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ABSTRACT

A series of five appendixes presents details related to Phase I of the three-stage project "Design of Training Systems" (DOTS). The first appendix discusses strategic assumptions and processes, while the second reviews mathematical models and data bases operational within the navel education and training command. The third appendix provides a bibliography of materials on three topics--mathematical modeling techniques, educational technology, and naval instructions and related pertinent matters. The fourth appendix lists the activities and locations visited in this phase of the project and the fifth provides a glossary of significant terms. (PB)

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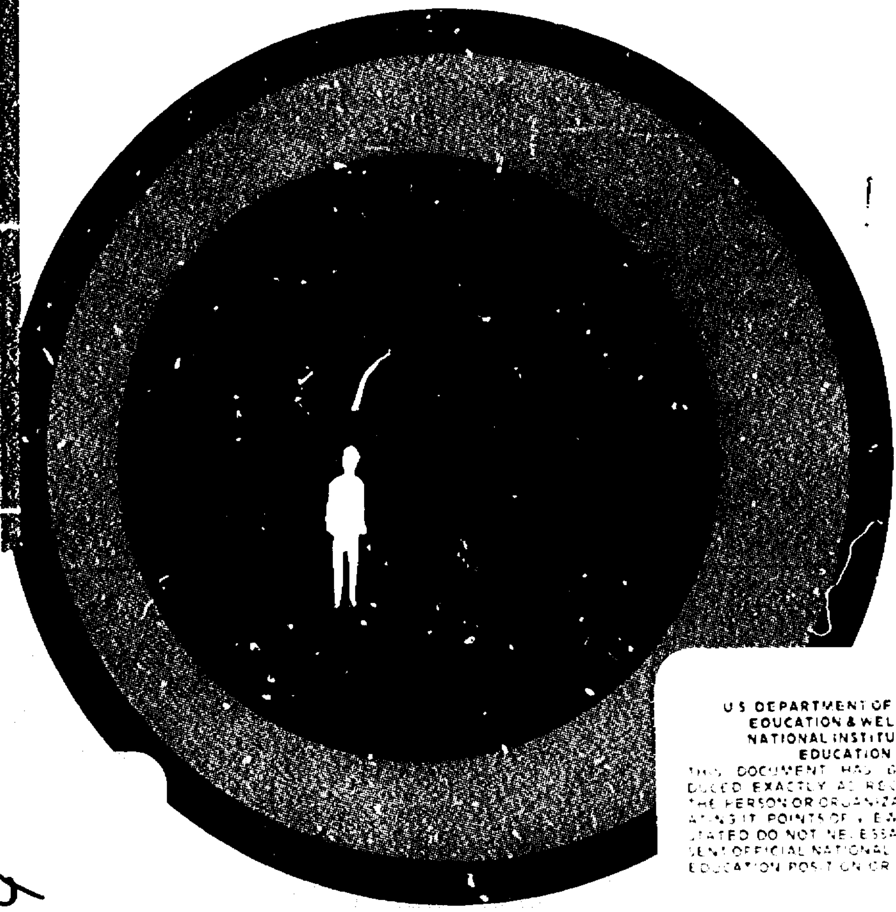
TAEG REPORT
NO. 12–1

DESIGN OF TRAINING SYSTEMS
PHASE I REPORT — Volume 2



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ORLANDO, FLORIDA 32813

Technical Report: TAEG REPORT NO. 12-1

DESIGN OF TRAINING SYSTEMS
PHASE I REPORT

ABSTRACT

This report presents a functional descriptive model of the current Naval Education and Training System and idealized concepts oriented toward a 1980 time frame. While technological gaps and problem areas are presented, no organizational elements are specified, since the prime areas of interest are the functions performed. In addition, the rationale for selection of candidate mathematical models to be developed in Phase II is given.

Strategic working assumptions for the 1980's are presented in Volume 2 of this report.

The study was performed by IBM for the Training Analysis and Evaluation Group of the Naval Training Equipment Center, Orlando, Florida (Contract No. N61339-73-C-0097).

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DESIGN OF TRAINING SYSTEMS

PHASE I - REPORT APPENDIX A

STRATEGIC ASSUMPTIONS

ABSTRACT

A DOTS, Phase I objective was the development of a descriptive functional model of the Naval Education and Training System (NETS) which would project an idealized system "in terms of the problems of the 1980's." Design of this projected system had to be based on sound Strategic Working Assumptions (SWA).

A set of Strategic Assumptions (SA), encompassing a broad range of potential impactors, was developed to form one of the supporting data bases required to develop the SWA's. The SWA's provide a vehicle for logically linking the numerous, very broad, and sometimes philosophical Strategic Assumptions to the specific tactical assumptions and recommendations of Section VI of the Phase I Report. The purpose of the appendix is to document those SA's pertinent to the idealized NETS descriptive model. Since this set of SA's should have application beyond the DOTS project, many are included that may not impact education, and the approach and format are designed to support other efforts.

This appendix also proposes a strategic process and format to become a component of the idealized NETS management system

Sources leading to the SA definitions contained in this appendix include those Naval strategic documents made available to the contractor, a wide range of general long range predictive documents, the Phase I interview data, and contributions of the IBM Advisory Group.

Section II - D of this appendix provides charts linking the SA's to each of the SWA's. The SWA's are repeated in Section VI D-2 of the Phase I report which also provides an expansion of the SWA's through a series of change statements.

APPENDIX A

STRATEGIC ASSUMPTIONS

I. THE STRATEGIC PROCESS

A. INTRODUCTION

1. Strategic Planning and the Naval Education Training System (NETS)

Whether military, public or industrial, "training system" planning can benefit from the application of strategic planning principles. Although development of a strategic plan or a set of strategic assumptions is a highly speculative exercise that seldom produces a "plan," which in its majority, proves correct, the process is essential to the efficient and effective management of any complex training system having extended life because it is the only way of properly orienting management thinking to the future.

NETS planning, as is the case of most industrial or military training systems, tends to be "driven" by strategic considerations developed "outside" the system. Correctly, the NETS planner must support the Department of the Navy Program Objectives and, therefore, is primarily concerned with plans and programs that are fairly clearly identified and generally contained within a five to eight year planning horizon. Currently, there is only limited direct application of a strategic process to NETS planning although strategic documents such as the Navy Strategic Study (NSS), Navy Mid-Range Guidance (NMRG), Navy Long-Range Guidance (NLRG), Navy Technological Forecast (NTF), etc., do have an indirect influence through their impact on development of the Navy Program Objectives.

Although, necessarily, the NETS management system must concentrate planning efforts on operational and tactical planning levels (to be defined in paragraph 4), increased emphasis on some elements of the strategic process can result in:

a. A systematic review and revision of NETS strategic goals and objectives.

b. A systematic correlation of system component plans to strategic NETS direction.

c. A forced withdrawal from current operating problems for strategic reviews.

The value of a "strategic process" to NETS will be in direct proportion to the extent it becomes a "working" component of the management system. The NETS strategic process should incorporate existing naval strategic planning, pertinent to education and training, but should also include strategic "drivers" outside the existing planning scope which impact training.

2. Pertinence to the DOTS Project - An objective of DOTS Phase I was to develop an idealized descriptive model of the Naval Education Training System (NETS) of the 1980's. Such a model must be based on a clearly defined set of strategic assumptions. At the same time, a subset of the management systems component of this "idealized" system would be a viable strategic process enabling systematic development of "a clearly defined set of strategic assumptions." This strategic assumptions section provides:

   a. The strategic assumption base for developing the 1980's "idealized" descriptive model.

   b. A suggested strategic process. As a vehicle for documenting the strategic assumptions, a format was developed that would facilitate future implementation of a systematic approach to a "working" strategic process. There are many viable approaches to strategic planning and the one suggested is only one possible alternative.

3. Sources - In developing the strategic assumption and proposed process, inputs from the Phase I data gathering interviews and the IBM Advisory Group were incorporated to assure inclusion of the most current naval, industrial and educational data.

   Specific sources are identified on the individual assumption charts.

4. Planning Levels - The major planning activity pertinent to an education or training system tends to occur within operational and tactical planning horizons. Although definitions vary from system to system, "operational planning" can be defined as that taking place within an operational unit of time such as a current fiscal year. "Tactical planning" will cover a more extended span and probably exclude the current period. For example, a Navy Training Plan (NTP) developed at a Naval Training Plan Conference (NTPC) may precede operational use of a device or system by approximately three years. Although judgmental assumptions are involved in both operational and tactical planning, these types are based more on defined than assumed (judgmental) parameters.

   Indications are that the application of a Strategic Process to the development of Strategic Assumptions (and the subsequent use of these SA's as a driver of the Operational/Tactical planning process) will result in the greatest benefit to NETS. This is not intended to preclude a fully developed NETS "Strategic Plan" but to recommend a reference for emphasis. For this reason, the title, STRATEGIC ASSUMPTIONS, has been applied to this section.

B. OBJECTIVES - STRATEGIC PROCESS

1. Definition of Objectives - The format used in documenting the Strategic Assumptions in this section was designed to support a systematic strategic planning process. In addition to supporting the major objective of assumption presentation, the format was designed to:

a. Standardize assumption definition format regardless of scope, category or level.

b. Identify sources and estimates of probability.

c. Identify other assumptions either impacting, or being impacted by, any given assumption.

d. Provide an estimate of the impact intensity on a given assumption by others.

e. Provide a numerical identification of assumptions that would:

1) Facilitate automation of the mechanical assembly of an SA influence structure.

2) Facilitate the indexing of specific assumptions by level, category, item or revision.

3) Facilitate the real-time revision of the SA structure through exclusion, inclusion, or modification of individual assumptions.

2. Objective Exclusions - As with any strategic process, the intent is not to:

a. Displace the detailed planning required within the operational or tactical planning horizon, but to provide an SA base for these types of planning.

b. Have the strategic process determine major goals and objectives but to assist in their definition, validation against future probabilities, and inclusion in lower level planning. The danger in a strategic process is that an SA will come to pass because it was included in a strategic plan, not because it was either a valid or desirable assumption.

C. FORMAT/PROCEDURAL DESCRIPTION

1. Assumption Form-Description - The following describes the basic document used to define the Strategic Assumptions. Figure 1, Page A-I-7, illustrates the descriptions and is indexed to match the alphabetic designations below:

   a. Assumption Identification is divided into three levels:

      1) Field - major areas of strategic concern such as National, Social/Cultural, Naval Factors, Education, Technological, etc.

      2) Category - a Field is broken into categories. As examples, Research and Development under the Field of Naval Factors; Educational Technology under the Field of Education; Maintenance under Technological.

      3) Item - a sub-level under Category, as examples, the "Item" of Task Modularization is under the "Category" of Educational Technology; the Indian Ocean under Naval Presence; Diagnostic Aids under Maintenance; etc.

      4) Date - if a strategy is to be maintained on a "real time" basis, frequent revisions of Fields, Categories and Items will be required. The "Revision" field of the SA number and SA date identifies the revision level.

      5) Number - to precisely identify assumptions, facilitate indexing and automation of SA structuring, each SA is assigned a number with the following fields:

XX:XXX:XXX:XXX

FIELD ITEM REVISION
CATEGORY NUMBER

   b. Assumption Statement provides a clear statement of the Strategic Assumption. This section should not be used for any significant detail except as required to assure a clear understanding of the statement. The "Sources" section should provide the references for the planner seeking supporting detail

   c. Periods define the planning horizon covered by a specific Field, Category or Item definition. It is not mandatory that all planning horizons be equivalent. However, the smallest Period should be a discrete fiscal year and a planning horizon in combinations of fiscal years.

1) "Periods" are the subdivisions within a planning horizon and may be of variable length within a horizon. For that reason, period start and stop spaces are provided. If used to indicate a series of years, only the "Start" blank is used. If a given Period represents a decade, then "Start" should indicate the first discrete Fiscal Year and "End" the final inclusive one.

2) Probability indicates a judgmental assessment, by Period, of the possibility that a given SA will come to pass. Since some SA planning horizons project far into the future and are primarily documented for future assessment, an "Indeterminate" evaluation, in addition to the normal "No" to "Hi" range is provided.

d. Input ID identifies other SA ID numbers impacting a given assumption. A degree ("O") column is provided for an assessment of impact intensity using the same scale as used for SA "Probability" definition.

e. Output ID identifies those SA numbers impacted by a given assumption.

f. Sources defines the "authority" for a given SA. Authority may range from an individual's judgmental opinion to references from such documents as the Navy Strategic Study (NSS), Joint Strategic Objective Plan (JSOP), Joint Research and Development Objectives Document (JRDOD), etc. The assumption may not be a direct quote of the source but an interpretive exercise based on an individual or combination of sources.

This section also constitutes the bibliography for a given SA to direct reviewers to more detailed material than can be provided under the "Assumption Statement" section.

2. Procedural - In developing the Phase I Strategic Assumptions, the following procedure was followed:

a. Preliminary assumptions were defined based on DOTS Phase I interview data, a variety of strategic papers, IBM Advisory Group contributions, and other pertinent sources of predictive information.

b. Preliminary assumptions were assessed for pertinence to the Naval Education Training System and those with significant impact identified.

c. Based on existing or anticipated relationships, a strategic "structure" was developed.

d. Based on the probability projections of the individual SA's, a set of working assumptions was synthesized to form a base for development of the idealized NETS model of the 1980's.

Although specifically developed to provide a base for synthesizing Phase I working assumptions, this set of Strategic Assumptions has application beyond the DOTS project. Therefore, the working assumptions are documented in the Phase I report body with the SA's being contained in Section II as a possible "stand-alone" addendum.

3. General Comments - The SA's to follow in Section II represent a "thesis" approach to the strategic process. A group of assumptions has been formulated and assembled within a short time to form a discrete document to provide one "driver" in the development of an idealized 1980 NETS model. In short, this is a "snap-shot" approach to defining the NETS environment at some strategic point in the future. However, it should be borne in mind that these SA's are based on a continuously evolving data base.

As has been previously indicated, a viable strategic process must be able to consider an ever changing data base and to produce updated SA structures that provide practical guidance to the operational, tactical, and strategic planning levels. Therefore, this specific set of Strategic Assumptions should be considered a start and not an end to the strategic process.

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: a-1 CATEGORY: a-2
ITEM: a-3 DATE: a-4 NO: a-5

ASSUMPTION STATEMENT:

b

INPUT I.D.	o	PERIODS								c							OUTPUT I.D.
			a	b	c	d	e	f	g			k	l	m	n	o	
d		Start										c-1					e
		End															
		Prob				c-2											

SOURCES:

f

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

Figure 1

II. STRATEGIC ASSUMPTIONS AND STRUCTURE

A. DESCRIPTION

1. SA Index - Every SA Field, Category and Item is assigned a number with an SA planning sheet developed for each number. The Field designating revision number is not included in the index. The Index is a listing of all SA numbers and associated titles.

2. SA Charts - These charts constitute the data base of the strategic process. Each SA Item Chart represents a fundamental assumption.

3. SA Structure - The SA Structure is the result of defining the SA's and the relationships between SA's. It is a graphic presentation of the Input/Output relationships between individual SA's leading to the Strategic Working Assumptions (SWA) providing the base for the Phase I Report, Section VI, on tactical assumptions and recommendations. An SA network is provided for each SWA.

B. STRATEGIC ASSUMPTION INDEX

Biological Control	03.002.XXX
Maturity	03.002.001
Life Expectancy	03.002.002
Behavior Modification	03.002.003
Social/Culture	04.XXX.XXX
Attitudes	04.001.XXX
Work Experience	04.001.001
Job Satisfaction	04.001.002
Effect of Change	04.001.003
Careers	04.002.XXX
Military	04.002.001
Work Schedule	04.003.XXX
Impact on Training	04.003.001
Human Resources	04.004.XXX
Organization	04.004.001
Urbanization	04.004.002
Communications	05.XXX.XXX
Devices	05.001.XXX
Interactive Terminals	05.001.001
Satellites	05.002.XXX
Military	05.002.001
Education	06.XXX.XXX
Student Skills	06.001.XXX
Learning Skills	06.001.001
Reading Ability	06.001.002
Entering Competency	06.001.003

Technological Change	06.002.XXX
Impact on Content	06.002.001
Key Individuals	06.002.002
Training Mode	06.002.003
Educational Technology	06.003.XXX
Task Modularization	06.003.001
Task Optimization	06.003.002
Modular Programs	06.003.003
Post Education/Training	06.004.XXX
Graduate Performance	06.004.001
Simulators	06.005.XXX
Feasibility	06.005.001
Administration	06.006.XXX
Automation	06.006.001
Advanced Weapons Potential	06.006.002
Measurement	06.007.XXX
Certification	06.007.001
Motivation	06.008.XXX
Student	06.008.001
International	20.XXX.XXX
Joint Efforts	20.001.XXX
Regional Powers	20.001.001
Military Environment	20.002.XXX
Multipolar	20.002.001
Law of the Sea	20.002.002
Small Navies	20.002.003
Geopolitical	20.003.XXX
Importance of Sea	20.003.001
Technology	20.003.002

Resources	20.004.XXX
Basic Necessities	20.004.001
National	21.XXX.XXX
Domestic Institutions	22.XXX.XXX
Economy	22.001.XXX
Worker Skill	22.001.001
Education	22.002.XXX
Value of Degree	22.002.001
Technological	30.XXX.XXX
Education/Training	30.001.XXX
Skill Transferability	30.001.001
Task Reduction	30.002.XXX
Devices	30.002.001
Reliability	30.002.002
Personnel	30.003.XXX
Competence	30.003.001
Weapons	30.004.XXX
Interchangeability	30.004.001
Satellite Neutralization	30.004.002
Automation	30.005.XXX
Computer Capability	30.005.001
Weapons Systems	30.005.002
Military Platforms	30.006.XXX
Air Cushion Vehicles	30.006.001

Military Doctrine	40.XXX.XXX
Mission	40.001.XXX
Political	40.001.001
Tactical Air Projection	40.001.002
Amphibious Projection	40.001.003
Presence Forces	40.001.004
Sea Control	40.001.005
National Policy	40.002.XXX
Defense	40.002.001
Nixon Doctrine	40.002.002
Armaments	40.003.XXX
Level	40.003.001
Strategic Deterrence	40.003.002
Second Strike	40.003.003
Submarine Launched Ballistic Missile (SLBM)	40.003.004
Capital Presence Ship	40.003.005
Satellite Impact	40.003.006
Naval Factors	60.XXX.XXX
Organizational	60.001.XXX
Mission Orientation	60.001.001
Training Centralization	60.001.002
Research and Development	60.002.XXX
Educational R&D	60.002.001
Student Motivation	60.002.002
Education	60.003.XXX
Civilian Contractors	60.003.001
Multi-service Use	60.003.002
Variable Loads	60.003.003
Graduate Study	60.003.004
Personnel	60.004.XXX
Job Commonalty	60.004.001
Enlistee Attitudes	60.004.002
Pilot Proficiency	60.004.003
Parental Authority	60.004.004
Women	60.004.005

Civil/Military Postulates	60.005.XXX
Postulate #1	60.005.001
Postulate #2	60.005.002
Postulate #3	60.005.003

C. STRATEGIC ASSUMPTION CHARTS

The charts to follow represent the highest level of strategic definition within the report. Generally, the Strategic Assumptions (SA) were selected for their pertinence to the Naval Education Training System (NETS). However, a number of others were included to illustrate the potential scope of the recommended Strategic Process.

The SA charts are followed by a series of SA Structure Charts establishing a network of SA relationships pertinent to the next lower level of strategic definition forming the basis of the Phase I Report, Section VI, tactical assumptions and recommendations. This lower level of assumption is called a Strategic Working Assumption (SWA).

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Demography **CATEGORY:** Education
ITEM: High School Graduates **DATE:** Sep 73 **NO:** 01.001.001.00

ASSUMPTION STATEMENT:

High school graduates as a percent of persons 18 years old are projected as follows:

1970 (Actual)- 76.5 (Actual)
1975 - 83.9
1980 - 89.5

Historical - High school graduates as a percent of persons 17 years old:

1950 - 59.0%
1960 - 65.1%
1965 - 72.4%
1969 - 78.4%

INPUT I.D.	O
02.002.001	1
03.002.001	3
03:002.003	3
04.004.002	2
05.001.001	2
06.007.001	3
06.008.001	2
22.001.001	2
60.004.004	2

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	3	3	3	3	3										

OUTPUT I.D
01.001.002
06.001.001
06.001.002
06.001.003

SOURCES:

1. U.S. Dept. of Commerce, Bureau of the Census, Statistical Abstract of the U.S., 1971, Washington, D.C., 1971, p. 124.
2. Reviewed by IBM Advisory Group; 18 Sept. 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Demography **CATEGORY:** Education
ITEM: College Graduates **DATE:** Sep 73 **NO:** 01.001.002.00

ASSUMPTION STATEMENT:

College graduates as a percent of persons 21 years old are projected as follows:

1960 - 18% (Actual)
1980 - 48%
1990 - 54%
2000 - 54%

The tapering off assumes that an IQ of at least 100 is needed to complete college. This point was derived from the high school senior mean I.Q. of 107 and the assumption that a higher IQ is necessary to do acceptable work at a good college.

(Source 1 & 2)

Note: Some of the trends apparent in 1973 tend to indicate that the above projection is too high. It should remain an assumption pending trend validation.

(Source 3)

INPUT I.D.	O
01.001.001	3
02.002.001	1
03.002.001	3
03.002.003	3
04.004.002	2
05.001.001	2
06.001.001	3
06.001.002	3
06.007.001	2
06.008.001	1
22.002.001	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	1	1	1	1										

OUTPUT I.D.
06.001.003
60.003.003

SOURCES:

1. Hilgard, Ernest R., Introduction to Psychology, Harcourt, Brace and Company, New York, 1953, p. 399.
2. Wehle, Mark and Rockett, Laurie, "Notes on World-Wide School Enrollment and Illiteracy and U.S. Graduates of the Year 2000", Working Paper Appendix to the Next Thirty Years: A Context for Speculation, Hudson Institute, Dec. 1966, A 29-31.
3. Adams, Dr. E. N. and Bowen, C.R., NETS Strategic Seminar, IBM Advisory Group Meeting, 18 Sept. 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Philosophical
CATEGORY: Religion
ITEM: Moral Values
DATE: Sep 73 NO: 02.001.001.00

ASSUMPTION STATEMENT:

Although it can be assumed that a number of trends apparent in current society will result in a decline of organized religion, it is doubtful that most basic moral and ethical concepts will decline greatly in effectiveness. However, all social institutions will be forced to do searching self-examinations pertinent to projected value changes.

Ethics, morals, and religion have been affected by contemporary social change. Traditional morality has come under attack on ethical and biological-psychological grounds. Established Judeo-Christian concepts of individualism, freedom of choice, and free will are challenged by modern philosophers and psychologists on the grounds that the need for cooperation, the reality of interdependence, and the truism of environmental conditioning have rendered the former ideals obsolete and inapplicable to current problems.

INPUT I.D.	O
03.002.001	3
03.002.003	2
04.004.002	3
60.004.004	3

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	2	2	4	4	4										

OUTPUT I.D.
02.002.001
04.001.001
04.001.003
06.007.001
06.008.001
22.002.001
60.002.002
60.004.002
60.004.004

SOURCES:

1. Wermuth, Dr. Anthony L., Potential Impact of Cultural Change on the Navy in the 1970's, Westinghouse, Falls Church, Va., August 1972, Vol-I, 28 & 29.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Philosophical
CATEGORY: Institutions
ITEM: Authority
DATE: Sep 73 NO: 02.002.001.00

ASSUMPTION STATEMENT:

It can be assumed that those institutions within our society which are authority oriented will be adversely affected by the declining legitimacy of authority in American society and by society's prospective declining interest in socializing its youth into at least some acceptance of the need for authority in a balanced relationship of rights and obligations.

This will have an especially strong effect on the military since social change will be conceding greater freedom to the individual in some areas, while promising to restrict it further in others.

INPUT I.D.	O
02.001.001	2
03.002.001	1
03.002.003	1
04.001.001	2
04.001.002	2
04.001.003	3
04.003.001	2
04.004.001	3
06.001.003	3
60.004.002	3
60.004.004	3

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	2	4	4	4										

OUTPUT I.D.
01.001.001
01.001.002
60.002.002

SOURCES:

1. Wermuth, Dr. Anthony L., Potential Impacts of Cultural Change on the Navy in the 1970's, Westinghouse, Falls Church, Va., August 1972, Vol-I, 30.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Bio-Medical
ITEM: Injuries

CATEGORY: Treatment
DATE: Sep 73 NO: 03.001.001.00

ASSUMPTION STATEMENT:

It can be assumed that major breakthroughs will continue in the field of medical engineering especially in the areas of antibiotics, the transplantation of organs, possibly the regeneration of organs, and the use of man-made machines to perform the functions of certain organs.

