can provide significant cost effective improvements in the operation of three training courses within the Air Training Command at Lowry Air Force Base.

AIS has the following broad goals:

(1) Apply the latest training technology and instructional media in such a way as to achieve full individualization of the training process.

(2) Determine the managerial processes which may be facilitated by the computer.

(3) Apply the most cost-effective multimedia approach to training.

(4) Achieve system modularity which will facilitate the expected growth of the AIS over the years.

(5) The final goal of AIS is somewhat specific to the nature of Air Force Human Resources Laboratory (AFHRL) and its relationship to the general mission of improved Air Force training. Since AIS is committed to a cost-effective operational training system, the fifth goal of AIS reflects both essential training requirements and features of an innovative nature.

b. Computerized Training System (CTS).

This Army project under the direction of COL George Howard, is being developed at the U.S. Army Signal Center and School (USASCS), Fort Monmouth, New Jersey. The scope of the CTS project includes the design,

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development, implementation, operation and evaluation of the integrated prototype CTS covering a four year period beginning August 1972. Critical outcomes of the CTS are expected to be a suitable, low cost, viable and effective hardware system, and a newly developed language that will facilitate course materials development and enable maximum flexibility in the use of these hardware systems and course materials among Army Training Centers.

The CTS Project will be carried out in five separate phases:

(1) System Design - involves the specific design of a complete system for use by the CTS.

(2) System Development - integration of the hardware/software into an operational system.

(3) Course Development - responsibility of the Project Manager (USASCS). Student terminals connected to the PLATO IV system will be used to train personnel as instructional programmers and for initial development of the course material.

(4) CTS Operation - will operate a minimum of one year prior to procurement of operational systems.

(5) CTS Evaluation - conducted by the Project Manager and will address feasibility and effectiveness of entire system.

c. General Training Systems (GENTRAS)

This system was developed to help the U.S. Marine Corps (USMC) obtain maximum value for its training dollar. The GENTRAS will correlate effectiveness and suitability of training with field requirements. Although initially limited to ground-oriented occupational fields for enlisted personnel, GENTRAS can be readily expanded to encompass all major occupational specialities for both officer and enlisted personnel.

Basic CENTRAS features are training measurements, career paths, effectiveness, appropriateness, additional support, and training costs.

It is anticipated that CENTRAS should provide a qualitative rather than a purely quantitative approach to training and training effectiveness. The system should enable USMC to index training effectiveness to the point that a training specialist can readily identify skills training based on actual field performance.

d. Programmed Logic for Automatic Teaching Operations (PLATO).

This is a computer-based teaching system which provides a means for individualizing student instruction. The instructor, student, and computer are all members of an interactive team.

The PLATO system has a goal of improving the productivity of instructors and the effectiveness of the educational process. The system utilizes a large, sophisticated computer in a centralized facility that will serve many courses. Much of its hardware, including a new type visual display for computer terminals, was developed especially for Computer Assisted Instruction (CAI).

The method of developing educational materials is headed by Don Bitzer of the University of Illinois and uses a more ad hoc approach of letting instructors design their own courses with the aid of the PLATO staff. The PLATO system is a large, elaborate, and sophisticated system which is the result of over 14 years of development. Based around a large computer, the system is intended to service as many as 4000 student terminals located anywhere within a 800 mile radius of the computer.

The PLATO system is one of the most ambitious time-saving systems ever attempted and much of the hardware, a new language, techniques for linking remote terminals, were designed specifically for educational use. The PLATO

IV is the most recent version of the PLATO system. Its main feature is a high resolution 8½ inch square plasma display which can simultaneously show computer generated graphics and computer selected color slides in microfiche format. It features a new programming language which is based on English grammar and syntax which is designed for instructors with no programming knowledge.

e. <u>Time-Share Interactive Computer Controlled Information Television (TICCIT).</u>