The treatment of injuries resulting from accidents or battle will benefit most from these projected advances. Procedures developed in such fields as artificial organs, organ transplants, and prosthetics will aid in rehabilitation of those who suffer from accident or battle-related injuries. Any medical techniques that provide swifter, more effective care, resulting in the recovery of higher proportions of wounded men, particularly those suffering permanent effects, will be welcomed by the military.

INPUT I.D.	O	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
																		03.002.002
		Start	1974	1980	1985	1990	2000											
		End	1979	1984	1989	1999	--											
		Prob	3	3	3	3	3											

SOURCES:

1. Wermuth, Dr. Anthony L., Potential Impacts of Cultural Change on the Navy in the 1970's, Westinghouse, Falls Church, Va., August 1972, Vol-I, 44 & 45

0 - No   1 - Lo   2 - Med   3 - Hi   4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Bio-Medical CATEGORY: Biological Control
ITEM: Maturity DATE: Sep 73 NO: 03.002.001.00

ASSUMPTION STATEMENT:

It can be assumed that significant breakthroughs in bio-medicine will decrease the length of time required for an individual to reach physical and mental maturity. This could happen within the next twenty years.

If this decrease is significant, it would have radical implications for most social institutions, especially the military. It is anticipated that the availability of persons, young in chronological age, but mature in terms of capability could generate a number of status and procedural changes in military organizations.

INPUT I.D.	O
03.002.003	2

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	1	2	3	3										

OUTPUT I.D.
01.001.001
01.001.002
02.001.001
02.002.001
04.001.003
04.002.001
06.008.001
60.002.002
60.004.002
60.004.004

SOURCES:

1. Wermuth, Dr. Anthony L., Potential Impacts of Cultural Change on the Navy in the 1970's, Westinghouse, Falls Church, Va., August 1972, Vol-I, 46.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Bio-Medical CATEGORY: Biological Control
ITEM: Life Expectancy DATE: Sep 73 NO: 03.002.002.00

ASSUMPTION STATEMENT:

It can be assumed that there will be significant extension of productive life-spans within the next twenty years resulting from R&D in medical engineering.

This change has many implications for existing institutions. If the burden of extended retirement costs is not to become prohibitive, institutions will have to plan extension of their personnel's active working years.

The delays imposed on the generation behind the first generation to achieve substantial life extension will result in significant disruptions to society and its institutions unless remedial programs are implemented.

INPUT I.D.	O	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
03.001.001	1																	60.002.002
		Start	1974	1980	1985	1990	2000											
		End	1979	1984	1989	1999	--											
		Prob	1	1	2	3	3											

SOURCES:

1. Wermuth, Dr. Anthony L., Potential Impacts of Cultural Change on the Navy in the 1970's, Westinghouse, Falls Church, Va., August 1972, Vol-I, 47.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Bio-Medical **CATEGORY:** Biological Control
ITEM: Behavior Modification **DATE:** Sep 73 **NO:** 03.002.003.00

ASSUMPTION STATEMENT:

It can be assumed that, within the next twenty to thirty years, major breakthroughs will occur in modification of an individual's behavior and characteristics through bio-medical or psychological means.

Society and its institutions will use behavior-manipulative techniques or drugs to relieve suffering, to cause desired behavior, or, possibly, to improve such areas as learning characteristics.

Although the breeding and conditioning of a group of people for specific objectives is not a new practice, the 'breakthroughs' referred to will greatly facilitate the process.

INPUT I.D.	O	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
04.001.002	1	Start	1974	1980	1985	1990	2000											01.001.001
04.004.001	2																	01.001.002
60.002.002	3																	02.001.001
																		02.002.001
																		03.002.001
																		04.001.003
		End	1979	1984	1989	1999	--											06.001.001
																		06.001.002
																		06.008.001
		Prob	1	1	2	2	3											

SOURCES:

1. Wermuth, Dr. Anthony L., Potential Impacts of Cultural Change on the Navy in the 1970's, Westinghouse, Falls Church, Va., August 1972, Vol-I, 47

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Social/Cultural **CATEGORY:** Attitudes
ITEM: Work Experience **DATE:** Sep 73 **NO:** 04.001.001.00

ASSUMPTION STATEMENT: It is assumed that many new entries to the national work force and military services during the strategic time span will lack any work experience in organizational settings where such factors as deadlines, schedules, teamwork, sustained productivity, and work standardization may be relatively unknown and perhaps unappreciated.

This will require not only the learning of work habits, but more fundamental awareness and appreciation of work roles and the attitudinal aspects of shared work environments. These attitudes and habits are not likely to be acquired under coercive conditions. They will constitute an increasingly severe demand on institutional training with an increasing proportion of people who have rejected the so-called "Protestant work ethic" without having experienced it.
(Source 1)

A counter assumption of the above states that the trend indicated will shortly level out or decline. Also, there is a question of to what degree the "Protestant work ethic" has been rejected.
(Source 2)

INPUT I.D.	O	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
02.001.001	2	Start	1974	1980	1985	1990	2000											02.002.001
04.004.001	1																	04.001.002
06.008.001	1																	60.002.002
60.004.004	3																	60.004.002
																		60.004.005
		End	1979	1984	1989	1999	--											
		Prob	3	3	3	3	3											

SOURCES:
1. Miller, Robert B., File Memo - Summary of Trends in Navy Training, IBM Advisory Group, 27 March 73, Section 1.3.
2. Adams, Dr. E. N., and Bowen, C. R., NETS Strategic Seminar, IBM Advisory Group Meeting, 18 Sept. 73.
3. Reviewed by IBM Advisory Group 18 Sept. 73.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Social/Cultural **CATEGORY:** Attitudes
ITEM: Job Satisfaction **DATE:** Sep 73 **NO:** 04.001.002.00

ASSUMPTION STATEMENT:
Due to an increasing emphasis on "job satisfaction" in industry and to the projected changes in many industrial and military job tasks, it can be assumed that the armed services will be required to structure jobs for satisfaction to overcome worker's need for interesting, fulfilling work.

Many companies are experimenting with "work teams" in which the overall objective is set for the group but the individual responsibilities are decided by the group. Concepts of vertical job loading to give the worker increased responsibility have also proven valuable. From a training standpoint, if the principles of transfer and generalization are to be taken into account, the training situation must be made to approximate the performance environment. This will dictate that such things as work teams and the like be built into the training environment.

INPUT I.D.	O
04.001.001	3
04.003.001	2
04.004.001	2
06.001.003	1
06.008.001	2
30.002.001	2
30.002.002	2
60.004.004	3

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	2	3	3	3										

OUTPUT I.D.
02.002.001
03.002.003
04.002.001
06.002.002
06.003.001
60.002.002
60.003.004
60.004.002
60.004.003

SOURCES:

1. Schwartz, H. A.: File Memo - Volunteers, IBM Advisory Group, 28 June 73, P-1, Sec 2.

2. Reviewed by IBM Advisory Group 18 September 73.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Social/Cultural CATEGORY: Attitudes
ITEM: Effect of Change DATE: Sep 73 NO: 04.001.003.00

ASSUMPTION STATEMENT:
It can be assumed that the rate of change within our society will continue to accelerate and, whether technological or philosophical, will have a profound influence on the thoughts and attitudes of our population.

Due to its acceleration and pervasiveness, the sense of uncertainty and intermittent confusion it generates, and the growing suspicion it fosters that there are no permanent answers, changes continue to be disruptive to men and institutions, unless men develop a sixth sense of continual awareness, or readiness, toward change.

INPUT I.D.	o	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
02.001.001	2	Start	1974	1980	1985	1990	2000											02.002.001
03.002.001	1																	06.002.001
03.002.003	1																	06.002.002
04.003.001	1																	06.008.001
04.004.002	1																	60.004.002
06.001.001	1																	60.004.004
06.001.002	1	End	1979	1984	1989	1999	--											
60.004.005	1																	
		Prob	1	2	2	4	4											

SOURCES:
1. Wermuth, Dr. Anthony L., Potential Impacts of Cultural Change on the Navy in the 1970's, Westinghouse, Falls Church, Va., August 1972, Vol-I, 6.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Social/Cultural **CATEGORY:** Careers
ITEM: Military **DATE:** Sep 73 **NO:** 04.002.001.00

ASSUMPTION STATEMENT:

Assuming a peacetime military environment, it can also be assumed that the military will offer many individuals a more orderly structure in which to cultivate and realize a meaningful life style than they will be able to find in their civilian lives. Formal military training may combine both technical and non-technical content directed towards these personal realizations resulting in a more effective person in the military and civilian environment.

These considerations will affect costs in time and facilities, instructional style and technique, and will probably result in an increased concern by the military for psychologically sensible patterns of career progression, based on achievement of performance criteria rather than simple possession of "credentials," and greater flexibility in technical assignments.

INPUT I.D.	O
03.002.001	1
04.001.002	3
04.003.001	1
06.001.003	1
06.003.001	1
60.001.002	1
60.002.001	1
60.002.002	1
60.003.002	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	2	2	4	4	4										

OUTPUT I.D.
60.003.004
60.004.002

SOURCES:

1. Miller, Robert B.: File Memo - Summary of Trends in Navy Training, IBM Advisory Group, 27 March 73, Section 1.5

2. Reviewed by IBM Advisory Group, 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Social/Cultural **CATEGORY:** Work Schedule
ITEM: Impact on Training **DATE:** Sep 73 **NO:** 04.003.001.00

ASSUMPTION STATEMENT:

It can be assumed that the trend towards the four (or three) day work week gaining acceptance in the industrial sector will continue, and, ultimately impact the military.

Implications of such shortened work weeks will have to be taken into account in both training and operational aspects of armed forces personnel. From the standpoint of economics, the shortened work week may require a larger work force which in turn would require greater output from the training function. The training function itself may be forced into experimentation with different schedules in order to incorporate these altered work weeks into its programs.

(Source 1)

A counter-assumption states that, although there will be a shift to a flexible work schedule, there will be no significant reduction in overall work hours.

(Source 2)

INPUT I.D.	O	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
04.004.001	1	Start	1974	1980	1985	1990	2000											02.002.001
06.001.003	1																	04.001.002
22.001.001	1																	04.001.003
60.004.002	3																	04.002.001
																		05.001.001
																		06.006.001
		End	1979	1984	1989	1999	--											60.003.003
		Prob	1	2	2	2	3											

SOURCES:

1. Schwartz, H. A.: File Memo - Volunteers, IBM Advisory Group, 28 June 73, P-1, Sec 1.
2. Bowen, C. R., NETS Strategic Seminar, IBM Advisory Group, 18 Sept. 73.
3. Reviewed by IBM Advisory Group, 18 September 1973.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Social/Cultural CATEGORY: Human Resources
ITEM: Organization DATE: Sep 73 NO: 04.004.001.00

ASSUMPTION STATEMENT:

Based on current trends in the organization of workers in the public sector such as teachers, police, firemen, etc., it can be assumed that the organization of armed forces personnel into quasi-union groupings will probably occur during the next two decades.

This will bring elements of the collective bargaining process to the armed forces. Training may be based on seniority as will promotions. The rapid changes in job structures and tasks predicted for the future may be impacted due to the restrictions of personnel organization.

INPUT I.D.	O
06.001.003	1
22.001.001	1
30.002.001	1
30.002.002	1
30.003.001	2
30.005.002	2

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	2	2	3	3										

OUTPUT I.D.
02.002.001
03.002.003
04.001.001
04.001.002
04.003.001
60.004.002

SOURCES:

1. Schwartz, Dr. H. A., <u>NETS Strategic Seminar</u>, IBM Advisory Group, 18 September 1973
2. Reviewed by IBM Advisory Group, 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Social/Cultural CATEGORY: Human Resources
ITEM: Urbanization DATE: Sep 73 NO: 04.004.002.00

ASSUMPTION STATEMENT:

By 1995, 90% of all Americans will live in urban areas. The suburbs will absorb most of this increase as the inner-city declines due to racial, economic, and housing problems. Decentralized suburbia may be prototypical for the cities of the future, with communication replacing physical presence as the dominant mode of idea exchange.

The institutions of society will be impacted by the need to modify training and personnel procedures to adjust to the decline of farm bred youth and the predominance of city-bred youth.

INPUT I.D.	O	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
		Start	1974	1980	1985	1990	2000											01.001.001 01.001.002 02.001.001 04.001.003 60.004.002 60.004.004
		End	1979	1984	1989	1999	--											
		Prob	1	1	1	2	3											

SOURCES:

1. Wermuth, Dr. Anthony L., Potential Impacts of Cultural Change on the Navy in the 1970's, Westinghouse, Falls Church, Va., August 1972, Vol-I, 53.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Communication CATEGORY: Devices
ITEM: Interactive Terminals DATE: Sep 73 NO: 05.001.001.00

ASSUMPTION STATEMENT:

Indications are that by the year 2000, the U.S. society will be saturated by information devices. These will differ from current devices primarily in the increased degree of "interaction" between terminals. Children will mature in a society saturated with information and sophisticated networks for dissemination of information.

For the most part, these will be telecommunications terminals and will include graphic capability. There are conservative predictions we will see ten million computer terminals by 1985. It is safe to assume that by 2000 A.D., truly interactive audio-visual terminals will be available in every home.

This has profound implications for society and especially for that part of education dealing with information. (Source 1 & 2)

The existence of these devices does not guarantee that most children will be strongly shaped by them. The degree of impact will be determined by how they are used, not by how many there are.
(Source 3)

INPUT I.D.	O
04.003.001	1
06.001.001	1
06.001.002	1
06.006.002	1
30.005.001	3
60.003.003	3
60.003.004	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	2	3	3	3										

OUTPUT I.D
01.001.001
01.001.002
05.002.001
06.005.001
06.006.001
30.002.001
60.001.002
60.002.001
60.002.002

SOURCES:

1. Bowen, C.R., IBM Advisory Group, 18 September 1973
2. Miller, Robert B.: File Memo - Summary of Trends in Navy Training, IBM Advisory Group, 27 March 73, Section 4.5
3. Adams, Dr. E. N.: NETS Strategic Seminar, IBM Advisory Group Meeting, 18 September 1973
4. Reviewed by IBM Advisory Group, 18 Sep 73.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Communications CATEGORY: Satellites
ITEM: Military DATE: Sep 73 NO: 05.002.001.00

ASSUMPTION STATEMENT:

It can be assumed that by 1980, military communications will be relayed by a multi-satellite, Department of Defense dedicated system. In the system of the 1980's, the present uses will become much more sophisticated. Those with military implications are weather assessment and prediction, navigational aid (very essential to U.S. nuclear deterrent forces), and a broad range of force detection uses.

One major satellite communication advance will be the technological and logistical advances required for real-time capability. Present problems of R.F. interference and relay capability will be overcome by the early 1980's.

INPUT I.D.	0
05.001.001	3
20.001.001	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	3	3	3	3										

OUTPUT I.D.
30.005.002
40.001.002
40.001.003
40.001.004
40.001.005
40.003.004

SOURCES:

1. Committee #25, "Impact of a Satellite Environment on Naval Operations," Naval Mission Area Paper, The U.S. Naval War College, Newport, R.I., 1973, 2, 3, & 5.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Education | CATEGORY: Student Skills
ITEM: Learning Skills | DATE: Sep 73 NO: 06.001.001.00

ASSUMPTION STATEMENT:

Based on current educational trends, the product of the public education system of the 1980's and beyond will be characterized by a lack of discipline and skills in the training-learning process.

It is assumed that this reduced formal background in skill acquisition must be compensated for by psychologically sound procedures for engaging and holding attention, and for inspiring suitable aspirations for achievement at the level of task learning.

There is some evidence that there will be a reversal of this trend in the public sector. However, even if this does take place, the change will be gradual and, as a strategic concern, lack of learning skills will remain at least through the 1980's.

INPUT I.D.	O	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
01.001.001	3	Start	1974	1980	1985	1990	2000											01.001.002
03.002.003	1																	04.001.003
06.007.001	1																	05.001.001
06.008.001	1																	06.001.003
22.002.001	1																	60.002.001
60.004.002	1																	60.002.002
		End	1979	1984	1989	1999	--											
		Prob	3	3	2	2	2											

SOURCES:

1. Miller, Robert B.: File Memo - Summary of Trends in Navy Training, IBM Advisory Group, 27 March 73, Section 1.1
2. Reviewed by IBM Advisory Group, 18 September 1973.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Education CATEGORY: Student Skills
ITEM: Reading Ability DATE: Sep 73 NO: 06.001.002.00

ASSUMPTION STATEMENT:

It is assumed that there will be a continuing deterioration in the reading and communication skills of the public education graduate. These deficiencies are generally attributable to failure of instruction in primary and secondary schools to overcome home inadequacies.

This factor becomes a strategic concern for projected military and industrial training systems if it is assumed that future individualized approaches will require significant skills in both reading and communicating.

These deficiencies will have to be remedied with much greater efficiency than attained in public schools.

(Source 1)

It can be assumed that there will be an increase in non-verbal training aids oriented to performance rather than verbal capability. There will also be an increase in Job Performance Aids (JPA's) also oriented to performance which will result in a reduction of formal and verbal training requirements.

(Source 2)

INPUT I.D.	O
01.001.001	3
03.002.003	1
06.007.001	1
06.008.001	1
22.002.001	1
60.004.002	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	3	3	3	2	1										

OUTPUT I.D.
01.001.002
04.001.003
05.001.001
06.001.003
60.002.001
60.002.002

SOURCES:

1. Miller, Robert B.: File Memo - Summary of Trends in Navy Training, IBM Advisory Group, 27 March 73, Section 1.2
2. Fox, Raymond G.: NETS Strategic Seminar, IBM Advisory Group Meeting, 18 Sept. 1973
3. Reviewed by IBM Advisory Group, 18 September 73.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Education | CATEGORY: Student Skills
ITEM: Entering Competency | DATE: Sep 73 | NO: 06.001.003.00

ASSUMPTION STATEMENT:

It can be assumed that, due to the AVF concept, the military will have to recruit the men they need in the labor market in the same manner as private firms and that this exposure to the "free market" may result in the following change:

"For years the military has drafted and recruited young men with few skills and little experience. It then trained these men to provide the services it required. A possibility that arises with the zero draft is that the military may decide to hire more experienced individuals in order to reduce training costs."

(Source 2)

An argument in opposition to the above is that the military pay scale will not permit competition with the "free market" for highly skilled people.

(Source 3)

INPUT I.D.	O
01.001.001	3
01.001.002	1
06.001.001	1
06.001.002	1
22.002.001	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	2	2	1	1	1										

OUTPUT I.D.
02.002.001
04.001.002
04.002.001
04.003.001
04.004.001
60.003.004
60.004.002

SOURCES:

1. Schwartz, H. A.: File Memo - Volunteers, IBM Advisory Group, 28 June 73, P-2
2. Moskow, M. M.: "The Zero Draft and the Labor Market" The Conference Board Record, September 1972
3. Adams, Dr. E. N.: NETS Strategic Seminar, IBM Advisory Group Meeting, 18 September 1973
4. Reviewed by IBM Advisory Group, 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Education **CATEGORY:** Technological Change
ITEM: Impact on Content **DATE:** Sep 73 **NO:** 06.002.001.00

ASSUMPTION STATEMENT:
It is assumed that rapid and frequent technological changes in both industrial and military hardware will have little influence on the specific task content of most activities. The trend will be towards training for "general skills" easily transferred from one device or system to another without additional training. The majority of people will receive a broad general base of skills rather than the "in-depth" training of the past. The change will, therefore, be one of breadth and degree rather than specific content.

This assumption is not intended to preclude training of the in-depth specialist.

INPUT I.D.	O
04.001.003	1
06.002.003	2
06.003.002	2
30.001.001	1
30.002.001	3
30.002.002	3
30.004.001	1
60.004.001	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	2	2	2	2										

OUTPUT I.D.
06.002.002
06.003.001
06.003.002
06.003.003
06.006.002
60.003.003

SOURCES:

1. Miller, Robert B.: File Memo - Summary of Trends in Navy Training, IBM Advisory Group, 27 March 73, Section 2.2
2. Reviewed by IBM Advisory Group, 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS — NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Education CATEGORY: Technological Change
ITEM: Key Individuals DATE: Sep 73 NO: 06.002.002.00

ASSUMPTION STATEMENT:

Although in-depth training will decrease, a number of factors inherent in rapid technological change will tend to emphasize the importance of key individuals within an organization. This will result from the diversity of level and relevance of the training of many "on-site" personnel, rapid technological changes that will be incompletely documented or transmitted; mismatches between tools, procedures, environments, support facilities --, these and other factors will tend to demand at least one or a few individuals with a high degree of expertise in taking initiative, working without direct documentation or experience on the problem and in other ways able to improvise answers which will keep the organization running. These key people will have the capability to diagnose (troubleshoot) under a wide variety of conditions and to improvise solutions.

INPUT I.D.	O
04.001.002	2
04.001.003	3
06.002.001	2
06.003.002	1
30.001.001	1
30.002.001	1
30.002.002	1
30.003.001	1
30.005.002	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	3	3	3	3	3										

OUTPUT I.D.
06.002.003
30.001.001
60.002.001
60.002.002

SOURCES:

1. Miller, Robert B.: File Memo - Summary of Trends in Navy Training, IBM Advisory Group, 27 March 73, Section 2.3
2. Reviewed by IBM Advisory Group, 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Education **CATEGORY:** Technological Change
ITEM: Training Mode **DATE:** Sep 73 **NO:** 06.002.003.00

ASSUMPTION STATEMENT:

Although the number and depth of procedural skills required of the operator of future industrial and military systems will decrease, the increasing degrees of interdependence of system functions in modern technologies mean that human operators will learn procedures that must be adapted to wider ranges of contingencies. Furthermore, the liabilities of various kinds of failure of equipment, and/or personnel, tend to increase the need for the operator to be able to take over when things normally planned for automatic or machine performance must have a manual intervention. Training to cope with a multitude of contingencies will be impractical. However, the use of interactive on-site devices will reduce the amount and depth of training required. (Source 1)

These J.P.A. (Job Performance Aid) devices will also reduce the level of individual required to maintain and operate equipment. (Source 2)

A counter-assumption to the above states that the takeover of increasingly complex systems by the operator will become difficult if not impossible. (Source 3)

INPUT I.D.	O
06.002.002	3
30.001.001	1
30.002.001	1
30.002.002	1
30.005.002	2
60.004.001	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	2	2	2	2										

OUTPUT I.D.
06.002.001

SOURCES:

1. Miller, Robert B.: File Memo - Summary of Trends in Navy Training, IBM Advisory Group, 27 March 73, Section 2.4
2. Fox, Raymond G.: NETS Strategic Seminar, IBM Advisory Group, 18 September 73
3. Adams, Dr. E. N.: NETS Strategic Seminar, IBM Advisory Group, 18 September 73
4. Reviewed by IBM Advisory Group 18 September 1973.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Education
ITEM: Task Modularization
CATEGORY: Educational Technology
DATE: Sep 73 NO: 06.003.001.00

ASSUMPTION STATEMENT:

Based on recent advances, it can be assumed that by the mid-1980's, techniques will have been developed that will permit efficient and effective task/skill definition and subsequent modularization of tasks. There will be generally acceptable criteria for subdividing a total job into segments of activity (or task clusters) that hang together psychologically.

A given cluster can be learned as a group, applied to the job as an entity, and used as a basis for estimating the range of variation in job situations to which the trained operator is likely to adapt with "x" amount of time for retraining or adjustment on the job.

An important indirect outcome of suitable task modularities is the ability to create data bases with an effective semantic (naming) discipline. These data bases will assist in making efficient changes to a training system. (Source 1)

These task modularities will enable training managers to manage training in relationship to specific job tasks and task profiles. (Source 2)

INPUT I.D.	O
04.001.002	2
06.002.001	2
06.003.002	1
06.006.002	2
30.002.001	1
30.002.002	1
30.004.001	1
60.002.002	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	2	2	3	3										

OUTPUT I.D.
04.002.001
06.003.003
06.004.001
30.001.001

SOURCES:

1. Miller, Robert B.: File Memo - Summary of Trends in Navy Training, IBM Advisory Group, 27 March 73, Section 3.1.
2. Fox, Raymond G.: NETS Strategic Seminar, IBM Advisory Group Meeting, 18 September 73.
3. Reviewed by IBM Advisory Group, 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Education CATEGORY: Educational Technology
ITEM: Task Optimization DATE: Sep 73 NO: 06.003.002.00

ASSUMPTION STATEMENT:
It is assumed that a major trend that stresses optimization of training through a more sophisticated task analysis process will continue to gain momentum. In the last twenty years, there has been an evolution from the training policy of "teach them what is nice for them to know" to that of "teach them what they will have to do." In part, this has come about because better ways of describing the performance requirements of jobs have been adopted and become widespread. Another development will be better means of translating performance requirements into psychological and behavioral models of the learning and performing process so that the "natural" capabilities of the student can be better capitalized, and his limits and liabilities compensated.

(Source 1)

Task analysis will relate to deferred training modules to facilitate the correlation of tasks with instructional delivery and management. Job needs/description will be cross-referenced to task requirements and instructional module cognitive content.

(Source 2)

INPUT I.D.	O
06.002.001	1
06.003.003	2
30.002.001	1
30.002.002	2
30.003.001	1
60.002.001	2
60.003.003	2

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	2	3	3	3	3										

OUTPUT I.D.
06.002.001
06.002.002
06.003.001
06.004.001
30.001.001
60.001.002
60.003.003

SOURCES:
1. Miller, Robert B.: File Memo - Summary of Trends in Navy Training. IBM Advisory Group, 27 March 73, Section 3.6.
2. Fox, Raymond G.: NETS Strategic Seminar, IBM Advisory Group Meeting, 18 September 1973
3. Reviewed by IBM Advisory Group, 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS

NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Education
CATEGORY: Educational Technology
ITEM: Modular Programs
DATE: Sep 73 NO: 06.003.003.00

ASSUMPTION STATEMENT:

It is assumed that by the mid-1980's the techniques of developing psychologically valid "modules of training" will have advanced to a degree that will permit the majority of training programs to be based strictly on modules. Discrete "courses," as we know them today, will cease to exist.

Each training module will logically and clearly interface with others of any pertinent sequence. The student's progression, therefore, capitalizes on what he has learned in previous modules. At the end of a given module, the trainee may branch to any one of several other modules; but in each case, the content of the previous module is a relevant and necessary stepping-stone to the next. Training modularities not only enable the economic benefits of scale, they also foster the focus of improvements in the state of the instructional art within well-defined sub-objectives in training curricula.
(Source 1)

Since modules will be precisely defined, it will be possible to test students and to construct individual performance profiles by module. This profile can be related to specific job requirements. (Source 2)

INPUT I.D.	O
06.002.001	2
06.003.001	3
30.001.001	1
30.002.001	1
30.002.002	1
30.004.001	1
60.002.001	2
60.003.003	3
60.004.001	2

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	2	2	2	2										

OUTPUT I.D.
06.003.002
06.004.001
06.006.002
60.001.002
60.003.002

SOURCES:

1. Miller, Robert B.: File Memo - Summary of Trends in Navy Training, IBM Advisory Group, 27 March 73, Section 3.7
2. Fox, Raymond G.: NETS Strategic Seminar, IBM Advisory Group, 18 September 1973
3. Reviewed by IBM Advisory Group, 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS

NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Education **CATEGORY:** Post Education/Training
ITEM: Graduate Performance **DATE:** Sep 73 **NO:** 06.004.001.00

ASSUMPTION STATEMENT:

It is assumed that by the mid-1980's, the modeling and concepts required to predict student post-training performance will have been developed to a level permitting practical inclusion in education management systems.

Recent models under development by the information and behavioral system theorists, and by contemporary investigations into the cognitive operations underlying linguistic processes, are revealing some models having promise. When these models are translated into instructional technique and into suitable task analytic statements, training may genuinely provide the psychological "fundamentals" for the transfer of training from very specific contexts to more general ones such as may underlie a job, family or a career structure.

INPUT I.D.	O
06.003.001	1
06.003.002	1
06.003.003	1
06.006.002	2
30.005.001	2
60.002.001	2

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	2	2	3	3										

OUTPUT I.D.
60.001.002
60.003.001

SOURCES:

1. Miller, Robert B.: File Memo - Summary of Trends in Navy Training, IBM Advisory Group, 27 March 1973, Section 3.2
2. Reviewed by IBM Advisory Group, 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Education CATEGORY: Simulators

ITEM: Feasibility DATE: Sep 73 NO: 06.005.001.00

ASSUMPTION STATEMENT:

It is assumed that by the mid-1980's a significant portion of current "hard" lab training will be administered in both the industrial and military training environments, through second level simulation. In the past, the high costs of computer hardware, programming and of terminals made the use of computer systems impractical as a vehicle to administer simulation exercises except for limited numbers of highly critical tasks where the cost of using the actual device more than off-set the cost of a computer system. Dramatic reductions in hardware costs and large simplifications in application programming will make the use of computers for simulation practical for even fairly low level jobs. This is particularly true if educational practice recognizes that absolute fidelity in representing the real-world is unnecessary, and that large variations from the total task environment may, for some training objectives, be adequate, and in fact preferable.

(Source 1)

In addition to simulation capability, computer technology will have reached a point where "stand alone" interactive devices will permit the administration of training modules on-site. The increased capability will permit individualization. (Source 2)

INPUT I.D.	O
05.001.001	3
30.002.001	1
30.002.002	1
30.004.001	1
30.005.001	3
30.005.002	1
60.002.001	3
60.003.003	1
60.004.001	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	2	2	3	3										

OUTPUT I.D.
06.006.002

SOURCES:

1. Miller, Robert B.: File Memo - Summary of Trends in Navy Training, IBM Advisory Group, 27 March 73, Section 3.3
2. Fox, Raymond G.: NETS Strategic Seminar, IBM Advisory Group, 18 September 1973
3. Reviewed by IBM Advisory Group, 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Education
ITEM: Automation
CATEGORY: Administration
DATE: Sep 73 NO: 06.006.001.00

ASSUMPTION STATEMENT:

It is assumed the present trend of automating the process of education administration will continue through the mid-1980's. Administrative overhead is very large in proportion to the direct costs of actual student instruction. There are substantial movements towards automation, whether acting alone or in consort with a human, to reduce the human processing time required in administering to the student: selection, housing, course program preparation, evaluation, accrediting, assigning, transferring, counselling, etc.

The result will be larger channels for student throughput, reduced variations in administrative competence and motivation, and a corresponding greater concentration on the primary mission of the training function. The creative application of automation to training administration could have larger and faster payoff than adapting the computer to training alone.

INPUT I.D.	O	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
04.003.001	1																	60.001.002
05.001.001	3	Start	1974	1980	1985	1990	2000											
30.005.001	3	End	1979	1984	1989	1999	--											
		Prob	2	3	3	3	3											

SOURCES:

1. Miller, Robert B.: File Memo - Summary of Trends in Navy Training, IBM Advisory Group, 27 March 73, Section 4.7
2. Reviewed by IBM Advisory Group, 18 September 1973.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Education CATEGORY: Administration
ITEM: Advanced Weapons Potential DATE: Sep 73 NO: 06.006.002.00

ASSUMPTION STATEMENT:

Assuming that current military and national doctrines continue on their present course and that resource restrictions remain, it can be further assumed that very complex weapons systems may be designed and developed to "paper" levels with either no or very limited hardware production. In the event of critical need, the "paper" system, already field tested through complex simulation, would be rapidly implemented.

The training program for such a "paper" weapon would have to be developed to an "off-the-shelf" stage and held in readiness. Course development and administrative predictive tools would be applied to course validation.

INPUT I.D.	O
06.002.001	1
06.003.003	1
06.005.001	2
30.001.001	1
30.002.001	1
30.002.002	1
30.005.001	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	2	2	2	2										

OUTPUT I.D.
05.001.001
06.003.001
06.004.001

SOURCES:
1. Bowen, C. R.: NETS Strategic Seminar, IBM Advisory Group Meeting, 18 September 1973.
2. Reviewed by IBM Advisory Group, 18 September 1973.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Education CATEGORY: Motivation
ITEM: Student DATE: Sep 73 NO: 06.008.001.00

ASSUMPTION STATEMENT:

It can be assumed that one of the primary student motivations of the past, the need for education/training to provide life's necessities, will decline in value and that public, industrial and military training organizations will be impacted.

Based on MacGregor's thesis that a satisfied need is no longer a motivation of behavior and the fact that in our affluent society many have no concern for filling their basic needs, training motivations will have to be of a higher level including appeals to social acceptance, social approval, self-acceptance and dignity, esteem, prestige, and self-fulfillment.

INPUT I.D.	0
02.001.001	2
03.002.001	3
03.002.003	1
04.001.003	1
60.004.004	2

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	3	3	3	3	3										

OUTPUT I.D.
01.001.001
01.001.002
04.001.001
04.001.002
06.001.001
06.001.002
06.007.001
22.002.001
60.002.002
60.004.002

SOURCES:

1. Wermuth, Dr. Anthony L., Potential Impacts of Cultural Change on the Navy in the 1970's, Westinghouse, Falls Church, Va., August 1972, Vol-I, 6.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Education CATEGORY: Measurement
ITEM: Certification DATE: Sep 73 NO: 06.007.001.00

ASSUMPTION STATEMENT:

The present movement towards certification of competence, as opposed to certification by completion of some formal study program, will gain momentum. This will be especially true in the industrial and military training areas.

This shift is being made possible through improvements in the capability to define training exit skills, knowledge and attitudes, and equally important, to measure criterion achievement.

The traditional motivators (a diploma after four years of college, a passing grade at the end of a semester, earning credits, etc.), will have to be modified somewhat to reflect the motivational needs of a student achieving criteria within an unstructured time base.

INPUT I.D.	O	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
02.001.001	1																	01.001.001
06.008.001	1	Start	1974	1980	1985	1990	2000											01.001.002
60.004.004	2																	06.001.001
																		06.001.002
																		22.002.001
		End	1979	1984	1989	1999	--											60.002.002
																		60.004.002
		Prob	2	3	3	3	3											

SOURCES:

1. Adams, Dr. E. N.: NETS Strategic Seminar, IBM Advisory Group Meeting, 18 September 1973
2. Reviewed by IBM Advisory Group, 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: International | CATEGORY: Joint Efforts
ITEM: Regional Powers | DATE: Sep 73 | NO: 20.001.001.00

ASSUMPTION STATEMENT:

Since all international powers will be restricted in force size by the high cost of weapon's technology, the next two decades will see significant increases in the sharing of mission responsibilities between powers with mutual concerns. This sharing could lead to specialization of national forces. For example, a small power could provide strictly "presence" naval forces with a cooperating large power providing a high technology force which would be supporting a number of small low-technology presence fleets.

INPUT I.D.	O
20.002.001	3
20.002.002	1
20.003.001	2
20.003.002	1
20.004.001	1
40.002.002	3
40.003.001	2
40.003.006	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	2	3	3	3										

OUTPUT I.D.
05.002.001
20.002.003
40.001.004

SOURCES:

1. Bowen, C. R.: NETS Strategic Seminar, IBM Advisory Group Meeting, 18 September 1973.
2. Reviewed by IBM Advisory Group, 18 September 1973.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: International
ITEM: Multipolar

CATEGORY: Military Environment
DATE: Sep 73 NO: 20.002.001.00

ASSUMPTION STATEMENT:

It can be assumed that the bipolar environment shared by the U.S. and the USSR will continue to evolve through the 1980's into a fairly complex multipolar environment consisting of sophisticated and as yet unsettled arrays of real economic, political and military influence.

The U.S., Western Europe and Japan, each having a critical dependence on resources beyond its shores will find unimpeded ocean trade and transport critical to its economy and defense posture.

Assuming a continued lack of adequate resources for U.S. sea control in the projected multipolar environment, it can be assumed that the U.S. will require either resource or force support from other powers benefiting from such control.

INPUT I.D.	O
20.002.002	1
20.003.001	2
20.003.002	1
20.004.001	1
40.002.001	2
40.002.002	2

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	3	3	3	4	4										

OUTPUT I.D.
20.001.001
30.004.002
40.001.004
40.001.005
40.003.001
40.003.002
40.003.003
40.003.006

SOURCES:

1. Committee #8, "Sea Control Forces," Naval Mission Area Paper, The U.S. Naval War College, Newport, R.I., 1973, 1-3

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: International CATEGORY: Military Environment
ITEM: Law of the Sea DATE: Sep 73 NO: 20.002.002.00

ASSUMPTION STATEMENT:

Since many of the states which will be participating in the November 1973, Law of the Sea Conference (LOSC) have expressed the belief that the breadth of the territorial sea and contiguous zone as proposed in the 1958 conventions are inadequate, it is reasonable to assume that an expanded territorial sea will be proposed. Consensus appears to support a 12 mile territorial sea with a somewhat larger contiguous zone, probably 24 miles.

If this assumption is correct, 116 straits in the world will revert to territorial waters and, presumably, require that vessels transiting such straits adhere to the provisions of innocent passage. Unless 6 critical straits of the 116 are excluded, amphibious projection operations will be seriously hampered, particularly in the Mediterranean, Red Sea, and Persian Gulf Areas.

INPUT I.D.	O	OUTPUT I.D.
20.003.001	3	20.001.001
		20.002.001
		40.001.003
		40.001.004

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	3	3	3	3	3										

SOURCES:

1. Committee #14, "Amphibious Projection Forces," Naval Mission Area Paper, The U.S. Naval War College, Newport, R.I., 1973, 31 & 32

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: International | CATEGORY: Military Environment
ITEM: Small Navies | DATE: Sep 73 | NO: 20.002.003.00

ASSUMPTION STATEMENT:

It can be assumed that the navies of "small" powers will have the following characteristics by the mid-1990's:

1. Surface effect ships will have replaced the displacement hull (of 1000 tons displacement).
2. Relatively small submarines will satisfy the sub-surface roll. Stress will be on detection rather than endurance.
3. Use of VTOL aircraft will have increasing application in the air support role.
4. Technological innovations such as laser weapons, multi-use platforms, modularity, etc., will significantly increase small navy effectiveness.

Many nations have had to make do with old WW II ships. The next two decades will provide an opportunity for small navies to make a major leap forward when they plan the acquisition of replacements.

INPUT I.D.	O
20.001.001	2
20.003.001	2
40.002.002	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	1	2	2	3										

OUTPUT I.D.
30.004.001
30.006.001
40.001.004
40.003.001

SOURCES:

1. Committee #38, "Small Future Navies," Naval Mission Area Paper, The U.S. Naval War College, Newport, R.I., 1973.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: International **CATEGORY:** Geopolitical
ITEM: Importance of Sea **DATE:** Sep 73 **NO:** 20.003.001.00

ASSUMPTION STATEMENT:

It can be assumed that within the next 10 years, 90 percent of the world's population will reside within 600 miles of navigable ocean surface.

From a U.S. viewpoint, the geopolitical importance of the sea cannot be denied. Of 111 sovereign states having coastlines, 42 enjoy defense treaty commitments with the U.S. In this day of rapid cultural, industrial, population, economic and, above all, technological growth, it can be assumed that the U.S. can no longer continue to serve as the world's policeman.

Recognition of this fact is evident in the Nixon Doctrine.

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	3	3	3	3	3										

INPUT I.D.	O	OUTPUT I.D.
		20.001.001
		20.002.001
		20.002.002
		20.002.003
		40.001.004
		40.001.005
		40.002.001
		40.002.002
		40.003.004
		40.003.005

SOURCES:

1. Committee #17, "Presence," Naval Mission Area Paper, The U.S. Naval War College, Newport, R.I., 1973, 1

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: International CATEGORY: Geopolitical
ITEM: Technology DATE: Sep 73 NO: 20.003.002.00

ASSUMPTION STATEMENT:

There is no question that technological advances can benefit entire populations and lead to increased international cooperation. However, it can also be assumed that certain types of change can become the seed cause of conflict.

The impacts of technology, primarily Western, on long-held values may be highly disturbing. To promote radical change without being aware of the latent potential disruptions is to invite strains the host community itself does not understand. Issues about which polarization may be expected include the need for population control, the dominance of Western life due to increased industrialization - contributing to the resultant revolution of rising expectations, and the coming competition over exploration of the resources in the oceans and the seabeds. These issues are potentially explosive.

INPUT I.D.	O	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
30.005.001	3	Start	1974	1980	1985	1990	2000											20.001.001
		End	1979	1984	1989	1999	--											20.002.001
		Prob	3	3	3	3	3											40.002.001

SOURCES:

1. Wermuth, Dr. Anthony L., Potential Impacts of Cultural Change on the Navy in the 1970's, Westinghouse, Falls Church, Va., August 1972, Vol-I, 32 & 33.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: International
CATEGORY: Resources
ITEM: Basic Necessities
DATE: Sep 73 NO: 20.004.001.00

ASSUMPTION STATEMENT:

It is assumed that the lack of basic resources required for survival will become an increasingly major factor in international relationships.

It is predicted that economic and technological gaps will widen, that 85% of the world will be struggling to survive, that food production may fall further behind population growth, and that resources are dwindling and will be difficult for the heaviest users to import. The less developed countries are already warning the advanced countries that they will not remain indefinitely in states of technological and economic inferiority.

It appears essential that the U.S. maintain a substantial Navy for deterrence of conflict or defense of American interests against resource predators for years to come.

INPUT I.D.	O	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
		Start	1974	1980	1985	1990	2000											20.001.001 20.002.001 40.002.001
		End	1979	1984	1989	1999	--											
		Prob	3	3	3	3	3											

SOURCES:

1. Wermuth, Dr. Anthony L., Potential Impacts of Cultural Change on the Navy in the 1970's, Westinghouse, Falls Church, Va., August 1972, Vol-I, 31 & 34

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Domestic Institutions CATEGORY: Economy
ITEM: Worker Skill DATE: Sep 73 NO: 22.001.001.00

ASSUMPTION STATEMENT:

It can be assumed that the American economy will be marked by increasing efficiency and automation, and that this, in turn, will lead to less demand for unskilled and semi-skilled workers. However, there will be an increased demand for professional, technical, and paraprofessional personnel.

Manpower utilization policies will change; shorter work days and weeks, more holidays, longer vacations, more fringe benefits, early retirement coupled with vested pension rights, and flexible hours - all will be part of industry's attempts to cope with automation - induced unemployment, greater employee self-assertion and organization, and concepts of increasing productivity through positive reinforcement.

INPUT I.D.	O	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
		Start	1974	1980	1985	1990	2000											01.001.001 04.003.001 04.004.001
		End	1979	1984	1989	1999	--											
		Prob	2	3	3	3	3											

SOURCES:

1. Wermuth, Dr. Anthony L., Potential Impacts of Cultural Change on the Navy in the 1970's, Westinghouse, Falls Church, Va., August 1972, Vol-I, 85.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Domestic Institutions CATEGORY: Education
ITEM: Value of Degree DATE: Sep 73 NO: 22.002.001:00

ASSUMPTION STATEMENT:

It can be assumed that in all sectors of society, the value of a college degree will decline as a prerequisite to employment. The degree explosion and consequent cheapening of a university education, coupled with the disillusionment of the "over-qualified" individual is tending to ensure this.

The concept of education, as an integral part of life, will grow and the current division between work and education will become less distinguishable.

INPUT I.D.	O
02.001.001	1
06.007.001	3
06.008.001	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	-										
Prob	2	3	3	3	3										

OUTPUT I.D.
01.001.002
06.001.001
06.001.002
06.001.003

SOURCES:

1. Wermuth, Dr. Anthony L., Potential Impacts of Cultural Change on the Navy in the 1970's, Westinghouse, Falls Church, Va., August 1972, Vol-I, 86.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Technological
CATEGORY: Education/Training
ITEM: Skill Transferability
DATE: Sep 73
NO: 30.001.001.00

ASSUMPTION STATEMENT:

It is assumed that future education and training plans will be increasingly impacted by two major variables: the psychological aspects of growable skill and competence from one "level" of skill (or range of skills) to another; and the administrative aspects which determine what is organizationally feasible in terms of opportunity for experience and migration of individuals into broader or more specialized work.

Source # 2 - "7. Navy manpower forecasts will be complicated by increased specialization, changing demand for individuals with key skills, and the rapidity with which certain skill requirements will change."

INPUT I.D.	O
06.002.002	2
06.003.001	2
06.003.002	2
30.004.001	1
60.001.002	2
60.002.001	1
60.004.001	2

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	2	3	3	3	3										

OUTPUT I.D.
06.002.001
06.002.002
06.002.003
06.003.003
06.006.002
60.003.002

SOURCES:

1. Miller, Robert B.: File Memo - Summary of Trends in Navy Training, IBM Advisory Group, 27 March 73, Section 2.1
2. Wermuth, Dr. Anthony L.: Potential Impacts of Cultural Change on the Navy in the 1970's, Westinghouse, Falls Church, Va., August 1972, Vol-I, 40.
3. Reviewed by IBM Advisory Group Meeting, 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Technological **CATEGORY:** Task Reduction
ITEM: Devices **DATE:** Sep73 **NO:** 30.002.001.00

ASSUMPTION STATEMENT:

It is assumed that the present trend of reducing or eliminating manual/mental tasks through low cost job aids will accelerate through the next decade. Micro-electronics is rapidly paving the way for miniaturized and low cost job aids in the form of calculators, information retrieval terminals and other devices, stand-alone or attached to computers. These devices will largely replace reference manuals, job instructions, checklists, planning guides and a large number of job aids ranging from planning and decision making, through diagnosis, down to clerical and low level procedural activities. These devices will have radical effects on the kinds and amount of formal training required to prepare people for their tasks, and especially for cross-training and modifications to training. Obviously, these devices will change job procedures, and, therefore, training objectives.

(Source 1)

The resultant of the above will be a shift from formal training to "on-the-job" acquisition of the skills required to properly utilize the JPA's (Job Performance Aids).

(Source 2)

INPUT I.D.	O
05.001.001	1
30.005.001	3
30.005.002	2
40.003.001	1

PERIODS	a	b	c	d	e	f	g	h	i	i	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	2	2	2	3										

OUTPUT I.D.
04.001.002
04.004.001
06.002.001
06.002.002
06.002.003
06.003.001
06.003.002
06.003.003
06.005.001
06.006.002

SOURCES:

1. Miller, Robert B.: File Memo - Summary of Trends in Navy Training, IBM Advisory Group, 27 March 73, Section 3.5
2. Fox, Raymond G.: NETS Strategic Seminar, IBM Advisory Group, 18 September 1973
3. Reviewed by IBM Advisory Group, 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Technological **CATEGORY:** Task Reduction
ITEM: Reliability **DATE:** Sep 73 **NO:** 30.002.002.00

ASSUMPTION STATEMENT:

Although difficult to quantify, it can be assumed that there will be a significant increase in the reliability of weapons systems and their supporting systems. The skill level required of maintenance personnel will be significantly reduced. Operators will not require as high a level or quantity of contingency skills.

Since failure rates will become so low as to preclude any meaningful reinforcement of skills through experience, the armed forces will increasingly depend on Job Performance Aids in lieu of training, artificial reinforcement of required skills through simulation, and/or remote maintenance or maintenance support.

INPUT I.D.	O	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
40.003.001	1	Start	1974	1980	1985	1990	2000											04.001.002
		End	1979	1984	1989	1999	--											04.004.001
		Prob	2	3	3	3	3											06.002.001
																		06.002.002
																		06.002.003
																		06.003.001
																		06.003.002
																		06.003.003
																		06.005.001
																		06.006.002

SOURCES:

1. Fox, Raymond G.: NETS Strategic Seminar, IBM Advisory Group, 18 September 1973.
2. Reviewed by IBM Advisory Group 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Technological	CATEGORY: Personnel
ITEM: Competence	DATE: Sep 73 NO: 30.003.001.00

ASSUMPTION STATEMENT:

Assuming that the "arms race" becomes a race for high technologies instead of quantitating arms, it can be assumed that the net resultant may be a requirement for a very considerably smaller number of manpower, a relatively small percent of whom constitute a highly trained, technologically sophisticated elite.

Very high technology has certain characteristics almost invariably wherever it appears. To operate high technology where deviance from a routine is required, generally much higher standards of intelligence and technical performance are required. Conversely, at a lower level where routine performance is required, a much lower level of competence is required which normally gives way to automation of the function.

INPUT I.D.	O
30.005.002	2
40.001.001	1
40.003.001	1
60.001.001	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	2	3	3	3										

OUTPUT I.D.
04.004.001
06.002.002
06.003.002
40.001.005
60.003.001
60.003.003
60.004.003
60.004.005

SOURCES:

1. Bowen, C. R.: File Memo - Future of the U.S. Navy Training System, IBM Advisory Group, 15 June 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Technological **CATEGORY:** Weapons
ITEM: Interchangeability **DATE:** Sep 73 **NO:** 30.004.001.00

ASSUMPTION STATEMENT:

Due to the cost and complexity of future weapon's technologies combined with the need to have weapon platforms serve multiple tactical requirements, it can be assumed that both the modules comprising a given weapon and the weapons of a given delivery platform will have a high degree of interchangeability.