This system is being developed by Mitre Corporation with the goal of mass dissemination of CAI. The TICCIT system has the explicit goal of showing that effective CAI can be produced, packaged and delivered economically, and that there exists a market for CAI which will stimulate its wide spread commercial use. The TICCIT system is a decentralized system built around small computers along with a package of hardware, operating programs, and course materials for each school involved in the program. Color TV is the display medium, and the system is primarily made up of off-the-shelf components. The method of developing course materials is formal using the interdisciplinary effort of programmers, educational technologists, psychologists, and technologists. The system's computers will operate as a time-sharing system, responding to student terminals (up to 128). The color TV sets will be able to display graphical or printed materials generated by the computer or video tapes. Audio is stored on record players which are also computer controlled. The lesson materials are stored on large disk memories.

Perhaps the most significant property of TICCIT is the course materials and how they are produced. Under the direction of V. Bunderson of Brigham Young University, the course materials are designed, pretested and programmed for the system by the team of specialists. Full scale demonstration of the system is scheduled for two community colleges in September 1974.

f. Satellite Training.

There is a National Aeronautics and Space Administration (NASA) developed satellite scheduled to be launched in 1974. As part of a large telecommunications experiment, the Federation of Rocky Mountain States has control of an educational experiment to beam communication to non-accessible areas of the Rocky Mountain States. There will be one video channel and four audio channels available which will allow instruction to be beamed in four different languages.

g. The Lincoln Terminal System (LTS).

The LTS is being developed at MIT Lincoln Laboratory with Air Force support. It is designed to meet the need for individualized, self-paced learning outside the conventional classroom. The LTS system uses microfiche as the basic medium for storing and distributing instructional material. The microfiche includes both an audio channel and digital control information with the usual photographic images. Students interact with lesson material through a keyboard. Responses are interpreted by a small computer which controls the selection and sequencing of the course material. The computer serves the processor function for all the student terminals and, in addition, records and analyzes student performance data.

APPENDIX C

MODELING AND SIMULATION

INTRODUCTION

The use of simulation and other operations research technologies to aid Navy managers in decision making can be better understood with a brief description of the concepts involved.

In order to apply simulation to a system, a comprehensive, realistic model of the system must be described. This system model identifies the interrelationships of objects within the system and the nature of these interactions. The objects, or entities, of the system are studied by their functional relationships with each other and with the whole. Therefore, a model is a representation of a system under study.

Mathematical programming models are just one of the technical decision-making components the manager can employ to arrive at feasible solutions to his problems. The model is used because it is easier and less costly to manipulate than a real or conceptual system. The model provides useful information as to what would result from manipulations of real world conditions and permits decisions to be made about the configuration of variables within the system. A manager's alternatives are in this way exercised, compared, and tested for feasibility. The predictive facet of simulation is the strength of this technique.

As stated previously, models and their simulation do not provide absolute decisions. They are tools which augment the manager in his decision making process. The manager is able to spend more time in true analysis instead of being concerned with detailed considerations. Managerial aids of this sort facilitate time compression in the decision process while at the same time providing a higher probability of selecting the alternative which will be best suited to the solution of the problem.

ELECTRONIC WARFARE (EW) SCHOOL SIMULATION

An in-house effort to demonstrate the feasibility and usefulness of simulation to managers concerned with training was initiated by the Project Office. The concurrent planning of a new EW school by another TAEG team provided the vehicle for the demonstration of a simulation technique. Since the EW school was being programmed to employ the latest techniques in training and education, it was considered an appropriate area in which to concentrate. Not only would it prove the feasibility of the technique but it would provide the EW planners with an assessment of their conceptual system and the validity of their assumptions. The end simulation project could then be generalized and applied to other specific applications by minor modifications. The area chosen to demonstrate simulation capabilities was the instruction to be provided to EW operator personnel at the school level.