It is understood that support systems for weapons will be so complex as to preclude "interchangeability." However, it is felt that force reductions will make versatility an essential characteristic of future force units.

INPUT I.D.	o	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
20.002.003	1																	06.002.001
40.001.004	1	Start	1974	1980	1985	1990	2000											06.003.001
40.003.001	1																	06.003.003
																		06.005.001
																		30.001.001
																		40.001.002
		End	1979	1984	1989	1999	--											40.001.005
																		60.001.001
																		60.001.002
																		60.003.002
		Prob	1	2	2	2	2											60.003.003

SOURCES:

1. Bowen, C. R., NETS Strategic Seminar, IBM Advisory Group Meeting, 18 September 1973.
2. Reviewed by IBM Advisory Group, 18 September 1973.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Technological **CATEGORY:** Weapons
ITEM: Satellite Neutralization **DATE:** Sep 73 **NO:** 30.004.002.00

ASSUMPTION STATEMENT:

If it can be assumed that to successfully accomplish its three missions (Presence, Projection and Control) with restricted force levels, the Navy must have the capability to deny its intentions to an enemy and to isolate the objective area, it becomes obvious that measures must be taken to neutralize projected enemy satellite capability.

Based on this, it can be assumed that R&D will lead to sophisticated methods of jamming, deception, denial or destruction of enemy satellites.

INPUT I.D.	O
20.002.001	1
40.001.002	2
40.001.003	2
40.001.004	2
40.001.005	2
40.003.002	1
40.003.003	2

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	2	3	3	3	3										

OUTPUT I.D.

SOURCES:

1. Committee #25, "Impact of a Satellite Environment on Naval Operations," Naval Mission Area Paper, The U.S. Naval War College, Newport, R.I., 1973, 11.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Technological **CATEGORY:** Automation
ITEM: Computer Capability **DATE:** Sep 73 **NO:** 30.005.001.00

ASSUMPTION STATEMENT:
Assuming a continuation of the current rate of computer development, it can be assumed that by the mid-1980's computer capability will increase approximately ten fold and physical size and environmental requirements will be reduced by a factor of ten. It is also assumed that the cost per interaction will significantly decrease.

The implications to even the smallest and most remote military unit or force are significant particularly in the area of information transfer and its associated area, training. The use of computing power for remote maintenance, on-site Job Performance Aids, computer assisted instruction, etc., will significantly increase.

INPUT I.D.	O	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
																		05.001.001
																		06.004.001
																		06.005.001
		Start	1974	1980	1985	1990	2000											06.006.001
																		06.006.002
																		20.003.002
																		30.002.001
		End	1979	1984	1989	1999	-											30.005.002
																		40.003.001
																		60.001.002
		Prob	2	3	3	3	3											60.002.001

SOURCES:

1. Bowen, C. R.: NETS Strategic Seminar, IBM Advisory Group Meeting, 18 September 1973
2. Reviewed by IBM Advisory Group, 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Technological CATEGORY: Automation
ITEM: Weapons Systems DATE: Sep 73 NO: 30.005.002.00

ASSUMPTION STATEMENT:

It can be assumed that the current trend to automated support and weapons systems will continue to accelerate. Although it is too early to assess the impact on personnel skill requirements, some sub-assumptions can be projected as follows:

a. Only a very limited number of people will be required to maintain and operate very large and complex systems relative to today's requirement for a similar system.

b. Although the normal tasks required of personnel will demand lower skills than required by current systems, the operator may require some very high level capabilities to permit his intervention in the automated process if the tactical situation demands it.

INPUT I.D.	O	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
05.002.001	3	Start	1974	1980	1985	1990	2000											04.004.001
30.005.001	3																	06.002.002
																		06.002.003
																		06.005.001
																		30.002.001
																		30.003.001
		End	1979	1984	1989	1999												40.001.002
																		40.001.005
																		40.003.001
																		60.003.003
		Prob	1	2	2	2	3											

SOURCES:

1. Bowen, C. R.: NETS Strategic Seminar, IBM Advisory Group, 18 September 1973
2. Reviewed by IBM Advisory Group, 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Technological **CATEGORY:** Military Platforms
ITEM: Air Cushion Vehicles **DATE:** Sep 73 **NO:** 30.006.001.00

ASSUMPTION STATEMENT:

It can be assumed that by the mid-1980's ACV hulls of 4000 to 5000 tons will be possible with sufficient size for any form of propulsion including nuclear.

The ACV has the following advantages:

1. The ACV raft-like shape gives a stable weapon platform.
2. It can be built to be amphibious.
3. It can have a light structure despite its large size.
4. It can be designed to have a large "flat top" almost as big as the craft allowing the operation of VTOL aircraft and helicopters or the positioning of weapon systems, radars, and payloads anywhere at will.
5. It can have a low acoustic, pressure and magnetic signature.

INPUT I.D.	0	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D
20.002.003	2	Start	1974	1980	1985	1990	2000											40.001.004
		End	1979	1984	1989	1999	-											40.001.005
		Prob	1	2	3	3	3											40.003.005

SOURCES:

1. Committee #38, "Small Future Navies," Naval Mission Area Paper, The U.S. Naval War College, Newport, R.I., 1973, 9 & 10

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Military Doctrine CATEGORY: Mission
ITEM: Political DATE: Sep 73 NO: 40.001.001.00

ASSUMPTION STATEMENT:

The present shift from a doctrine of "mutual exclusion," a reasonably clear separation of civilian and military functions, to a doctrine using the military as a bargaining instrument for acceptable political solutions will continue through the mid-1980's.

Prior to this shift, the mission was the destruction of the enemy armed force in the shortest period of time with the fewest possible friendly casualties. During the negotiating phase of the Korean war, the combat function lost its last vestige of autonomy from politics. The world situation will require the orchestration of the military instrument with the other elements of statecraft - political, economic, psychological, and social. The mutual exclusion of civilian and military roles has given way to what has been called "fusionism." Civilian participation in what had been the exclusive province of the military has proceeded rapidly.

INPUT I.D.	O	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
40.002.001	3																	30.003.001
40.002.002	3	Start	1974	1980	1985	1990	2000											60.005.001
																		60.005.002
																		60.005.003
		End	1979	1984	1989	1999	--											
		Prob	3	3	3	3	3											

SOURCES:

1. Gard, Brigadier General Robert G., Jr., U.S. Army, "The Military Profession", Naval War College Review, Naval War College, Vol. 26 No. 1/244, July/August 1973, 8

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Military Doctrine **CATEGORY:** Mission
ITEM: Tactical Air Projection **DATE:** Sep 73 **NO:** 40.001.002.00

ASSUMPTION STATEMENT:

Excluding strategic nuclear war, the worst case threat to the U.S. is general non-nuclear or tactical nuclear war with the USSR. The following assumptions pertinent to use of naval tactical air under non-nuclear case conditions are:

1. Since in the early worst case situation, the sea control mission would predominate, Naval air projection forces should be tailored to use in later stages of worst case when at least local sea control and air superiority have been established.
2. For low threat environments, the Sea Control Ship with VSTOL aircraft would produce the desired results.
3. Although attack carrier levels will decline, the international situation will demand sufficient numbers to cover mid-intensity and greater exposures.

INPUT I.D.	O
05.002.001	1
30.004.001	1
30.005.002	1
40.001.005	1
40.002.001	3
40.002.002	3
40.003.001	1
40.003.005	1
40.003.006	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	3	3	3	2	4										

OUTPUT I.D.
30.004.002
60.004.003

SOURCES:

1. Committee #12, "Naval Tactical Air Projection Forces," Naval Mission Area Paper, The U.S. Naval War College, Newport, R.I., 1973, i, 3 & 13

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Military Doctrine **CATEGORY:** Mission
ITEM: Amphibious Projection **DATE:** Sep 73 **NO:** 40.001.003.00

ASSUMPTION STATEMENT:

Assuming no major shift in the Nixon Doctrine, the following can be assumed pertinent to the use of Amphibious Projection Forces (APF).

1. APF's will continue to provide the U.S. with a vital capability for prosecution of a maritime strategy as amplified by the Nixon Doctrine. The APF allows the President to choose the time, place and degree of involvement without concern for shore-basing or over flight rights.
2. Current APF sealift and manpower levels will be adequate to meet any contingencies within the 1975-1985 time-frame.
3. Current tactics and weapons systems will require continuous R&D and procurement in order to maintain a credible balanced force.

INPUT I.D.	δ	PERIODS																OUTPUT I.D
05.002.001	1		a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	30.004.002
20.002.002	1	Start	1974	1980	1985	1990	2000											
40.001.005	1																	
40.002.001	2																	
40.002.002	3																	
40.003.001	1																	
40.003.006	1	End	1979	1984	1989	1999	--											
		Prob	3	3	4	4	4											

SOURCES:

1. Committee #14, "Amphibious Projection Forces," Naval Mission Area Paper, The U.S. Naval War College, Newport, R.I., 1973, 28 & 30.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS

NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Military Doctrine **CATEGORY:** Mission
ITEM: Presence Forces **DATE:** Sep 73 **NO:** 40.001.004.00

ASSUMPTION STATEMENT:

Due to the range and degree of forces required to support the Naval presence mission, it can be assumed that some significant changes may be made in the tactics of maintaining presence if the mission is to be accomplished within available limited resources.

Assuming that U.S. Naval Forces diminish and task forces can no longer be sustained indefinitely in distant areas, individual ships or forces consisting of a few ships will have to be relied upon to convey at least occasional evidence of U.S. goodwill and concern in those areas where once the U.S. Navy was able to sustain formidable presence forces.

INPUT I.D.	O
05.002.001	1
20.001.001	2
20.002.001	2
20.002.002	2
20.002.003	2
20.003.001	2
30.006.001	1
40.002.001	2
40.002.002	3
40.003.001	2
40.003.006	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	3	3	3	4	4										

OUTPUT I.D
30.004.001
30.004.002
40.003.005

SOURCES:

1. Committee #17, "Presence," Naval Mission Area Paper, The U.S. Naval War College, Newport, R.I., 1973, 12

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Military Doctrine
CATEGORY: Mission
ITEM: Sea Control
DATE: Sep 73 **NO:** 40.001.005.00

ASSUMPTION STATEMENT:

It can be assumed that up to 1980, Sea Control among the Naval General Forces will receive resource priority.

Despite the encouraging aspects of detente with the Soviet Union, the fact remains that the Soviets are capable of challenging us now, and other countries will probably be able to do so in the forseeable future. More importantly, our decreasing ability to survive in the open ocean environment without incurring significant, if not prohibitive, losses, is probably the Achilles heel of the U.S. Navy's posture today.

INPUT I.D.	O
05.002.001	1
20.002.001	2
20.003.001	3
30.003.001	1
30.004.001	1
30.005.002	1
30.006.001	1
40.002.001	3
40.002.002	2
40.003.001	2
40.003.006	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	2	4	4	4	4										

OUTPUT I.D
30.004.002
40.001.002
40.001.003

SOURCES:

1. Committee #27, "Achieving a Shift in Focus of General Purpose Naval Forces From a Projection Mission to a Sea Control Mission," Naval Mission Area Paper, The U.S. Naval War College, Newport, R.I., 1973, 11.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Military Doctrine **CATEGORY:** National Policy
ITEM: Defense **DATE:** Sep 73 **NO:** 40.002.001.00

ASSUMPTION STATEMENT:

The concept of "national security" as opposed to "national defense" will remain a primary base through the mid-1980's.

The national defense approach was based on security maintenance through reliance on a tiny, physically isolated army and a relatively large but still small Navy, both of which could be expanded by mobilization in time of emergency. In case of threat, destruction of the offending force was considered the clearest way to end the threat to freedom. Little attention was paid to using limited force to defeat the enemy.

The national security policy is applicable in both peace and war. The world situation will continue to require not only the maintenance of substantial ready forces, but also the orchestration of the military instrument with the other elements of statecraft-political, economic, psychological and social. Deterrence of general war will have the highest national priority.

INPUT I.D.	O	PERIODS																OUTPUT I.D.
20.003.001	2		a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	20.002.001
20.003.002	2	Start	1974	1980	1985	1990	2000											40.001.001
20.004.001	1																	40.001.002
40.002.002	3																	40.001.003
																		40.001.004
																		40.001.005
		End	1979	1984	1989	1999	--											40.003.001
																		40.003.003
																		60.005.001
																		60.005.002
		Prob	3	3	3	3	3											60.005.003

SOURCES:

1. Gard, Brigadier General Robert G., Jr., U.S. Army, "The Military Profession," Naval War College Review, Naval War College, Vol. 26, No. 1/244, July/August 1973, 10

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Military Doctrine **CATEGORY:** National Policy
ITEM: Nixon Doctrine **DATE:** Sep 73 **NO:** 40.002.002.00

ASSUMPTION STATEMENT:
It is assumed that the key elements of the Nixon Doctrine will continue to form the basis for U.S. military doctrine into the mid-1980's. Although the doctrine stresses diplomatic efforts for peace and the avoidance of confrontation, it does state that the U.S. will:

1. Keep all treaty commitments.
2. Provide a nuclear shield for its allies.
3. Provide military and economic assistance when requested.
4. Rely on the nation directly threatened to provide manpower and the major effort in its own defense.
5. Provide help wherever it will make a difference and contribute to the interests of the United States.

In support of the above, the Navy defines four mission areas.
1. Strategic nuclear deterrence; 2. Power Projection; 3. Sea Control; 4. Overseas Presence.

INPUT I.D.	O
20.003.001	2

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	3	3	3	4	4										

OUTPUT I.D.
20.001.001
20.002.001
20.002.003
40.001.001
40.001.002
40.001.003
40.001.004
40.001.005
40.002.001
40.003.001
40.003.002

SOURCES:
1. Committee #17, "Presence," Naval Mission Area Paper, The U.S. Naval War College, Newport, R.I., 1973, 1-2

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Military Doctrine
CATEGORY: Armaments
ITEM: Level
DATE: Sep 73 NO: 40.003.001.00

ASSUMPTION STATEMENT:

Due to a leveling in the quantity of naval armaments, just as was the case with strategic missiles, it can be assumed that the race will be technological rather than quantitative. The diversion of expenditures otherwise slated for additional fleet units (beyond replacement) will go into increased research and development. This should lead to much more complex, sophisticated equipment to insure a continued qualitative superiority in weapons over any other nation.

INPUT I.D.	O
20.002.001	2
20.002.003	2
30.005.001	3
30.005.002	3
40.002.001	3
40.002.002	3
40.003.002	2
40.003.006	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	2	3	3	3										

OUTPUT I.D.
20.001.001
30.002.001
30.002.002
30.003.001
30.004.001
40.001.002
40.001.003
40.001.004
40.001.005
60.001.001
60.003.003

SOURCES:

1. Bowen, C. R.: File Memo - Future of the U.S. Navy Training System, IBM Advisory Group, 15 June 1973.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Military Doctrine **CATEGORY:** Armaments
ITEM: Strategic Deterrence **DATE:** Sep 73 **NO:** 40.003.002.00

ASSUMPTION STATEMENT:

The following can be assumed to be a general U.S. nuclear deterrence strategy that will support stated national policy:

> "A comprehensive direction of power (military, diplomatic, and economic power) to persuade our adversaries that it is in their interest to desist from a nuclear attack on the United States and to pursue, with us, serious negotiations toward limiting, then reducing, and eventually banning nuclear weapons."

Although national policy is hard to define, President Nixon's statements that we are seeking a decade or generation of peace; that we are moving from an era of confrontation to one of negotiation; that we are seeking to curb and reverse the arms race; and that our ultimate goal is complete nuclear disarmament; tend to support the above strategy.

INPUT I.D.	O
20.002.001	1
40.002.002	3

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	3	3	3	4	4										

OUTPUT I.D.
30.004.002
40.003.001
40.003.003
40.003.004

SOURCES:

1. Committee #3, "Strategic Deterrence Forces," Naval Mission Area Paper, The U.S. Naval War College, Newport, R.I., 1973, 3 & 4

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS

NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Military Doctrine CATEGORY: Armaments
ITEM: Second Strike DATE: Sep 73 NO: 40.003.003.00

ASSUMPTION STATEMENT:

It is assumed that the U.S. currently has the level of nuclear second strike capability required to support its present strategy.

Since "deterrence" is the key philosophy guiding this strategy, it can be assumed that the limited funds projected for national defense will not be diverted to development of a first strike capability. It can be assumed that the destructive capability of the U.S. arsenal, even granting the unlikely event that two-thirds of it were destroyed, is still sufficient to wreck such devastation as any rational adversary would consider unacceptable. To the extent that any adversary can be deterred, therefore, our present nuclear capability is sufficient for such deterrence.

INPUT I.D.	o
20.002.001	2
40.002.001	3
40.003.002	3

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	3	3	3	4	4										

OUTPUT I.D.
30.004.002
40.003.004

SOURCES:

1. Committee #3, "Strategic Deterrence Forces," Naval Mission Area Paper, The U.S. Naval War College, Newport, R.I., 1973, 5 & 7

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Military Doctrine **CATEGORY:** Armaments
ITEM: SLBM **DATE:** Sep 73 **NO:** 40.003.004.00

ASSUMPTION STATEMENT:

It is assumed that, in a five to ten year range, nuclear deterrence strategy will continue to depend upon the triad of strategic bomber, ICBM and SLBM. However, it can also be assumed that after that period has elapsed, the SLBM will predominate.

Current vulnerability of the strategic bomber and ICBM missile silos will result in the SLBM leading based on its survivability of a first strike. Even if the enemy suddenly made a gargantuan technical breakthrough in ASW sensors, his forces would still have to search over three million square miles of ocean to locate and destroy FBM submarines.

This assumption is predicated upon development and implementation on a totally reliable and effective command, control, and communications system.

INPUT I.D.	O
05.002.001	2
20.003.001	3
40.003.002	3
40.003.003	3
40.003.006	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	2	2	3	3										

OUTPUT I.D.

SOURCES:

1. Committee #3, "Strategic Determence Forces," Naval Mission Area Paper, The U.S. Naval War College, Newport, R.I., 1973, 16 & 17.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Military Doctrine **CATEGORY:** Armaments
ITEM: Capital Presence Ship **DATE:** Sep 73 **NO:** 40.003.005.00

ASSUMPTION STATEMENT:
Based on the assumption that aircraft carriers, perhaps the ultimate in presence forces, have become inordinately expensive to construct and operate, it can be assumed there will be an evolution to a smaller, less costly, and more plentiful type of ship with some air-projection potential. Therefore, the Sea Control Ship may very well become the capital presence ship of the future.

Although the SCS will never replace the aircraft carrier, it can serve in a power projection role in those areas where the presence of a carrier may be provocative or unwarranted.

INPUT I.D.	O
20.003.001	3
30.006.001	1
40.001.004	3

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	2	3	4	4										

OUTPUT I.D.
40.001.002

SOURCES:

1. Committee #17, "Presence," Naval Mission Area Paper, The U.S. Naval War College, Newport, R.I., 1973, 12-13

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Military Doctrine **CATEGORY:** Armaments
ITEM: Satellite Impact **DATE:** Sep 73 **NO:** 40.003.006.00

ASSUMPTION STATEMENT:
It can be assumed that most of the power structures will have developed and implemented sophisticated military satellite communication and tactical systems by the mid-1980's. The major effect will be on U.S. Sea Control, Presence, and Projection missions.

In both cases, reduced Naval forces increase the need for surprise. Satellite detection will greatly increase the probability of detection. A submerged FBM or SSN submarine is not presently susceptible to satellite detection. However, the possibility of a technological breakthrough enabling such detection should be considered within a planning horizon of two decades.

INPUT I.D.	O	PERIODS															OUTPUT I.D
20.002.001	2		a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	20.001.001
		Start	1974	1930	1985	1990	2000											40.001.004
																		40.001.002
																		40.001.003
																		40.001.005
																		40.003.00'
		End	1979	1984	1989	1999	-											40.003.004
		Prob	1	2	3	3	3											

SOURCES:

1. Committee 25, "Impact of a Satellite Environment on Naval Operations," Naval Mission Area Paper, The U.S. Naval War College, Newport, R.I., 1973, 5 & 6.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Naval Factors CATEGORY: Organizational
ITEM: Mission Orientation DATE: Sep 73 NO: 60.001.001.00

ASSUMPTION STATEMENT:

It is assumed that the armed forces will become increasingly mission as opposed to service oriented.

This assumption is predicated on the increasingly higher costs of new technology and the continued trend in Armed Force size reduction. With some of the high technology systems approaching $50 or $100 billion in cost, we probably will see multiple uses for the U.S. Armed Forces such as outer space and underocean exploration; also, the use of these high technology forces for commercial purposes such as farming and mining to give the armed forces a return on their incredibly huge investment.

INPUT I.D.	O
30.004.001	1
40.003.001	2

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	-										
Prob	1	1	2	3	3										

OUTPUT I.D.
30.003.001
60.001.002
60.003.002

SOURCES:

1. Bowen, C. R.: File Memo - Future of the U.S. Navy Training System, IBM Advisory Group, 15 June 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Naval Factors
CATEGORY: Organizational
ITEM: Training Centralization
DATE: Sep 73
NO: 60.001.002.00

ASSUMPTION STATEMENT:

Assuming that the Navy continues its thrust towards high technologies and that this thrust results in the need for a "technological elite", it can be further assumed that increased centralization of training will be essential.

Since the success of the naval forces will essentially depend upon the competence of this "technological elite," they will be the major focus of naval training. In order to insure the success of this training and to focus top resources on it, it is believed the U.S. Navy will centralize, as a minimum this training and as a maximum all, their training.

INPUT I.D.	O
05.001.001	3
06.003.002	2
06.003.003	3
06.004.001	3
06.006.001	3
30.004.001	3
30.005.001	3
60.001.001	1
60.003.002	1
60.004.001	1
60.003.001	2

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	2	3	3	3	3										

OUTPUT I.D.
04.002.001
30.001.001
60.002.001

SOURCES:

1. Bowen, C. R., File Memo - Future of the U.S. Navy, IBM Advisory Group, 15 June 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Naval Factors **CATEGORY:** Research and Development
ITEM: Educational R&D **DATE:** Sep 73 **NO:** 60.002.001.00

ASSUMPTION STATEMENT:

Assuming that a combination of factors will result in centralization of naval training, it can be assumed a greater amount of R&D will be accomplished by naval training.

Given the possibility of a necessary "critical mass" of research, real progress can more readily be achieved in the following areas:

A. The basic disciplines such as psychology, learning theory, statistical prediction of behavior, etc.

B. Behavior Modification. In particular, the Navy, due to its extremely complex weapon systems, will be interested in intelligence enhancement through chemicals and prosthetic devices.

C. Instructional devices and systems utilizing rapidly advancing computer and communication technology.

INPUT I.D.	O
05.001.001	2
06.001.001	1
06.001.002	1
06.002.002	1
30.005.001	2
60.001.002	3

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	2	3	3	3	3										

OUTPUT I.D.
04.002.001
06.003.001
06.003.002
06.003.003
06.004.001
06.005.001
30.001.001

SOURCES:

1. Bowen, C. R.: File Memo - Future of the U.S. Navy, IBM Advisory Group, 15 June 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Naval Factors
CATEGORY: Research and Development
ITEM: Student Motivation
DATE: Sep 73 **NO:** 60.002.002.00

ASSUMPTION STATEMENT:

Based on the combined trends in naval training, it is anticipated that an increasingly large share of the resources available for training R&D will be directed towards developing techniques for student "motivation."

Student motivation has greater impact on training efficiency and effectiveness than any other one factor. The combined trends of individualized instruction and emphasis on certification based on skill proficiency will result in a need for improved techniques for student motivation.

INPUT I.D.	O
02.001.001	2
02.002.001	3
03.002.001	3
03.002.002	3
04.001.001	3
04.001.002	3
05.001.001	2
06.001.001	1
06.001.002	1
06.002.002	2
06.007.001	2
06.008.001	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	-										
Prob	3	3	3	3	3										

OUTPUT I.D.
03.002.003
04.002.001
06.003.001

SOURCES:

1. Adams, Dr. E. N.: NETS Strategic Seminar, IBM Advisory Group, 18 September 1973
2. Reviewed by IBM Advisory Group 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Naval Factors **CATEGORY:** Education
ITEM: Civilian Contractors **DATE:** Sep 73 **NO:** 60.003.001.00

ASSUMPTION STATEMENT:

Assuming a continuing emphasis on resource reduction, there will be an increasing need for the armed forces to assign their personnel to direct support functions. As a resultant, there will be an increase in the use of civilian contractors to fulfill training responsibilities now being accomplished with military people.

There are other assumptions, pertinent to improved job assessment and associated task analysis combined with improved post-training measurements, which will greatly facilitate development of training contracts and in measuring contractor performance.

INPUT I.D.	O	OUTPUT I.D.
06.004.001	1	60.001.002
30.003.001	3	

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	2	3	3	3	3										

SOURCES:

1. Fox, Raymond G.: NETS Strategic Seminar, IBM Advisory Group Meeting, 18 September 1973
2. Reviewed by IBM Advisory Group, 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Naval Factors
CATEGORY: Education
ITEM: Multi-service Use
DATE: Sep 73 NO: 60.003.002.00

ASSUMPTION STATEMENT:

It can be assumed that there will be a significant trend towards the sharing of training facilities and courses by the armed services.

The projected trends in weapons systems and the skills required to operate and maintain them will make the sharing of the training burden both feasible and cost-effective. Continuing budget restrictions may make this essential.

INPUT I.D.	o	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D
06.003.003	3																	04.002.001
30.001.001	3	Start	1974	1980	1985	1990	2000											60.001.002
30.004.001	3																	
60.001.001	1																	
60.004.001	2																	
		End	1979	1984	1989	1999	--											
		Prob	1	2	2	3	3											

SOURCES:

1. Fox, Raymond G.: NETS Strategic Seminar, IBM Advisory Group, 18 September 1973.
2. Reviewed by IBM Advisory Group, 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Naval Factors
ITEM: Variable Loads
CATEGORY: Education
DATE: Sep 73 NO: 60.003.003.00

ASSUMPTION STATEMENT:

It is assumed that future naval doctrine will attempt to anticipate a complex and significant range of requirements with a resulting potential for wide variations in training loads. Therefore, the Navy will increasingly stress application of those educational technologies accommodating wide variations in loads. This assumption amplifies the current trend towards self study and "individualized" instruction platforms.

This is supported by the assumption that some future weapons systems will be designed and developed only to the "paper" stage and then held until the military situation dictates production. Self study packages will be required to form an "at ready" training program for these paper systems.

INPUT I.D.	O
04.003.001	2
06.002.001	3
06.003.002	2
30.003.001	2
30.004.001	1
30.005.002	1
40.003.001	3

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	1	2	2	3										

OUTPUT I.D.
05.001.001
06.003.002
06.003.003
06.005.001

SOURCES:

1. Bowen, C. R.: NETS Strategic Seminar, IBM Advisory Group Meeting, 18 September 1973
2. Reviewed by IBM Advisory Group, 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Naval Factors CATEGORY: Education
ITEM: Graduate Study DATE: Sep 73 NO: 60.003.004.00

ASSUMPTION STATEMENT:

Due to the complexity of the technological and social environment of the 1980's and beyond, it is assumed that the Navy will significantly increase the number of graduate level programs pertinent to its officers and certain enlisted ratings.

It is anticipated that the "college without walls" concept will continue to spread in the community at large and will greatly facilitate both graduate and undergraduate level work in the Armed Forces.

INPUT I.D.	O
01.001.002	1
04.001.002	2
04.002.001	1
06.001.003	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	-										
Prob	2	3	3	3	3										

OUTPUT I.D.
05.001.001

SOURCES:

1. Fox, Raymond G.: <u>NETS Strategic Seminar</u>, IBM Advisory Group, 18 September 1973
2. Reviewed by IBM Advisory Group, 18 September 1973

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Naval Factors CATEGORY: Personnel
ITEM: Job Commonalty DATE: Sep 73 NO: 60.004.001.00

ASSUMPTION STATEMENT:

Due to the trend towards mission (as opposed to service) orientation of the armed services, and to the trend projected for skills required to support future weapons systems, it is assumed that the armed services will move towards a uniform system for defining occupational tasks and skills.

This is compatible with the assumption that the armed forces will increasingly share training facilities and courses.

INPUT I.D.	°	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
		Start	1974	1980	1985	1990	2000											06.002.001
		End	1979	1984	1989	1999	--											06.002.003
		Prob	1	1	2	2	3											06.003.003
																		06.005.001
																		30.001.001
																		60.001.002
																		60.003.002

SOURCES:

1. Fox, Raymond G.: NETS Strategic Seminar, IBM Advisory Group, 18 September 1973
2. Reviewed by IBM Advisory Group, 18 September 1973
3. Committee #38, "Small Future Navies", Naval Mission Area Paper, The U.S. Naval War College, Newport R.I., 1973, ii

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Naval Factors CATEGORY: Personnel
ITEM: Enlistee Attitudes DATE: Sep 73 NO: 60.004.002.00

ASSUMPTION STATEMENT:

It can be assumed that the general attitude of today's youth, that military service is an interruption of their lives rather than a learning experience and career enhancement step, will continue to some degree through the next two decades.

The captive force permitted by the draft since World War II, with the exception of one year, permitted development of some approaches within the military which tended to foster emphasis on institutional objectives, even unimportant ones, with minimum regard for the impact on personnel. The military, as is true of industrial and civil institutions, will have to develop a deeper understanding of human attitudes, motivations, and behavior. An objective of military training will be to change the attitude of military service as an "interruption" to that of an "opportunity" for continued development.

INPUT I.D.	δ	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
02.001.001	2																	02.002.001
03.002.001	2	Start	1974	1980	1985	1990	2000											04.003.001
04.001.001	3																	06.001.001
04.001.002	3																	06.001.002
04.001.003	2																	
04.002.001	1																	
04.004.001	2	End	1979	1984	1989	1999	--											
04.004.002	2																	
06.001.003	1																	
06.007.001	2																	
06.008.001	2	Prob	2	3	3	3	3											

SOURCES:

1. Gard, Brigadier General Robert G., Jr., U.S. Army, "The Military Profession," Naval War College Review, Naval War College, Vol. 26, No. 1/244, July/August 1973, 14 & 15.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Naval Factors
ITEM: Pilot Proficiency
CATEGORY: Personnel
DATE: Sep 73 NO: 60.004.003.00

ASSUMPTION STATEMENT:

Based on the assumption the AVF concept will continue as will a continued reduction in Navy size, it can be further assumed conditions and steps taken will result in increased proficiency of Naval pilots.

As the number of tactical VA/VF pilots/NFO's is reduced, the Navy will have an opportunity to make these reductions qualitatively as well as quantitatively. The pilot selection, training, and assessment programs could be geared to assure that the best qualified aviators would follow a career pattern emphasizing flying culminating in a high percentage receiving squadron command by their 15th year. A side benefit would be the reduction of the average age of tactical pilots without sacrificing experience since they would be flying a greater percentage of the time.

INPUT I.D.	O
04.001.002	1
30.003.001	3
40.001.002	2

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	1	2	2	4	4										

OUTPUT I.D.

SOURCES:

1. Committee #12, "Naval Tactical Air Projection Forces" Naval Mission Area Paper, The U.S. Naval War College, Newport, R.I. 1973, 15

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS

NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Naval Factors CATEGORY: Personnel

ITEM: Women DATE: Sep 73 NO: 60.004.005.00

ASSUMPTION STATEMENT:

It can be assumed that ultimately there will be no activities in which men engage that will not admit women on an equal basis, not excluding selected combat roles.

It can be further assumed that the military will have a special interest in research into sex roles, leadership situations involving women in command roles over men, and the firmness of sexual stereotyping. There may be conflict in close-knit institutions between members from ethnic groups with restrictive views of women and the expansion of women's roles in the Navy.

A major increase in the role of women will necessitate a thorough review of all institutional policies to eliminate all forms of sex discrimination.

INPUT I.D.	o
04.001.001	2
30.003.001	1

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	2	3	3	3	3										

OUTPUT I.D.
04.001.003

SOURCES:

1. Wermuth, Dr. Anthony L., Potential Impacts of Cultural Change on the Navy in the 1970's, Westinghouse, Falls Church, Va., August 1972, Vol-I, 64.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Naval Factors **CATEGORY:** Civil/Military Postulates
ITEM: Postulate #1 **DATE:** Sep 73 **NO:** 60.005.001.00

ASSUMPTION STATEMENT:
The first postulate envisions a civilianized armed force whose values steadily converge with those of civil society. Technology, the rise of "individuation," adaption by the military to youth values in attempts to obtain volunteers, and the improvisational tendency of modern, low-intensity conflict - all may well cause democratization of the military and a decline of the military mystique, substantial decline in authoritarian leadership, and even the emergence of unionization, as in Sweden or West Germany. Factors militating against this trend are the sustained stress and rigor of actual or potential combat, once entered; the disaffection of career personnel with the "New Sensibility," and the marginal impact that changes to appease the "New Sensibility" might have on truly committed anti-establishment dissidents.

INPUT I.D.	O	PERIODS															OUTPUT I.D.
40.001.001	3		a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	
40.002.001	3	Start	1974	1980	1985	1990	2000											
		End	1979	1984	1989	1999	--											
		Prob	1	1	1	1	1											

SOURCES:

1. Wermuth, Dr. Anthony L., Potential Impacts of Cultural Change on the Navy in the 1970's, Westinghouse, Falls Church, Va., August 1972, Vol-I, 107.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Naval Factors
ITEM: Postulate #2

CATEGORY: Civil/Military Postulates
DATE: Sep 73 NO: 60.005.002.00

ASSUMPTION STATEMENT:

The second postulate stresses a divergence of the civil and military and is the reverse of the first. It assumes that an all-volunteer force will be unleavened by a constant influx of disgruntled civilian soldiers and upper class officers from liberal backgrounds, and would be recruited instead from traditionally conservative regions and universities. An increase in hereditary service recruitment and a decline in the importance of the civilian reserve would provide further impetus.

This postulate has a low probability since divergence implies conflict with the general culture and trends within it, a course which is not likely to attract enough quality personnel in the future.

INPUT I.D.	O	PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	OUTPUT I.D.
40.001.001	3	Start	1974	1980	1985	1990	2000											
40.002.001	3	End	1979	1984	1989	1999	--											
		Prob	1	1	1	1	1											

SOURCES:

1. Wermutn, Dr. Anthony L., Potent'al Impacts of Cultural Change on the Navy in the 1970's, Westinghouse, Falls Church, Va., August 1972, Vol-I, 108.

0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

NETS

NAVAL EDUCATION TRAINING SYSTEM

Strategic Assumptions

FIELD: Naval Factors CATEGORY: Civil/Military Postulates
ITEM: Postulate #3 DATE: Sep 73 NO: 60.005.003.00

ASSUMPTION STATEMENT:

Postulate #3 envisions a mix of combat and support elements segmented into traditionally military and civilianized support groups. Therefore, the system will be partially divergent, and partially convergent. However, all elements of the military will be affected by drastic social change, will interact more with civilian society, and will be called upon to perform non-military functions. New administrative tools will combine with value and attitude change to keep the whole area of personnel administration influx for the next decade. New norms of interpersonal relations will undergo persistent readjustment.

INPUT I.D.	O
40.001.001	3
40.002.001	3

PERIODS	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Start	1974	1980	1985	1990	2000										
End	1979	1984	1989	1999	--										
Prob	2	3	3	3	3										

OUTPUT I.D.

SOURCES:

1. Wermuth, Dr. Anthony L., Potential Impacts of Cultural Change on the Navy of the 1970's, Westinghouse, Falls Church, Va., August 1972, 108

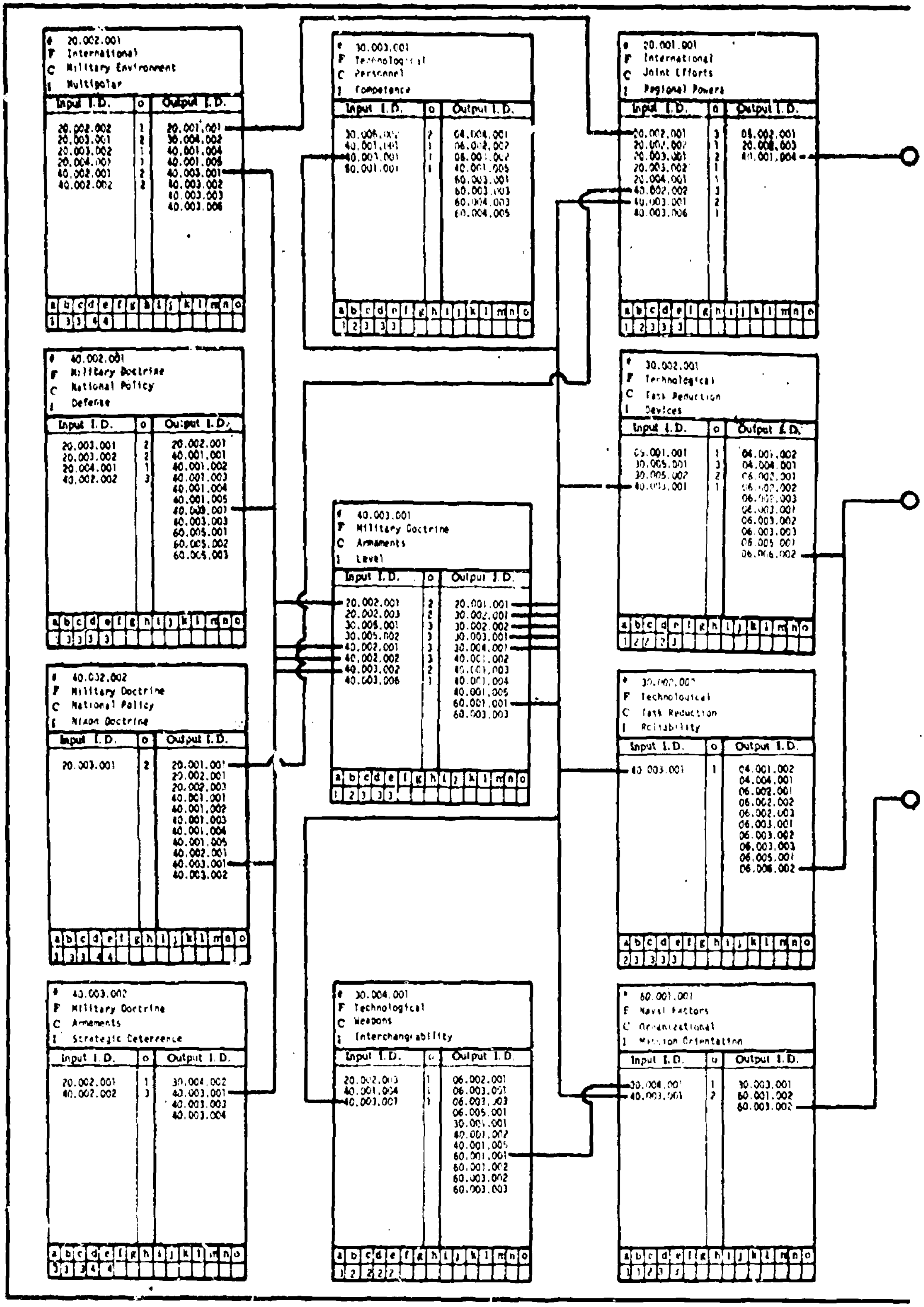
0 - No 1 - Lo 2 - Med 3 - Hi 4 - Indeterminate

D. STRATEGIC ASSUMPTION STRUCTURE

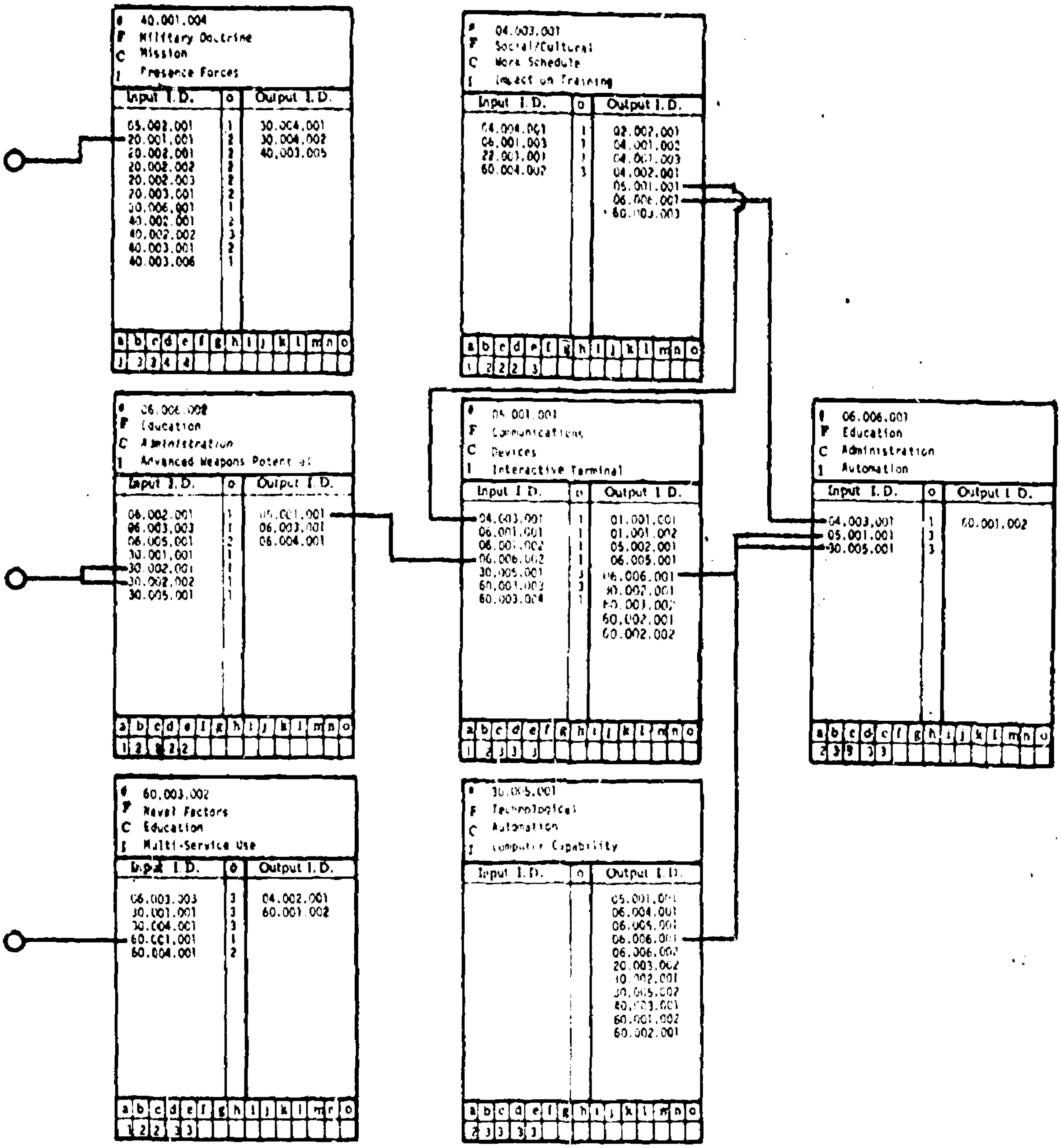
The tactical assumptions and recommendations, projecting the idealized NETS of the 1980's in Section VI of the DOTS Phase I Report, were based on a set of five key Strategic Working Assumptions (VI D-2). The charts to follow provide a reference network to enable correlation of the Strategic Working Assumptions to the Strategic Assumptions.

Since the relationships between SA's are numerous and complex, only those judged most significant were included. The Strategic Process, at best, is a judgmental one and it is understood that the configuration of any given net could take an almost infinite number of patterns.

It is hoped that the forced discipline of the hierarchical approach will increase the validity of the process. The SA, SWA, change statement, tactical assumption and tactical recommendation flow does provide a defined and documented flow permitting analysis and critique of the logic of any given tactical assumption or recommendation.

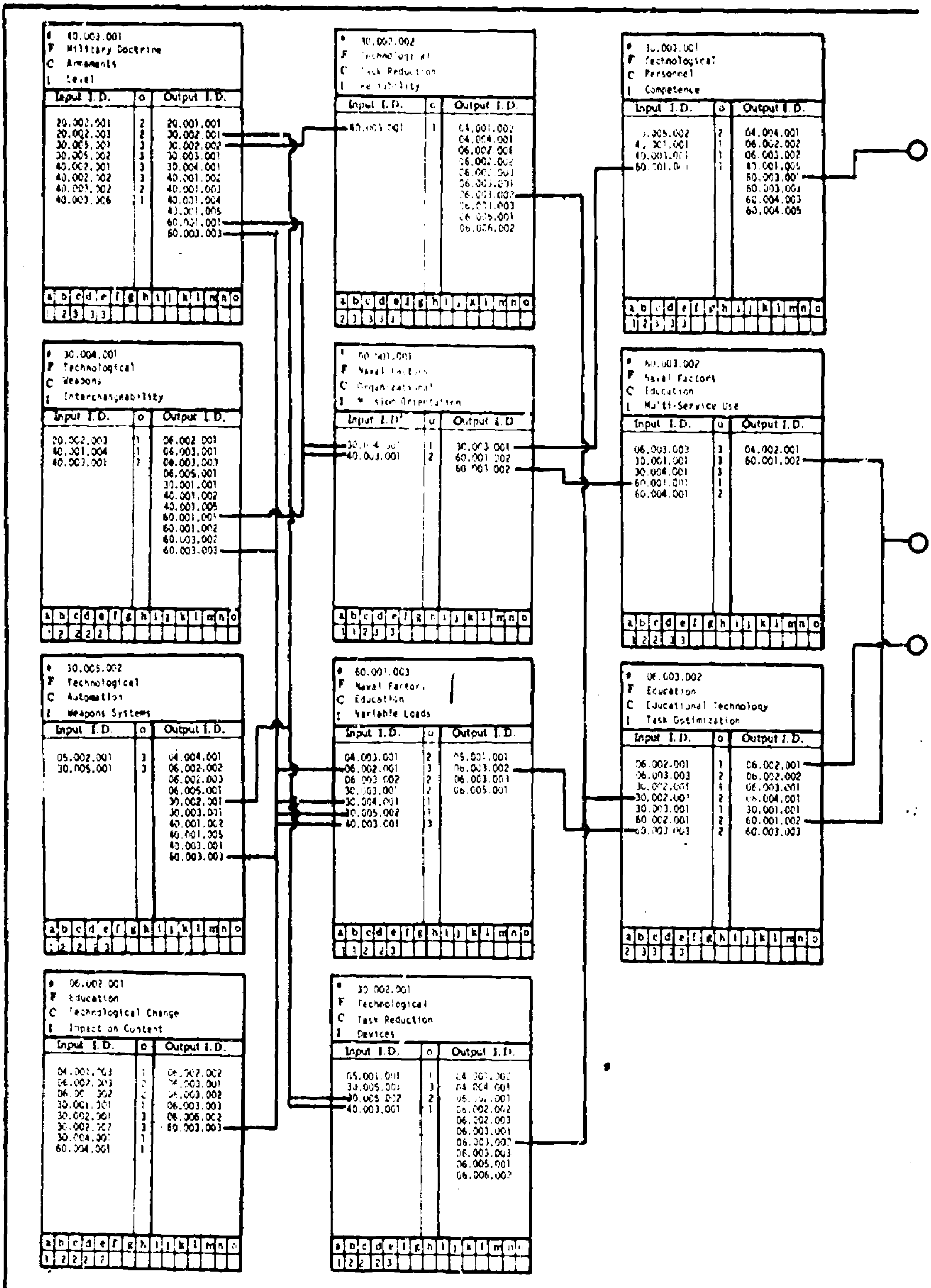


20.002.001
F International
C Military Environment
I Multipolar
Input I.D.
O
Output I.D.
20.002.002
20.003.001
20.003.002
20.004.001
40.002.001
40.002.002
20.001.001
30.004.002
40.001.004
40.001.005
40.003.001
40.003.002
40.003.003
40.003.006
30.003.001
F Technological
C Personnel
I Competence
20.001.001
F International
C Joint Efforts
I Regional Powers
05.002.001
20.008.003
40.001.004
40.002.001
F Military Doctrine
C National Policy
I Defense
20.003.001
20.003.002
20.004.001
40.002.002
20.002.001
40.001.001
40.001.002
40.001.003
40.001.004
40.001.005
40.003.001
40.003.003
60.005.001
60.005.002
60.005.003
30.002.001
F Technological
C Task Reduction
I Devices
40.003.001
F Military Doctrine
C Armaments
I Level
20.002.001
20.002.003
30.005.001
30.005.002
40.002.001
40.002.002
40.003.002
40.003.006
20.001.001
30.002.001
30.002.002
30.003.001
30.004.002
40.001.002
40.001.003
40.001.004
40.001.005
60.001.001
60.003.003
40.032.002
F Military Doctrine
C National Policy
I Nixon Doctrine
20.003.001
20.001.001
20.002.001
20.002.003
40.001.001
40.001.002
40.001.003
40.001.004
40.001.005
40.002.001
40.003.001
40.003.002
F Technological
C Task Reduction
I Reliability
40.003.001
04.001.002
04.004.001
06.002.001
06.002.002
06.002.003
06.003.001
06.003.002
06.003.003
06.005.001
06.006.002
40.003.002
F Military Doctrine
C Armaments
I Strategic Deterrence
20.002.001
40.002.002
30.004.002
40.003.001
40.003.003
40.003.004
30.004.001
F Technological
C Weapons
I Interchangeability
06.002.001
06.005.001
30.001.001
40.001.002
40.001.005
60.001.001
60.001.002
60.003.002
60.003.003
60.001.001
F Naval Factors
C Organizational
I Mission Orientation
40.003.001
30.003.001
60.001.002
60.003.002
a b c d e f g h i j k l m n o