The conceptual instruction program contains seven types of students with 21 areas of instruction, or learning modules, to consider. Not all students would take all learning modules, i.e., each student's progress was tailored to the instructional needs of that student. The system characteristic of individualized instruction with common learning modules was deemed ideal for modeling. In addition, the students were to proceed through their programs of instruction at their own learning rate. Therefore, the problem confronting the EW school planners was one of individualized self-paced instruction with limited resources available and a required output.

Determination of the proper numbers, or appropriate mix, of system entities, both dynamic and static, in the EW operator training system was addressed by using a computer simulation technique. In this way the system could be replicated, exercised, and observed. By manipulation of the entities within the system, such as number of students or number of carrels, the manager could see what effect was made and what set of parameters, within certain external constraints such as budget, would satisfy his overall objective of a certain number of trained students by type.

A detailed description of the EW Simulation problem and the programming effort will be the subject of a subsequent TAEG report. For purposes of this report, it is important to note the application of this technique and the benefits of such an application to a Navy manager.

MANPOWER AND PERSONNEL MODELING

A quick survey of existing models in the Department of Defense (DOD) and industry indicated that the largest developer, implementer, and maintainer of models was the Navy, or more specifically Chief of Naval Personnel (CHNAVPERS). The nature of the tasks involved in manpower and personnel planning at BUPERS necessitates a dependence on models and computers. The main reason is the sheer bulk of data which must be handled. Fortunately, BUPERS's researchers were in the process of surveying all existing models relevant to manpower and personnel considerations. The report of the survey, WTR-73-25,[2] "Computer Models for Manpower and Personnel Management: State of Current Technology," (April 1973) provided an invaluable tool in assessing what models were available, who developed them, who used or uses them, and if they were or are applicable to the training system. In addition, some findings are presented concerning the characteristics of the

[2]Hutchins, Elmer S., et al. Computer Models for Manpower and Personnel Management: State of Current Technology. WTR 73-25. April 1973. Naval Personnel Research and Development Laboratory, Washington, D. C.

modeling environment. The same general findings were observed in this study. Some of the key findings are as follows:

a. Computer modeling technology in the Navy equals or exceeds other service components.

b. All of the Navy is not adequately configured for manpower requirements determinations, e.g., billet structures are not adequately defined qualitatively and quantitatively.

c. Numerous models have been developed at different activities which solve similar or identical problems.

d. A serious communication problem exists in the management community with regard to computer modeling applications.

e. Almost 50 percent of the models developed in the Navy produce outputs which could prove useful at more than one activity in the Navy.

The results of the WTR 73-25 survey support the Navy Manpower Planning System (NAMPS) which is being conceived as a specialized manpower decision system, traversing the manpower planning and personnel management functions. Its design requires the capability to provide timely, well organized data to managers in decision making roles throughout the entire manpower/personnel system. This conceptual system provides for integration of all manpower/personnel processes. However, functions which are of concern to BUPERS, yet over which BUPERS has no control, are merely identified; i.e., the training function is not detailed.

Training is viewed by BUPERS planners as a function through which personnel must pass and have some value added (training) before proceeding to the next function in the personnel flow process.

The development of models as management tools to aid managers in decision making could provide the first step toward a truly integrated and unified Navy. If the integrated conceptual manpower, personnel modeling system is integrated with the functional analysis of the NETS, the result would be as depicted in figure 7. This figure shows how the manpower/personnel/training functions overlap and cannot be divorced purely due to organizational boundaries. The strength of this integrated approach will prove itself as models are developed by the training community which impact personnel and manpower planning. The training community must make concerted attempts in this direction to insure that the evolutionary, reactive nature of NETS develops into a viable, dynamic role ready to respond in a relevant way to the Fleet training requirements.

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The appendices contain a broad overview of the project office efforts in describing: (1) the Navy Education and Training System, (2) educational technology innovations, and (3) existing modeling and simulation efforts.