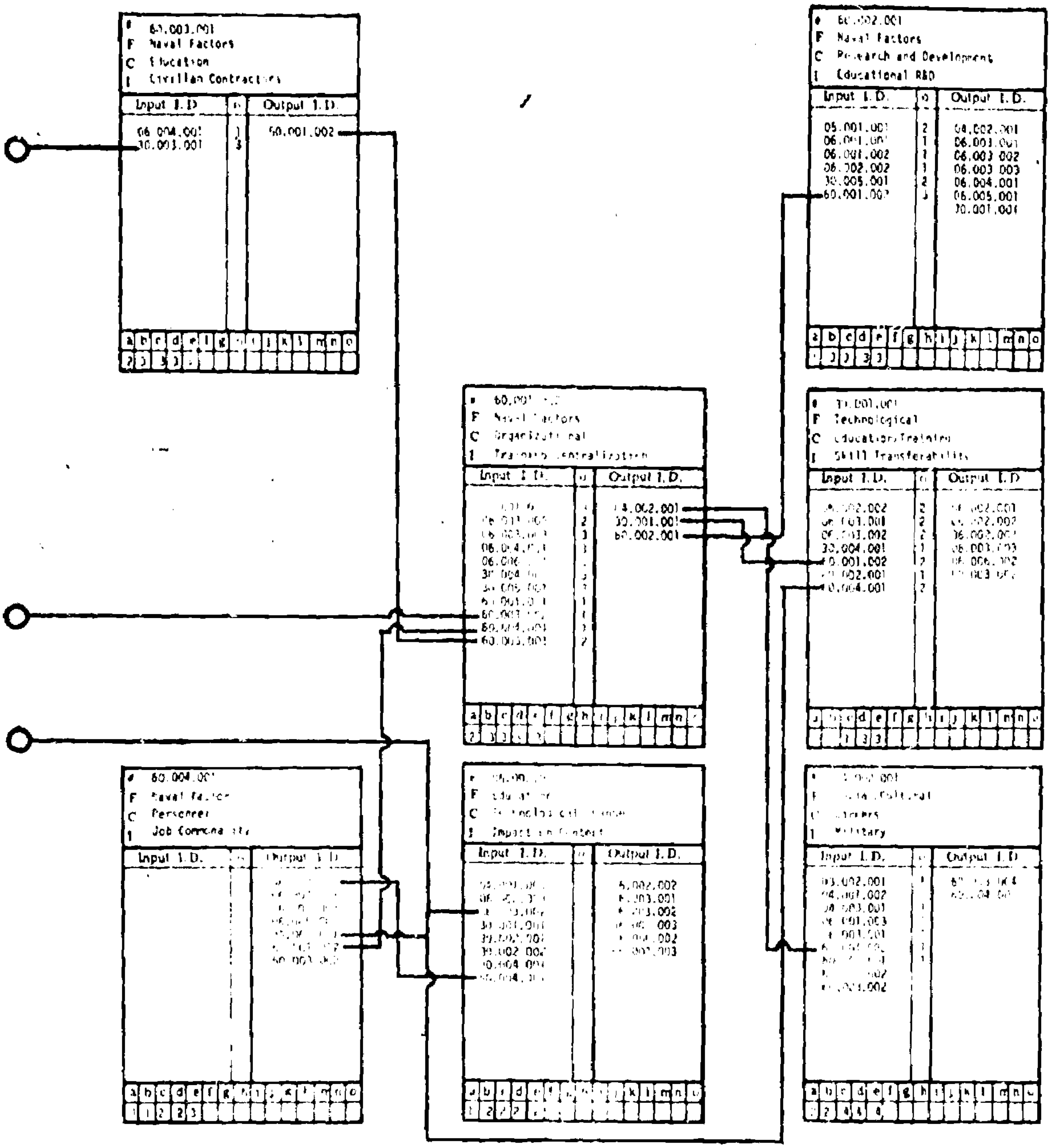


Strategic Working Assumption #1 Resource Control

A confluence of factors will result in a significant reduction in the resources available to accomplish the NETS training mission. Although a current concern, the degree and scope of resource restriction will become increasingly severe through the mid-1980's and will result in major changes to the NETS resource control approach and structure.

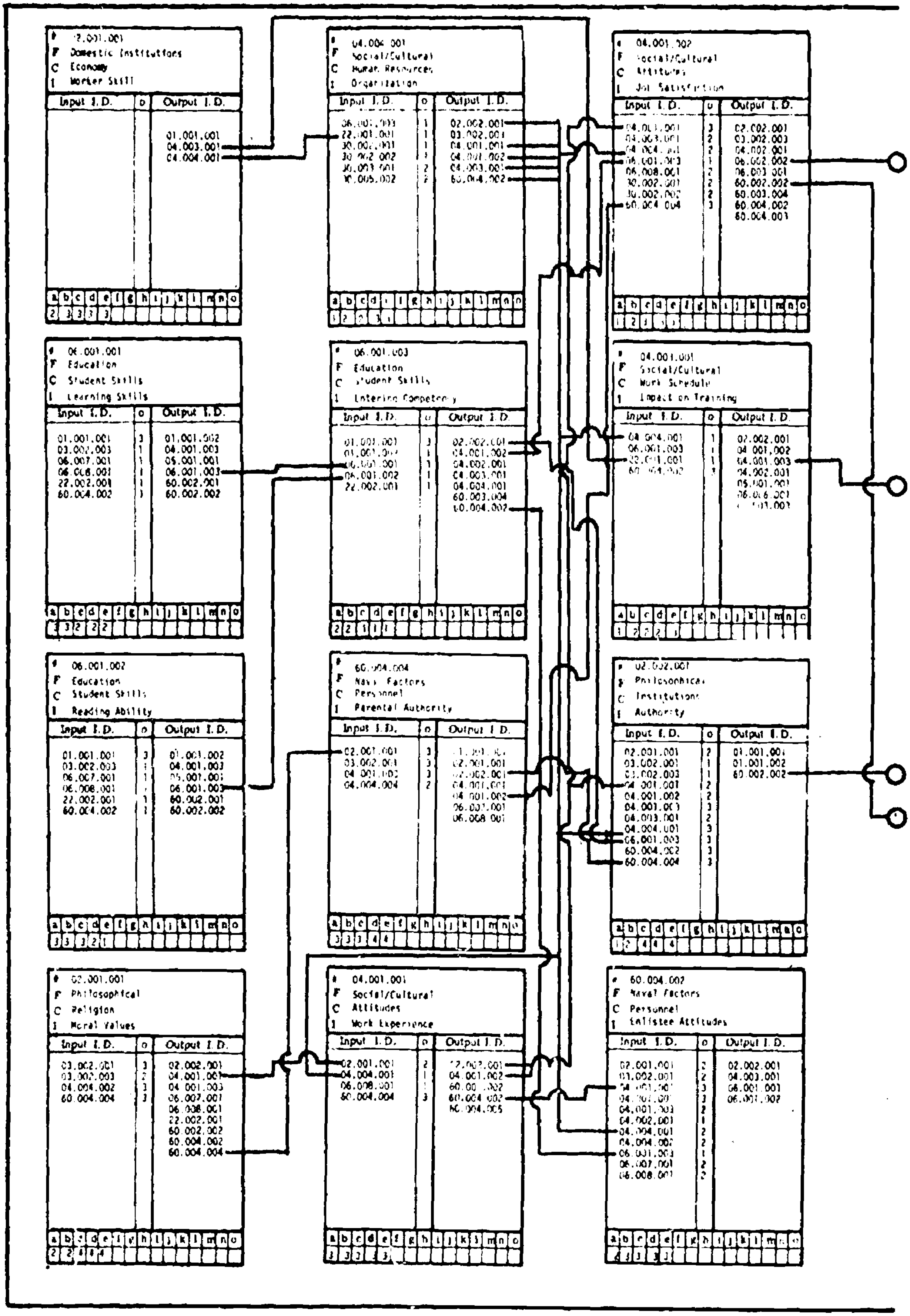


40.003.001
Military Doctrine
Armaments
Level
Input I.D.
Output I.D.
30.004.001
Technological
Weapons
Interchangeability
30.005.002
Technological
Automation
Weapons Systems
06.002.001
Education
Technological Change
Impact on Content
Technological
Task Reduction
60.001.001
Naval Factors
Organizational
Mission Orientation
60.001.003
Naval Factors
Education
Variable Loads
30.002.001
Technological
Task Reduction
Devices
30.003.001
Technological
Personnel
Competence
60.003.002
Naval Factors
Education
Multi-Service Use
06.003.002
Education
Educational Technology
Task Optimization



Strategic Working Assumption #2 Resource Distribution

The projected combination of restricted resources, technological change, national doctrine, and military strategy will result in a major change in the traditional distribution of resources across the military services and, also, across the various commands and functions of any given service. The impact on NETS will be substantial since its mission is driven by most of the other functions within the Navy.


Domestic Institutions
Economy
Worker Skill
Input I.D.
Output I.D.
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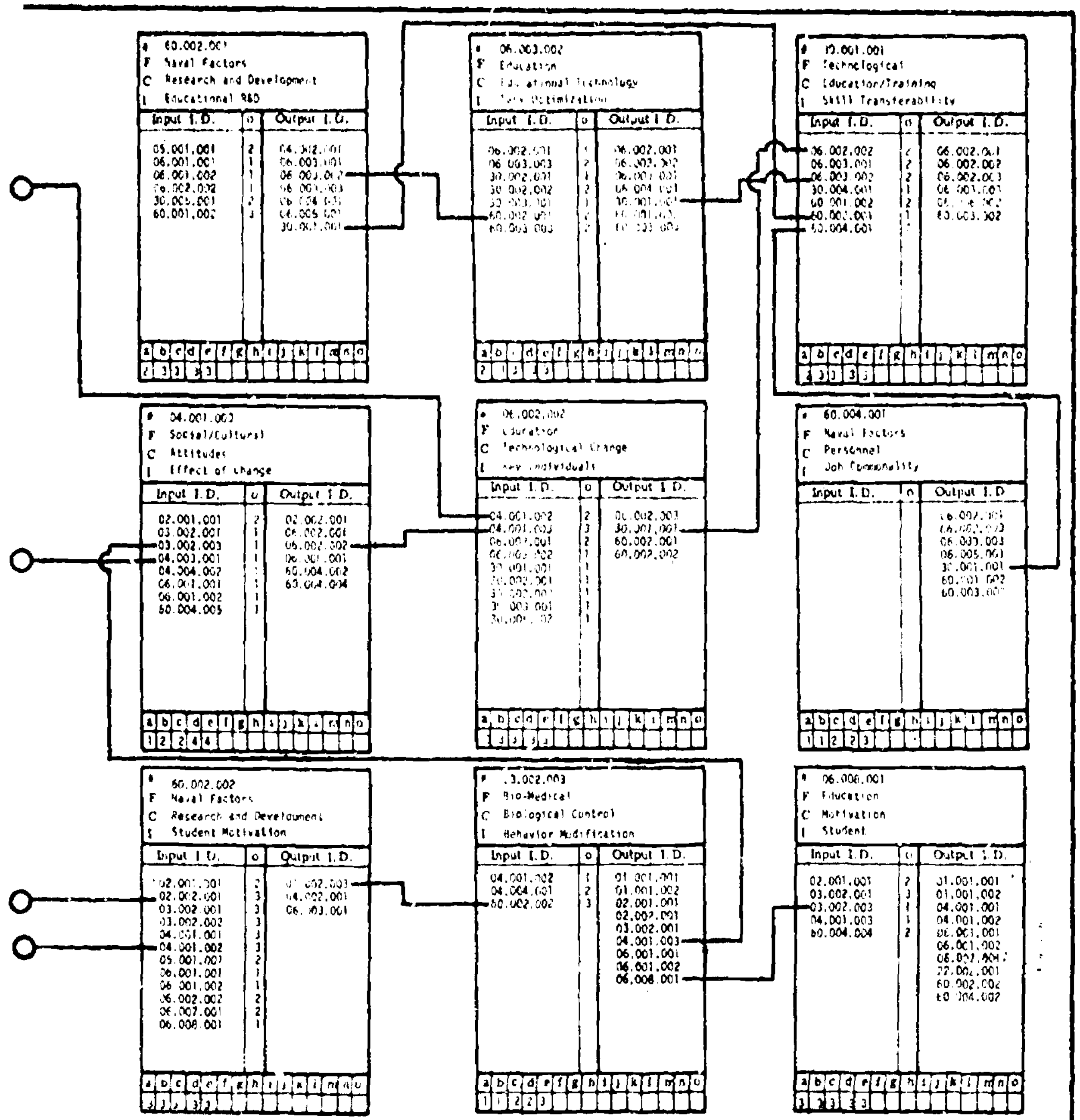
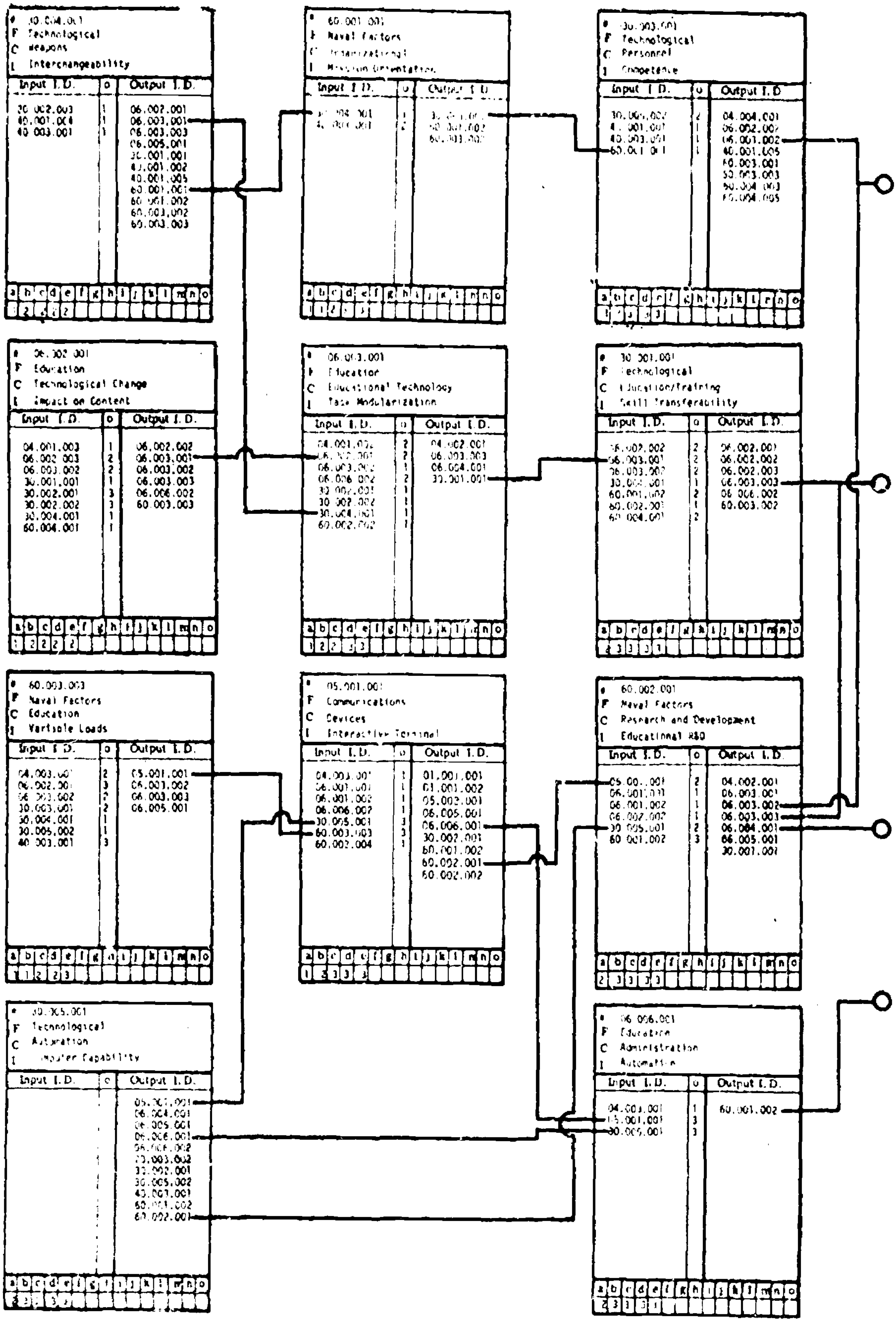
04.003.001
04.004.001
04.004.001
Social/Cultural
Human Resources
Organization
22.001.001
02.002.001
03.002.001
04.001.001
04.001.002
04.003.001
60.004.002
04.001.002
Social/Cultural
Attitudes
Job Satisfaction
02.002.001
03.002.003
04.002.001
06.002.002
06.003.001
60.002.002
60.003.004
60.004.002
60.004.003
06.001.001
Education
Student Skills
Learning Skills
01.001.001
03.002.003
06.007.001
06.008.001
22.002.001
60.004.002
01.001.002
04.001.003
05.001.001
06.001.003
60.002.001
60.002.002
06.001.003
Education
Student Skills
Entering Competency
06.001.002
22.002.001
02.002.001
04.001.002
04.002.001
04.003.001
04.004.001
60.003.004
60.004.002
04.001.001
Social/Cultural
Work Schedule
Impact on Training
04.004.001
06.001.003
02.002.001
04.001.002
04.001.003
04.002.001
05.001.001
06.002.001
Education
Student Skills
Reading Ability
01.001.001
03.002.003
06.007.001
06.008.001
22.002.001
60.004.002
01.001.002
04.001.003
05.001.001
06.001.003
60.002.001
60.002.002
60.004.004
Naval Factors
Personnel
Parental Authority
02.001.001
03.002.001
04.004.004
06.003.001
06.008.001
02.002.001
Philosophical
Institutions
Authority
02.001.001
03.002.001
03.002.003
04.001.001
04.001.002
04.001.003
04.003.001
04.004.001
06.001.003
60.004.002
60.004.004
01.001.001
01.001.002
60.002.002
02.001.001
Philosophical
Religion
Moral Values
03.002.001
03.002.003
04.004.002
60.004.004
02.002.001
04.001.001
04.001.003
06.007.001
06.008.001
22.002.001
60.002.002
60.004.002
60.004.004
04.001.001
Social/Cultural
Attitudes
Work Experience
02.001.001
04.004.001
06.008.001
60.004.004
04.001.002
60.004.002
60.004.005
60.004.002
Naval Factors
Personnel
Enlistee Attitudes
02.001.001
03.002.001
04.001.003
04.002.001
04.004.001
04.004.002
06.001.003
06.007.001
06.008.001
02.002.001
04.003.001
06.001.001
06.001.002
a b c d e f g h i j k l m n o

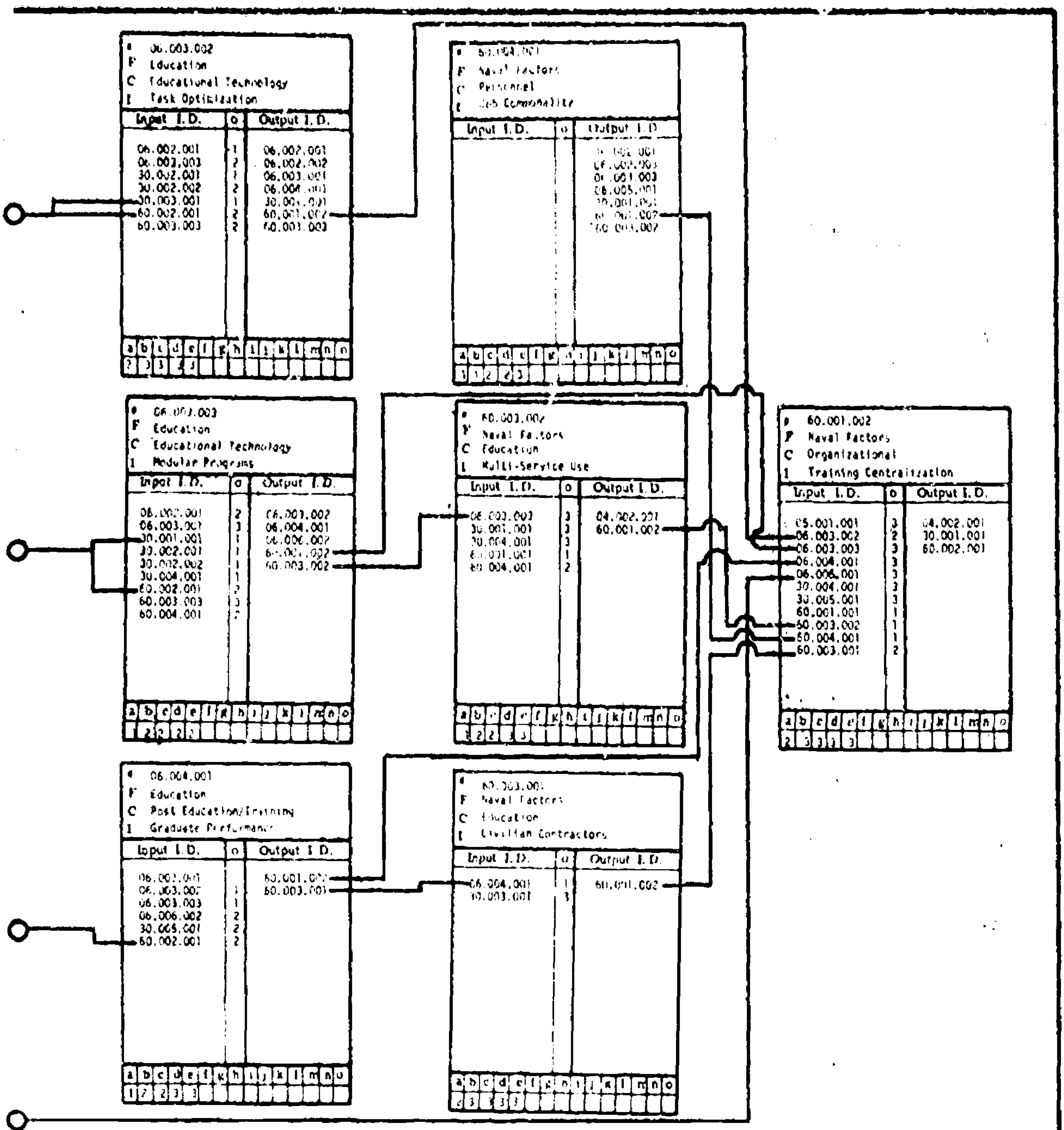


Strategic Working Assumption #3 Human Resource Management and Accounting

The average recruit entering the military service in the mid-1980's will have been influenced by the changes in national culture, attitudes, and the total pre-service education process. The changes resulting from these influences combined with the changing requirements of the services will necessitate changes in the management of human resources, especially in those areas leading to a trained and motivated person capable of fulfilling their designated mission.

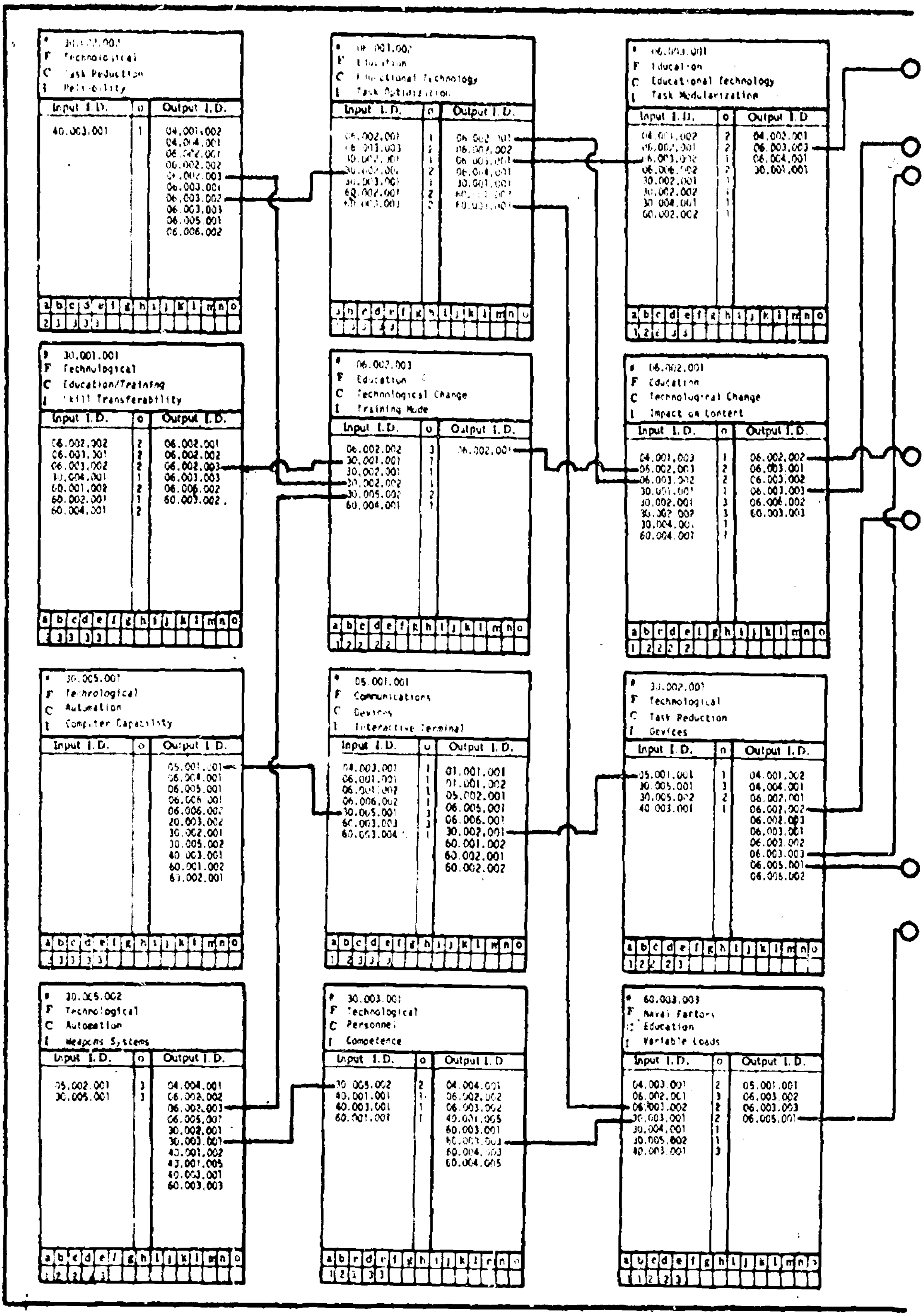


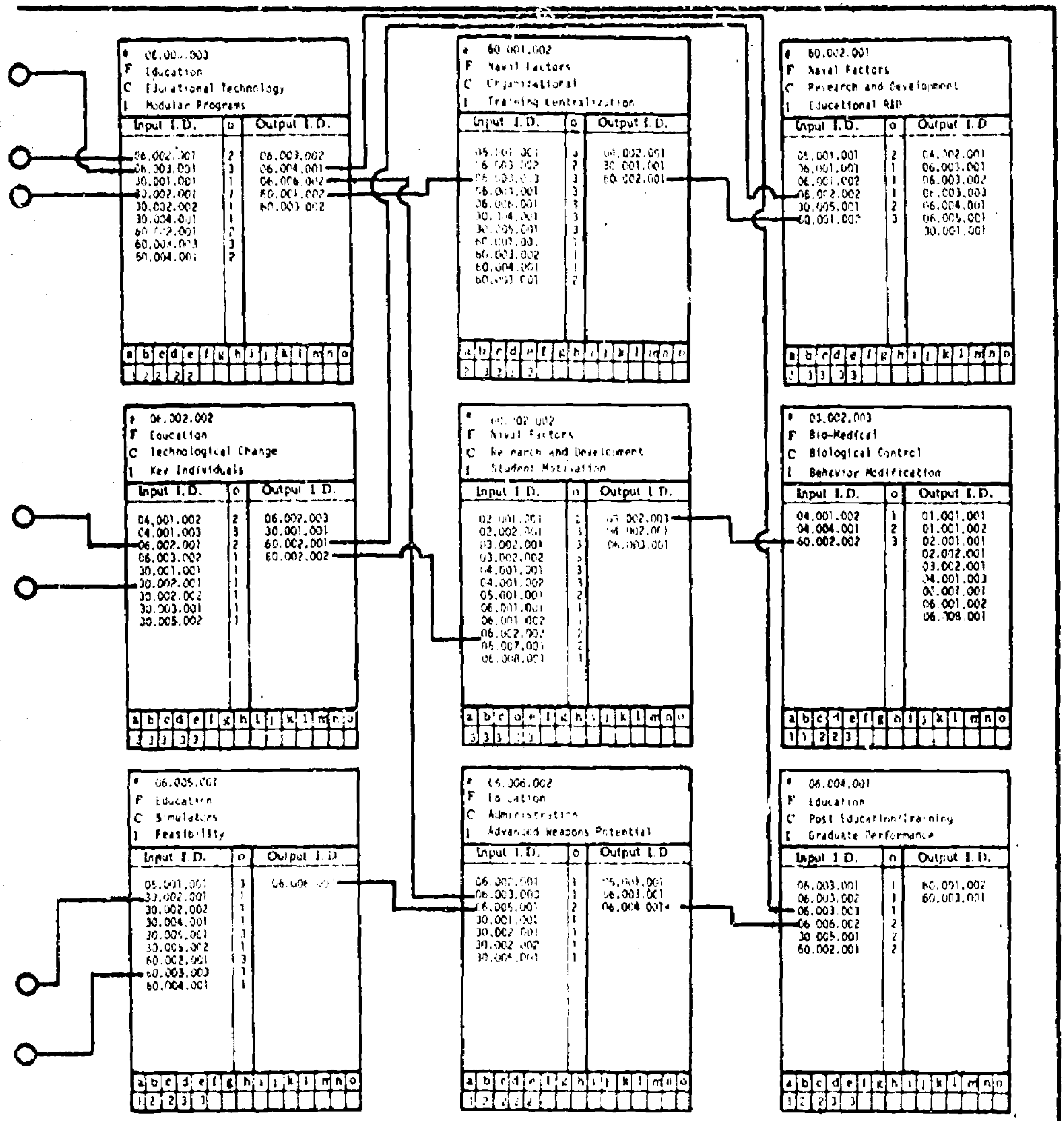
F Technological
C Weapons
I Interchangeability
Input I.D.
o
Output I.D.
06.002.001
06.003.001
06.003.003
06.005.001
40.001.005
60.001.001
60.003.003
60.001.001
F Naval Factors
Input I.D.
Output I.D.
F Technological
C Personnel
Input I.D.
o
Output I.D.
04.004.001
40.001.005
F Education
C Technological Change
I Impact on Content
Input I.D.
o
Output I.D.
04.001.003
06.003.002
30.001.001
30.002.001
30.002.002
30.004.001
60.004.001
06.002.002
06.003.001
06.003.002
06.003.003
06.006.002
60.003.003
06.003.001
C Educational Technology
I Task Modularization
Input I.D.
o
Output I.D.
06.003.003
06.004.001
F Technological
I Skill Transferability
Input I.D.
o
Output I.D.
06.003.001
06.002.002
06.002.003
06.003.003
60.003.002
60.003.003
F Naval Factors
C Education
I Variable Loads
Input I.D.
o
Output I.D.
40.003.001
05.001.001
06.003.003
06.005.001
05.001.001
F Communications
C Devices
I Interactive Terminal
Input I.D.
o
Output I.D.
06.001.002
06.006.002
30.005.001
60.003.003
60.002.004
01.001.001
05.002.001
06.005.001
06.006.001
60.001.002
60.002.001
60.002.002
60.002.001
F Naval Factors
C Research and Development
I Educational R&D
Input I.D.
o
Output I.D.
06.001.002
60.001.002
04.002.001
06.003.001
06.003.002
06.003.003
06.004.001
06.005.001
F Technological
C Automation
Input I.D.
o
Output I.D.
06.004.001
06.006.001
30.005.002
60.002.001
F Education
C Administration
Input I.D.
o
Output I.D.
04.003.001
05.001.001
30.005.001
60.001.002



Strategic Working Assumption #4 **Organization**

Inter-service cooperation and consolidation of the training function, increased need for precise control of training resources, a need for human resource accounting, the thrust towards instructional modes requir ng highly systematized and disciplined development, and a shift to more on-board training will result in a NETS exercising strong centralized control over all Naval education and training by the mid-1980's. This increased control will be mandatory if the education-training mission is to be accomplished as currently planned.


F Technological
C Task Reduction
Input I.D.
o
Output I.D.
40.003.001
F Education
C Educational Technology
Input I.D.
o
Output I.D.
F Education
C Educational Technology
I Task Modularization
Input I.D.
o
Output I.D.
04.002.001
06.003.003
06.004.001
30.001.001
30.001.001
F Technological
C Education/Training
Input I.D.
o
Output I.D.
06.002.001
06.002.002
06.002.003
06.003.003
06.006.002
60.003.002
06.002.003
F Education
C Technological Change
I Training Mode
Input I.D.
o
Output I.D.
06.002.002
30.001.001
30.002.001
30.002.002
30.005.002
60.004.001
F Education
C Technological Change
I Impact on Content
Input I.D.
o
Output I.D.
06.002.002
06.003.001
06.003.002
06.003.003
06.006.002
60.003.003
F Technological
C Automation
Input I.D.
o
Output I.D.
05.001.001
F Communications
C Devices
I Interactive Terminal
Input I.D.
o
Output I.D.
01.001.001
05.002.001
06.005.001
06.006.001
30.002.001
60.001.002
60.002.001
60.002.002
F Technological
C Task Reduction
I Devices
Input I.D.
o
Output I.D.
04.001.002
04.004.001
06.002.001
06.002.002
06.003.001
06.003.002
06.003.003
06.005.001
06.006.002
30.005.002
F Technological
C Automation
I Weapons Systems
Input I.D.
o
Output I.D.
30.003.001
F Technological
C Personnel
I Competence
Input I.D.
o
Output I.D.
60.003.003
F Naval Factors
Education
I Variable Loads
Input I.D.
o
Output I.D.
05.001.001
06.003.002
06.003.003
06.005.001
a b c d e f g h i j k l m n o



Strategic Working Assumption #5 Process

The present trend towards increasing the efficiency and effectiveness of the NETS training process will continue and will be complemented by major improvements in the areas of job and task analysis. Improvements in these technologies will significantly increase the integration of the training process into the actual job stream, especially in the maintenance and complex task environments.

APPENDIX B

MATHEMATICAL MODELS AND DATA BASES OPERATIONAL WITHIN THE NAVAL EDUCATION AND TRAINING COMMAND

I. OPERATIONAL DATA BASES

The following data bases represent the major operational data bases within the Naval Education and Training Command. Additional major data bases, which are maintained by organizations other than CNET, such as the Enlisted Master File in BUPERS, the Navy Cost Information System (NCIS), and the Resource Management System (RMS) are utilized extensively within CNET, but are not included in this discussion. Also, special purpose data bases may exist at lower organizational levels within CNET but because of their limited application are not discussed in this section. Included in this section are general descriptions of the following systems:

Formal Training Data System (FTDS)
Training Administration System (TRAD)
Per Capita Cost-to-Train
Mechanized Course Cost System
Naval Aviation Training Information System (NATIS)
Mechanized Training Equipment Requirements Plan (MECTERP)
Training Aids Material Automated Reporting System (TAMARS).

A. FORMAL TRAINING DATA SYSTEM (FTDS)

The FTDS consists of three files or data banks which provide tools to manage and monitor the total Navy training effort.

1. The Master Course Reference File (MCRF) compiles Navy training class and course information. Primarily it:

    a. Collects and standardizes, at one central source, information necessary to publish the indices and convening date schedules for the Navy formal schools catalog.

    b. Provides class quotas and convening dates for the Recruit Allocation Control System (RACS).

2. The Student Master File (SMF) is an exception reporting system designed to provide timely information on Navy personnel undergoing training. It also provides an automated method for assigning the training history codes and school generated NEC's to the Enlisted Master File.

3. The Student Candidate File (SCF) compiles data on prospective students detailed by BUPERS, to formal training schools.

B. TRAINING ADMINISTRATION SYSTEM (TRAD)

TRAD is a student and support personnel accounting system which is administered by the Chief of Naval Technical Training (CNTECHTRA).

Personnel data is compiled at the lowest level (course, school, or activity) to which support and trainee data is identifiable.

The TRAD input vehicle is the CNTECHTRA School/Course Report, CNTECHTRA-GEN 1500/6. The CNTECHTRA School/Course Report contains the following data:

Identifying Data

Unit Identification Code
School Cost Code
Course Identification
Date M/Y

Student Data (By Service Group)

Planned Input
Actual Input
Block Input
Graduated
Academic Drops
Non-Academic Drops
Academic Setbacks
Non-Academic Setbacks
Average Under Instruction
Average Awaiting Instruction
Average Awaiting Transfer

Support Data (By Category)

Instructor Requirement
Instructor Allowance
Instructor On-Board
Administrative Allowance
Administrative On-Board

Average Awaiting Instruction Data (By Service Group)

Mess Cooks
Compartment Cleaners
Backlogged
All Others

Average On-Board (AOB)

Total of average under instruction, average awaiting instruction, and average awaiting transfer.

C. PER CAPITA COST-TO-TRAIN

The Chief of Naval Education and Training (CNET) has the responsibility for developing and maintaining cost-to-train data for Navy formal education and training. Training cost data is frequently required by inter-service committees conducting studies in personnel retention and replacement, common core training, and related efforts. Also, per capita cost serves as the basis in determining foreign training costs for foreign military assistance programs. In conjunction with CNO, CNET has developed a reporting system to provide information as to the actual cost of training.

The following cost-to-train data is reported on CNT Form 7310/1 (Financial/Student Data) for each school and course:

1. Heading Entries

    a. Activity
    b. School/Course
    c. Report Year

2. Cost Factors/Student Data

    a. Direct Training

        1) Instructional equipment and supplies
        2) Aircraft
        3) Instructor personnel
        4) Other

    b. Direct Support

        1) Training support
        2) Aircraft intermediate maintenance
        3) Facilities major repair projects

    c. Command and Staff

    d. Indirect Support

        1) Hospital
        2) Family housing
        3) Carrier operations

e. Staff and Instructor PCS Travel

f. Equipment

1) Capital equipment depreciation
2) Aircraft depreciation
3) Capital equipment maintenance
4) Progressive aircraft rework
5) Totals by appropriation

g. Student Compensation

1) Pay and allowances
2) Travel

h. Student Data

1) Average on-board
2) Total student weeks available
3) Total student completions
4) Average weeks to complete
5) Total attrition
6) Total attrition weeks.

D. MECHANIZED COURSE COST SYSTEM

The objective of the Mechanized Course Cost System is to provide uniform cost collection and reporting which can be utilized to:

1. Answer Congressional inquiries

2. Aid managers in making decisions concerning training

3. Support training budgets

4. Provide basic cost data which can be used to develop cost-of-training chargeable for military grant-in-aid and charges to DOD contractors for training.

The system utilizes costs collected under the present Resources Management Accounting System (RMS) and utilizes cost codes which fit into existing cost coding procedures. Training cost codes identify departments, divisions, or school groups in addition to direct course cost. Cost data is grouped for certain special Fleet and short duration courses, and those where the training methods or organizations require students from different courses to train on the same equipment and/or in the same classes with students for other courses.

The following data is collected through the Course Cost System:

1. Work units in man-months of training

2. Military man-hours chargeable to a specific course or work function

3. Civilian man-hours chargeable to a specific course or work function

4/5. Military and civilian labor costs charged at the organizational level where the services are performed

6. Materials and supplies charged to a direct course or work function

7. Work costs which have been contracted

8. Miscellaneous costs such as travel, printing, utilities, rents, etc., charged at the applicable level

9. Cumulative costs which constitute the activity Operating Budget (OB) expense, broken down by cost level

10. Cumulative New Obligatory Authority (NOA) expense, plus prior year charges, broken down by cost level.

The Mechanized Course Cost System is administered by CNTECHTRA. The data collected through this system forms the basic input to the Per Capita Cost-to-Train Report which is compiled by CNET.

E. NAVAL AVIATION TRAINING INFORMATION SYSTEM (NATIS)

NATIS consists of the following six modules:

1. In-Flight Training Information Subsystem (IFTIS) provides data on individual student flow, student performance, instructor performance, and pipeline flow and control. These data are utilized to manage large groups of Student Naval Aviator's (SNA's) and Instructors Under Training (IUT's) to achieve more uniform grading, and to provide the Naval Air Medical Institute with source data for their research program supporting the training of student aviators.

2. Student/Instructor Control and Reporting Subsystem (SICARS), which has been renamed Personnel Data Base Application (PDBA), is used to control the personnel factors relative to naval air training. Entries and modifications to the IFTIS master file are accomplished through the SICARS system.

3. Individual Flight Activity Reporting System (IFARS) is an operational system used by the Navy to report on flight activity.

4. 3M-Aviation Statistical Data (3M-ASD) represent the composite information taken from the IFARS data.

5. The Bunker-Ramo-700 (BR-700) is an off-the-shelf application of equipment to speed the flow of information relative to maintenance requirements and assets within the squadron, while at the same time allowing random access of information relative to maintenance problems.

6. UDAPS/MIZDO are supply applications to provide information on parts inventory and to control such inventory.

With the exception of IFTIS and SICARS, each of the modules represent independent data subsystems and are not combined at the system level.

F. MECHANIZED TRAINING EQUIPMENT REQUIREMENTS PLAN (MECTERP)

MECTERP is an automated system established in 1970 to enable CNATRA training activities to report their technical training equipment (including general purpose electronics test equipment) and training aids material requirements information. The system supports training material support requirements for aviation training activities under CNTECHTRA.

G. TRAINING AIDS MATERIAL AUTOMATED REPORTING SYSTEM (TAMARS)

TAMARS was established in 1966 to enable education and training activities to report training aids material requirements information. The system is operated by CHNAVTRASUPP.

II. DATA BASES UNDER DEVELOPMENT

Effort is currently underway to consolidate, centralize, and improve many of the existing information systems within CNET. The plan for the development of a common Navy education and training data base is detailed in the Automated Data System Development Plan for the Naval Training Information System (NAVTIS). Brief summaries of several of the NAVTIS modules which represent potential data sources for the mathematical model development phase of the Design of Training Systems project are included in this section.

A. NAVAL AIR TRAINING COMMAND MANAGEMENT INFORMATION SUBSYSTEM (NATIS)

NATIS, using the Data Base Management System concept, will provide a common data base to support the following Naval Air Training Command (NATRACOM) areas:

1. Planning

   An interactive simulation model, similar to the existing Integrated Facilities Requirements System (IFRS), will be developed to support three basic planning functions: (1) determine asset requirements; (2) predict short-range system performance; and (3) determine mission impact of unprogrammed changes.

2. Personnel

   Existing applications are being revised and files expanded to provide a data base which can be utilized to account for and control personnel resources, as well as interface with the BUPERS personnel system.

3. Training

   Existing applications are being redesigned and data files expanded to develop a system which will:

   a. Provide feasibility for computerized scheduling of student training

   b. Provide detailed information on student status

   c. Provide detailed data relative to instructor grading.

4. Maintenance

   The system will aid in scheduling a dynamic maintenance workload.

5. Resources Management

   The system must be designed to interface with the CNET standard financial and accounting system.

6. Supply

   Applications should be developed to supplement the standard Navy UADPS-SP.

The preceding system description represents a long range NATRACOM goal. Only the personnel and training objectives are currently being pursued.

B. NAVY INTEGRATED TRAINING AND RESOURCES ADMINISTRATION SUBSYSTEM (NITRAS)

NITRAS is designed to consolidate two existing training systems, FTDS and TRAD, and to establish interfaces with the following existing systems of other major commands:

1. Manpower and Personnel Management Information System (MAPMIS)

2. Recruit Allocation Control System (RACS)

3. CNTECHTRA RMS Cost Accounting System

4. Computer Managed Instruction System (CMI).

C. MILITARY PERSONNEL INFORMATION SUBSYSTEM (MILPERSIS)

MILPERSIS will be implemented to provide the required military personnel accounting information for pipeline management. Accurate student population data which will be responsive to the requirements imposed by higher commands will be maintained on a daily cyclic basis.

D. CENTRALIZED TRAINING MATERIAL MANAGEMENT SUBSYSTEM (CENTRA)

CENTRA will consist of the following primary data bases:

1. Activity

   Identifies all training activities by title and location and contains data related to budget support.

2. Course

   Identifies each course by title, catalog number, and location and contains data necessary for budgeting and planning.

3. Material

   Contains approved training material allowances and inventories; maintains projection of requirements for seven out-years.

4. Trainer Material Support

   Consists of information to identify material shortages on Naval Air Maintenance Trainees (NAMT) and to provide inventory and budget information.

III. OPERATIONAL MATHEMATICAL MODELS

A comprehensive survey of computerized mathematical models related to manpower and personnel management, with emphasis on Navy operational models, was recently compiled by the Naval Personnel Research and Development Laboratory.[1] All models were classified into one of two general categories: Manpower Management which involves determining, forecasting, planning, and programming manpower requirements necessary to accomplish the mission of the Navy; and Personnel Management which embraces budgeting for acquiring, training, controlling, and forecasting the personnel inventory in filling authorized programmed billets. All training related models are therefore included in the Personnel Management classification. Of the total 101 Navy models reviewed by Hutchins, 50 were classified as Personnel Management models. Two subdivisions within the Personnel Management category are specifically related to the training function. Included in the category Active Inventory Maintenance are those models which deal with career pipelines, including the establishment and operation of special training schools. Training requirements is one of several functions included in the Policy Alternative Generator category. A total of seven training related models were identified within the above two categories. These models address such topics as training requirements, occupational data analyses, selection criterion impact on training costs, and school assignments. In addition to these seven models, two additional models, which were classified as Manpower Management models by Hutchins, deal with training related activities. STAPLAN (Status-Time-Attrition Planning) is used within BUPERS to develop Class "A" school requirements, and IFRS (Integrated Facilities Requirement System) is being developed by CNATRA to assess the impact of changes in pilot training rate requirements. Of the above nine training models (six reported to be operational, three are being developed) only one, IFRS, falls under the domain of CNET. The remaining eight are utilized either within BUPERS or at the Naval Personnel Research and Development Center. The net conclusion is that there are <u>no</u> operational mathematical

[1] Hutchins, E. S. Jr., et al., <u>Computer Models for Manpower and Personnel Management: State of Current Technology</u>, Washington, D.C.: Naval Personnel Research and Development Laboratory, April 1973, (TR 73-25).

models within CNET. This conclusion was verified by an independent survey conducted by the IBM Study Team in conjunction with Phase I of this project. Appendix D notes the activities/locations which were surveyed.

Although not directly related to any of the candidate modeling areas identified in Section VII, brief descriptions, including input and output variables, of the nine models identified in the Hutchins report as models related to Navy training, are included in this Appendix. Output data generated by these models represent an additional source of input data for models selected to be developed during Phase II of this project.

MODEL NAME

Status-Time-Attrition-Planning (STAPLAN)

COMPUTER

IBM 360/65

COMPUTER LANGUAGE

FORTRAN III

MODEL DESCRIPTION

STAPLAN examines the projected inventory of the U.S. Navy enlisted force (by rating) for a period of seven years in the future and compares the inventory status with the future requirements for petty officers (E4 through E9). Based on this comparison, flow requirements are calculated to provide, on the most efficient basis, necessary candidates for each rating for advancement to E4. STAPLAN optimizes on this single criterion, producing candidates for E4, and optimizes in the sense that it selects a preferred alternative of a fixed set of three alternative methods of providing input to a rating. The flow requirements produced by the model are balanced with expected recruit training output. Based on physical and policy constraints, the flow to each rating is further subdivided into school and on-the-job pipelines.