KEY WORDS

Training System
Training Organization Management
Functional Analysis
Descriptive Functional Model
Mathematical Model
Strategic Assumptions (1980)

Naval Training Equipment Center
Lindahl, W. H., McNaney, T. W., Okraski, H.C., Rankin, W. C.
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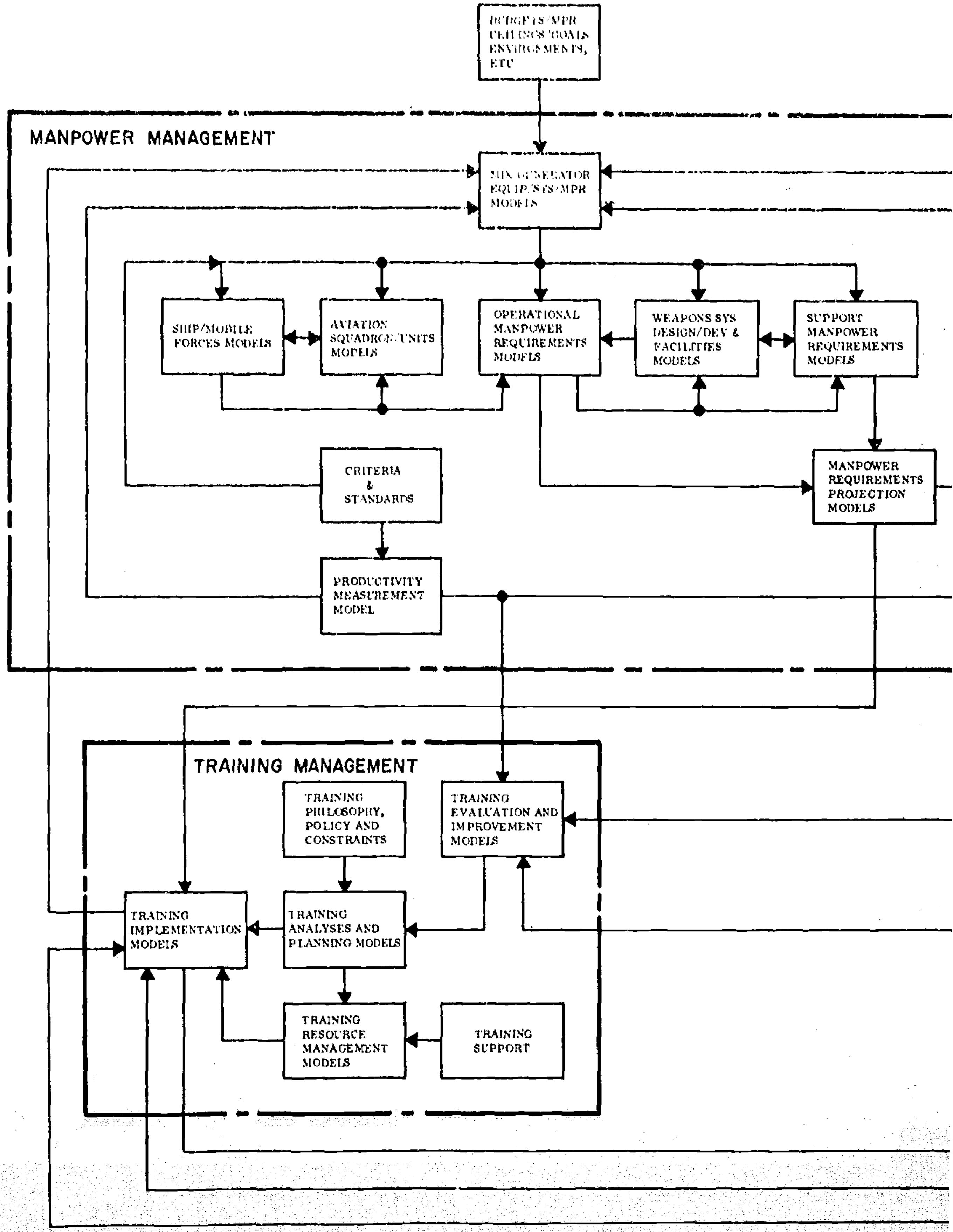

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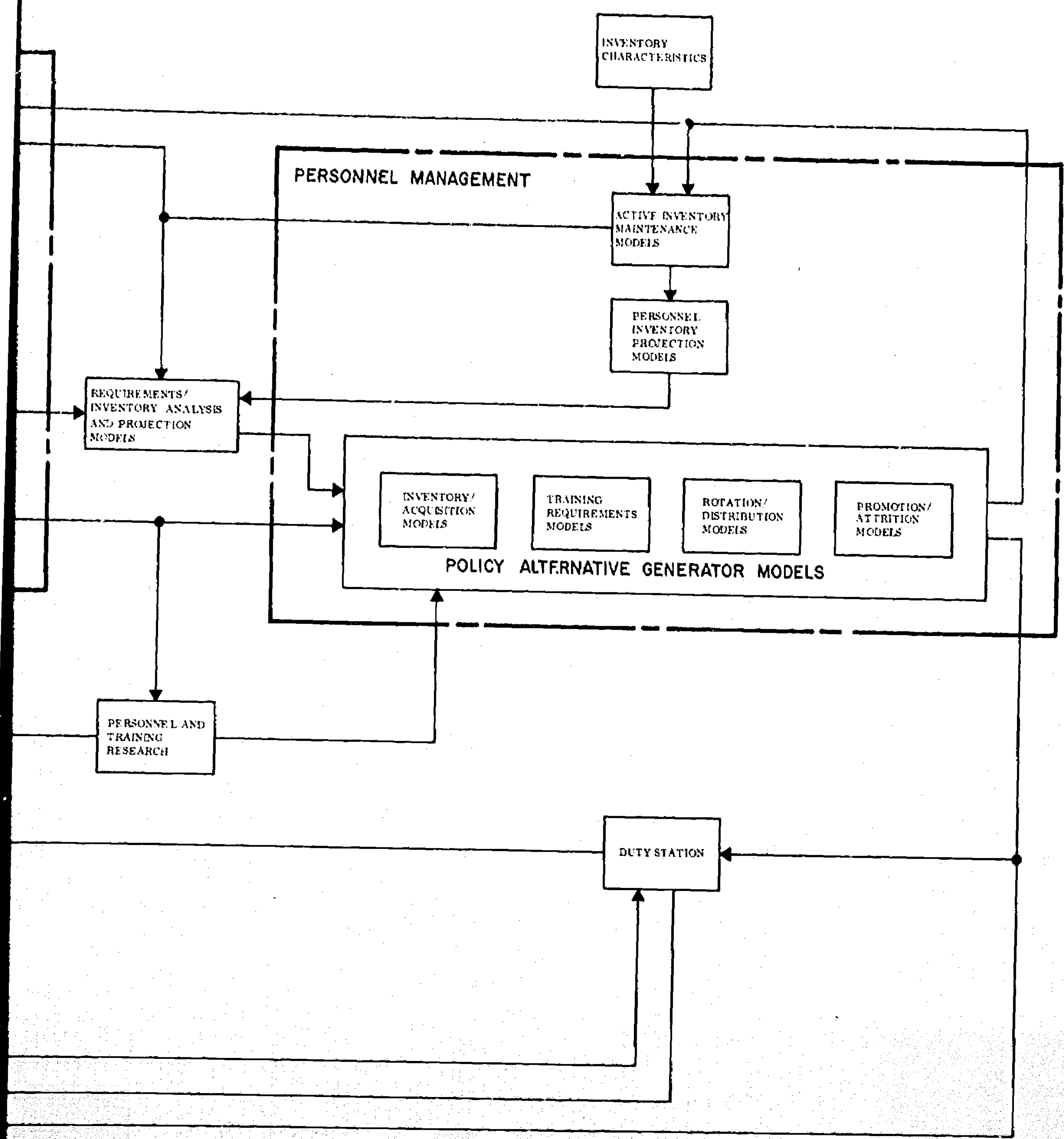
Figure 7.



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