MODEL INPUTS

Forecasts of fixed gains, losses, and reenlistments; accessions, advancements, and losses necessary to maintain each of the nine paygrades at required levels on a monthly basis.

MODEL OUTPUTS

Lists imbalance between projected inventory and projected strength needed. Input and training are then adjusted to compensate variance (i.e., flow rates for each rating to OJT or "A" school training pipelines are determined by the model).

STATUS

Operational (to be replaced by RIO, a model being developed within the ADSTAP system).

MODEL NAME

Recruit Input Optimization Model (RIO)

COMPUTER

IBM 360/65

COMPUTER LANGUAGE

FORTRAN

MODEL DESCRIPTION

The RIO model optimizes the number of recruits input to a rating during a time period by minimizing a function of the number of recruits. The model expresses the costs of various recruit allocations. The RIO model is being developed to replace the STAPLAN model currently performing these functions in the ADSTAP system. In the development of the RIO model, attention has been given to a continuous optimization function which employs five criteria for selection, with provisions for weighting and discounting weights over time. This will permit better analysis of new accession resources.

MODEL INPUTS

Petty officer "requirements"/rating distribution over length of service of those advanced to paygrade E4.

MODEL OUTPUTS

Forecast of optimal recruit inputs by rating, for future time periods.

STATUS

Under development within ADSTAP system.

MODEL NAME

Integrated Facilities Requirements System (IFRS)

COMPUTER

GE-635 (time-sharing)

COMPUTER LANGUAGE

FORTRAN IV

MODEL DESCRIPTION

This model simulates management decisions by computing logistic support, facility requirements, and costs needed to achieve the desired annual pilot training rate.

The long-term objective of IFRS is to develop an operational system that can be used by the Navy to determine the optimum economic utilization of its facilities for specific pilot training rates (PTR's), training syllabus (MODE), and percentage (MIX) of pilots trained for jet, prop, and helo aircraft. More specifically, IFRS is designed to provide an operating system to allow the Chief of Naval Air Training to determine more quickly and precisely the changes in both the total Navy military construction budget and total Naval Air Training Command system cost which may result from changes in PTR, MODE, and MIX of pilots trained.

MODEL INPUTS

MODE - training sequence (prop, jet, or helo), specific content and duration of each training phase (primary, basic, and advanced)
PTR - the annual pilot training rate (assumed constant throughout the year)
MIX - the proportion of pilots trained for jet, prop, and helo aircraft.

MODEL OUTPUTS

Logistic support requirements by phase of training; logistic support requirements by base; runway and OLF requirements; facility requirements/assets/deficiencies/excesses; aircraft and facility investment costs; O&M costs by station.

STATUS

Under development.

MODEL NAME

U.S. Navy Computer-Assisted Recruit Assignment Model (COMPASS)

COMPUTER

CDC 3600

COMPUTER LANGUAGE

FORTRAN

MODEL DESCRIPTION

Given the properties of up to 2500 recruits from each of the three Naval Training Centers and school quotas for up to 91 different school types, this model assigns all recruits to formal schools or general duty such that the following assignment objectives are successively optimized subject to given enlistment guarantees and constraints imposed by previous optimizations: (1) maximize quota accommodations, (2) minimize transportation costs, (3) maximize accommodation of interviewer recommendations, (4) maximize the selection - relevant area aptitude score, and (5) maximize adherence to BUPERS distribution specifications regarding the assignment of lower mental standard personnel to various GENDET apprenticeships.

MODEL INPUTS

School quotas; priority level; share distribution values, test scores; interviewer's recommendations with associated level of importance; transportation costs.

MODEL OUTPUTS

Recommended disposition of each recruit; management reports.

STATUS

Operational.

MODEL NAME

Computerized Advance Personnel Requirements Information System - Billet and Inventory Subsystem (CAPRI - B&I Subsystem)

COMPUTER

IBM 7080

COMPUTER LANGUAGE

COBOL

MODEL DESCRIPTION

This model has six subsystems: Planned Requirements, Approved Requirements, Selected Requirements, Inventory of Personnel Training, On-Board Inventory, Training Plan Computations and Output Reports. Together these modules map the management of personnel subsystem development and production. The Billet and Inventory subsystem continues to function during both the development and production phases of a personnel subsystem life cycle. During the development phase, it is used to produce projected time-phased personnel and training requirements. In the production phase, it produces current and projected on-board personnel status reports for use in evaluation of weapon system operational readiness and for any reprogramming required.

MODEL INPUTS

Planned requirements; loss factor development input parameters; Training Program Plan - processing options and "C" school data; Training Plan Program - input data parameters; Training Plan Output Options.

MODEL OUTPUTS

Complete Training Plan detail; required training input; projected on-board status; billet requirements; output parameters.

STATUS

Reported operational.

MODEL NAME

Computerized Occupational Data Analysis Program (CODAP)

COMPUTER

IBM 360/65, IBM 370/155

COMPUTER LANGUAGE

FORTRAN, ALC

MODEL DESCRIPTION

CODAP is a series of about 23 programs used to manipulate and display task data and other related items garnered from questionnaires administered to personnel in selected occupational fields. CODAP is executed under the direction of an occupational analyst for the purpose of describing, evaluating, and structuring jobs in a hierarchy. The heart of the CODAP system is a technique for clustering individuals beginning with those performing the most similar jobs and progressing toward larger groups at levels of decreasing homogeneity. An assortment of data processing tools is provided for sorting, ranking, and statistically analyzing certain data on user selected groups of individuals. Use of CODAP leads to improved manpower utilization in the areas of classification, assignment, and training.

MODEL INPUTS

Background data on person completing questionnaires; time spent on various tasks; how various tasks were learned; equipment.

MODEL OUTPUTS

Successive groupings of people based on similarity of jobs performed; various rankings of, and statistics on, responses of selected groups of personnel, e.g., time spent on various tasks, personal history data, method of acquiring skills, and measures of job satisfaction (NAVY), job descriptions; regression analysis for one dependent and up to 34 independent variables.

STATUS

Operational within USAF and USMC; to be implemented within Navy.

MODEL NAME

Cost of Attaining Personnel Requirements Model (CAPER)

COMPUTER

CDC 3800, RCA 301

COMPUTER LANGUAGE

FORTRAN

MODEL DESCRIPTION

Using cost and empirical frequency data provided by the user, the CAPER model determines the following 11 estimated values for the ordinary or existing strategy, and for an experimental recruiting/selecting strategy at each possible cutting score on the selection test: Number recruited; number accepted; number of erroneous acceptances; number of erroneous rejections; costs of recruiting; cost of selection; cost of induction; cost of training; cost of erroneous selection decisions; total cost; and total cost per graduate. Therefore, the CAPER model determines an optimal recruiting-selection strategy for minimizing the estimated total cost of recruiting, selecting, inducing, and training a sufficient number of persons to meet a specified quota of satisfactory personnel.

MODEL INPUTS

Quota for graduates; base rate; proportion of graduates plus failures qualified at cutting score; personnel costs.

MODEL OUTPUTS

Cost consequences of alternative recruiting-selection strategies.

STATUS

Being developed at NPRDC.

MODEL NAME

Nuclear Power Training Input (9901 Model)

COMPUTER

IBM 360/65

COMPUTER LANGUAGE

FORTRAN IV

MODEL DESCRIPTION

This model encompasses the computational procedures involved in planning the recruit input and flow patterns necessary to establish quotas for students for the Basic Nuclear Power Class, Class "C", that will be filled in the future. The model provides a five-year projection run when given the necessary NPS class convening dates and planned class sizes. The model considers quota requirements of the "C" school in each quarter and determines the number of men needed in each of eight preparatory levels of the normal inventory flow to meet these quotas. Appropriate attrition rates are applied to each of these levels as the inventory is aged over 22 quarter-length time periods. The levels considered by the model include: Class "C" school in, "C" school ordered, Fleet pool (4-6 months), Fleet pool (0-3 months), "A" school graduates, "A" school in, recruit out, and recruit in.

MODEL INPUTS

Baseline inventory - specified by current level attained with the training route. Attrition rates determined from statistical analysis of historical data. Descriptive material.

MODEL OUTPUTS

The following information is provided for each of the training levels described for each of the 22 quarters projected by the model: "C" school required; "C" school quota fill rate; ASO personnel; PSI personnel, ASE personnel, RI personnel; Fleet pool; attrition expected; recalculations of required recruit input.

STATUS

Reported operational.

MODEL NAME

A Network Flow Technique for Optimizing Personnel On-Board by Paygrade

COMPUTER

IBM 360/50

COMPUTER LANGUAGE

FORTRAN

MODEL DESCRIPTION

The model considers the present number of personnel on-board at each paygrade of a rating and will attrite and advance them realistically in future time periods. The future allocation of personnel among paygrades is optimized for a five-year period relative to the paygrade requirements within the constraints of predicted personnel attrition, advancements, reductions in grade (demotions), and the non-petty officer base. Thus, under the assumption that it is equally important to meet requirements as closely as possible at each paygrade, the model will select the best advancement policy. Such an ability to optimize is a major feature of this model, which enhances the capability and flexibility planners would have in their effort to match inventory to requirements.

MODEL INPUTS

Baseline Personnel Inventory for a given rating; billet requirements for that rating; attrition rates by paygrades; test taker rates for advancement exams by paygrades; test passer rates.

MODEL OUTPUTS

Initial status of manpower variables - and predicted inventory flow rates (e.g., attrition rates); Requirements-Inventory comparisons for each of the out-years by paygrade; Percent of requirements met for each of the out-years by paygrades.

STATUS

Reported operational.

APPENDIX C

BIBLIOGRAPHY

I. INTRODUCTION

This bibliography represents a very tentative and subjective judgment of the literature most relevant to the Design of Training Systems Project. It covers an immense area, including mathematical modeling techniques and applications related to training, a variety of topics under the broad heading of educational technology, and a listing of Navy instructions related to education and training.

Annotations are provided for all items included in the bibliography. Most of the annotations represent objective reviews of the literature; many are simply abstracts composed by the author or publisher. Several of the annotations are critical, pointing out virtues and faults of the document at hand.

II. MATHEMATICAL MODELING TECHNIQUES

This section consists of a representative sampling of mathematical technique descriptions and of technique applications in the areas of education and training as well as manpower and personnel management. The literature has been classified by modeling technique. Major classifications include:

- Linear Programming Applications
- Network Flow Models
- Linear Regression Models
- Markov Models
- Mathematical Analytic Models
- Simulation Models
- Model Surveys

A. LINEAR PROGRAMMING APPLICATIONS

By far, the largest contingent of papers representing modeling technique applications falls in the area of linear programming. Linear programming is an optimization technique in which the expression of system performance (the objective function) to be optimized is expressed as a linear relationship of the system variables. In addition to descriptions of applications of the simplex linear programming technique, this section also includes articles describing applications of modeling techniques closely related to linear programming such as goal programming, integer programming, transportation algorithm, assignment problems, dynamic programming, and scheduling problems.

Harden and Tcheng [1] discuss the application of linear programming to the classroom utilization/scheduling problem. The resources available for scheduling are the classrooms and laboratories; the constraints considered are the course load demands and classroom capacities. The objective is to determine the minimum number of course sections which satisfy all constraints. The model assumes that faculty preferences and availability provide no effective constraints. A scheduling algorithm developed by Shoeman and Bhaumik [2] considers student and faculty day and time preferences, faculty location preferences, and previous preferential treatment of faculty in addition to the above variables. The objective of this formulation is to schedule all classes within specified constraints while maximizing either student or faculty preference achievement. Lawrie [3] describes constraints to the scheduling problem in terms of departments, groups of pupils (i.e., all the pupils in the first or other year of the school), and layouts, which are statements of the curriculum and its organization for a group of pupils. A variation of Gomory's Method of Integer Forms is then applied to a rather complex arrangement of many layouts to arrive at a schedule permutation which meets all specified requirements. Of the three scheduling algorithms examined, Lawrie's integer programming approach was by far the most complex and, by his own admission, difficult to implement. A generalized scheduling algorithm incorporating the best points from the many existing techniques, and applicable to most Navy training schoolhouses, should be investigated for feasibility and potential benefit to the training organization.

Another variation of the linear programming technique documented in this section is goal programming [4,5,6]. All three articles utilize goal programming to study problems in the manpower planning arena. Charnes [6] examines the implications of utilizing training as an alternative to recruitment (in the civilian job market) and job transfers in order to meet specified goals. Patz's [4] stated goal is to manage human resources based upon a sound understanding of the structural, policy, and behavioral variables of the organization being considered. His goal programming formulation of the problem solves for the procurement rate, the retention rate, and the overages or underages by level necessary to maintain a steady state flow of people through a specific structure given a set of promotion policies, a set of continuation policies and a set of attrition rates. The technique is sufficiently general that with slight modification it could be utilized at an aggregated level within the Navy training complex.

Dynamic programming is an optimization technique which tests a series of interrelated decisions. The objective is to determine an optimal policy for the entire sequence of decisions. Although Alper, Armitage, and Smith [7] propose a dynamic programming formulation to optimize alternate decision sequences which must be evaluated in the course of planning an educational system at the national level, the variables and relationships presented are too vague and ill-defined to be of practical use. Bellman (the father of dynamic programming) [8] presents a dynamic programming solution to a multistage decision process in which the constraints constitute classes of alternatives whose boundaries are not sharply defined. Bellman's treatise is mathematically oriented and represents a first attempt at constructing a conceptual framework for the theory of decision-making in a "fuzzy" environment. Two Navy personnel system models utilizing dynamic programming are described in 9 and 10. Both models, the former concerned with the establishment of advancement policies for petty officers and the latter addressing the personnel distribution function, were developed at the Naval Personnel Research and Development Center at San Diego.

Fox, McCamley, and Plessner [11] use a transportation model to allocate college faculty among courses and between courses, research, and administrative activities, while Lt. Commander Andrilla [12], when faced with a similar situation in the assignment of Naval officers, stops short of recommending the adaption of an optimization process. Andrilla presents a case for the automation of the massive data handling task associated with officer-billet matching. In item 13, researchers have formalized the decision criteria on which the enlisted personnel assignment process is based. An optimization process is utilized in CADA (Computer Assisted Distribution and Assignment) and assignments are made based on optimal values for specified decision criteria. Three variables are optimized in CADA -- utility (value of man to billet), desirability (value of billet to man), and cost. As in CADA, King [14] also attempts to predict the result of the assignment and then include this prediction in the actual optimization process. All that is required for the application of King's Stochastic Assignment model using maximization of the joint probability of success as the criterion, is a set of tests that can be used to predict performance along with past experience on which to base parameter estimates.

Eastman and Kortanek [15] apply a combination of the Markov process and the linear programming technique to the problem of generating requirements for community schools. Variables considered are the mix of housing designs and their sequence of construction. A description of how linear programming can be used to analyze the effects of different personnel policies on organizational manpower flows is contained in 16. A less sophisticated technique is used in the Policy Planning Program (POLIP) of the ADSTAP System to accomplish nearly identical objectives related to Navy force structure planning.

Sengupta, in his discussion of stochastic linear programming [17], offers a theoretical discussion of the stability (in terms of variance) of optimal solutions when the parameter space (coefficients of the objective function and constraints), defined in terms of probability functions, is allowed to generate a sequence of optimal solutions. The article points out the difficulties encountered in application of this technique as a result of approximations involved in estimating the distribution of the objective function.

The total modeling process, from problem description to model development, analysis, and implementation, is discussed in 18. The example used to illustrate the modeling process develops a linear programming model to design a teacher salary structure.

Willingham [19] formulates the problem of determining school capacities as a linear programming problem based on facilities, instructors, course content, and specified throughput. An annual schedule for the optimal number of convenings of each course is then developed and its feasibility verified. A variation of this approach will be investigated to determine its applicability to the school capacity and resource allocation areas identified in Section VII.

A macro-level approach to manpower planning is discussed by Maki [20]. The model, which is mathematically similar to a recursive programming model, is designed to serve as a framework for coordinating several aspects of labor-market analysis.

Thelwell [21] and Henderson and Schlaifer [22] both present brief tutorials on the technique of linear programming. Thelwell's objective is to evaluate linear programming and multiple regression as alternate techniques for determining manpower requirements. He concludes that the analysts' objectives and the application itself, rather than the technique, should determine which technique to use in a given situation since neither is universally superior to the other. Item 22 concentrates on a series of hypothetical examples which exhibit a range of application areas for the linear programming technique. McNamara [23] presents a synthesis of literature on the application of mathematical programming in educational planning. His major conclusions are that most applications have been at the macro-economic level and that the lack of communication between educator and O.R. specialists has impaired the utility of mathematical models in the educational arena.

1. HARDEN, W.R. and TCHENG, M.T., Classroom Utilization Planning by Linear Programming. Normal, Illinois: Illinois State University, Office of Academic Planning Educational Sciences Section and Association for Institutional Research, Atlantic City, New Jersey, November 8-10, 1972.

This paper presents a linear programming formulation of the classroom utilization problem at Illinois State University. The objective of the study was to determine the feasibility of accommodating the projected course load with existing classrooms under present scheduling time frames. No change in time frames was required. Similar to other LP applications on same type of problem. The results, in this case, were actually applied to a real situation.

2. SCHOEMAN, M. and BHAUMIK, G., A Class Scheduling Model and Algorithm. Austin, Texas: Project GUM, Phase III, Graduate School of Business, University of Texas, December 1968, WP 70-30.

This paper describes the use of the transportation algorithm to schedule university classes. The routine integrates the information provided by an analyses of student flow and faculty and faculty availability into a workable plan of course offerings involving day, room, and time assignments.

3. LAWRIE, N.L., An Integer Linear Programming Model of a School Timetabling Problem. United Kingdom: University of Strathclyde, Department of Operational Research, March 1969.

Earlier papers have defined the input requirements of a program for timetabling in terms of a list of lists of items, each item being a teacher, a class or set, a classroom, or a piece of equipment. This paper describes an approach based on larger items of departments, groups of pupils (generally year groups), and layouts. The problem is given an integer linear programming formulation, and computational methods used in obtaining solutions are discussed.

4. PATZ, A.L., Manpower Flow Problems and Goal Programming Solutions. Cambridge, Mass.: Alfred P. Sloan School of Management, Massachusetts Institute of Technology, January 1969, Report No. 366-69.

A goal programming version of the standard linear programming model is a mathematical technique which provides a method for simultaneously considering a large number of management goals and some of the structural, policy and behavioral variables related to these goals. The model focuses attention on promotion, continuation, retention, and attrition problems and forces some explicit formulations necessary for the resolution of these problems. The goal programming model solves for the conditions necessary to attain and maintain a steady state personnel flow through an organization.

5. CHARNES, A., COOPER, W.W., and NIEHAUS, R.J., A Goal Programming Model for Manpower Planning. Pittsburgh, Pa.: Graduate School of Industrial Administration, Carnegie-Mellon University, December 1967, Management Science Research Report No. 115.

A goal programming model is formulated for guiding and controlling manpower planning at the level of the Office of Civilian Manpower Management of U.S. Navy. Markov elements are used to trace through the effects of initial and subsequent personal commitments and budgeting constraints, personnel ceilings, etc., and form parts of the total multi-dimensional goal considered. Further extensions will include training, environmental factors, etc., after clarification is secured concerning the pertinence of such a line of development.

6. CHARNES, A., COOPER W.W., and NIEHAUS, R.J., A Generalized Network Model for Training and Recruiting Decisions in Manpower Planning. Pittsburgh, Pa.: Graduate School of Industrial Administration, Carnegie-Mellon University, May 1970, Management Science Research Report No. 206.

   This paper represents an extension of a set of models for manpower planning which utilize goal programming mathematics with embedded Markov processes. The author develops an analytical model which examines internal training possibilities as alternatives to recruitment and job transfers in order to meet specified goals. This allows coordination of "career management" and "manpower planning" by allowing for possible variations in manpower mixes and trade-off possibilities in recruitment, transfer, and training. This is accomplished in a context that considers constraints such as financial budgets, supply and recruitment limitations imposed by policy or the environment, and various limitations on training facilities.

7. ALPER, P., ARMITAGE, P.H., and SMITH, C.S.,"Educational Models, Manpower, Planning and Control." Operational Research Quarterly, Volume 18, No. 2.

   This paper describes the setting up of models of the educational system and their use in decision making. The methodological problems of planning and controlling a large socioeconomic system, such as education, are discussed.

8. BELLMAN, R.E., and ZADCH, L.A., "Decision-Making in a Fuzzy Environment," Management Science, 17(4), December 1970.

   By decision-making in a fuzzy environment, is meant a decision process in which the goals and/or the constraints, but not necessarily the system under control, are fuzzy in nature. This means that the goals and/or the constraints constitute classes of alternatives whose boundaries are not sharply defined.

   An example of a fuzzy constraint is; "The cost of *A* should not be substantially higher than α," where α is a specified constant. Similarly, an example of a fuzzy goal is; "X should be in the vicinity of X_0," where X_0 is a constant. The italicized words are the sources of fuzziness in these examples.

Fuzzy goals and fuzzy constraints can be defined precisely as fuzzy sets in the space of alternatives. A fuzzy decision, then, may be viewed as an intersection of the given goals and constraints. A maximizing decision is defined as a point in the space of alternatives at which the membership function of a fuzzy decision attains its maximum value.

The use of these concepts is illustrated by examples involving multistage decision processes in which the system under control is either deterministic or stochastic. By using dynamic programming, the determination of a maximizing decision is reduced to the solution of a system of functional equations. A reverse-flow technique is described for the solution of a functional equation arising in connection with a decision process in which the termination time is defined implicitly by the condition that the process stops when the system under control enters a specified set of states in its state space.

9. MOONAN, W.J., and COVHER, M.H., A Computer Program for the Determination of an Optimal Advancement Policy for Petty Officers: A Dynamic Programming Approach. San Diego, Calif.: U.S. Naval Personnel Research Activity, May 1966, SRM 66-31.

An important function of personnel planners in BUPERS is concerned with the establishment of advancement policies of petty officers. This report describes the details of a digital computer program which will permit the determination of the optimum advancement policy for a rating for one time period. This program will assist these planners in performing their tasks more effectively. The background material, flow charts, operating procedures, and illustrative examples are provided. The method of optimization used is known as dynamic programming.

10. THORPE, R.P., and CONNER, R.D., A Computerized Model of the Fleet Personnel Distribution System. San Diego, Calif.: U.S. Naval Personnel Research Activity, February 1966, SRR 66-13.

This report describes the development and operational test of a computerized personnel distribution model designed to simulate the distribution functions of the Enlisted Personnel Distribution Office (Pacific) (EPDOPAC). The model consists of the Sort-Match model, which is designed to screen personnel made available to EPDO by BUPERS, and the Quota-Determination model which allocates to the type commands those personnel who are not assigned by the Sort-Match model.

The report also describes other current research concerned with personnel assignment, prediction and policy-testing techniques, and personnel rotation.

11. FOX, K.A., MCCAMLEY, F.P., and PLESSNER, Y., Formulation of Management Science Models for Selected Problems of College Administration. Ames, Iowa: Iowa State University for the U.S. Dept. of Health, Education and Welfare, November 1967, Final Report, Contract No. OEC-3-6-068058.

This paper deals with optimum allocation of teachers in a two-level system. By the authors' definition, a two-level system is one in which the teacher's duties consist of classroom instruction and research. Three models are presented, none of which is an "applications" model.

12. ANDRILLA, J.J., LCDR., "A Computer Assisted Officer Assignment System," Naval War College Review.

In a recent issue of the Naval War College Review, Capt. G.H. Lewis advocated the need for automating the naval officer selection and promotion system. As a sequel to that work, the author evaluates the existing officer assignment system and argues the case for automation. Decisionmakers in the present system are simply overloaded with raw personnel and billet data, and pressure is building that will, of necessity, lead to a better way - a computer assisted assignment system.

13. WHITEHEAD, R.F., SUITER, R.N., and THORPE, R.P., The Development of a Computer Assisted Distribution and Assignment (CADA) System for Navy Enlisted Personnel. San Diego, Calif.: Naval Personnel and Training Research Laboratory, August 1969, SRM 70-1.

This report describes the development of a computerized system to assist Navy personnel managers in carrying out the functions associated with the distribution and assignment of enlisted personnel. The Computer Assisted Distribution and Assignment System (CADA) will broaden the range of assignment alternatives for each man and billet, expand the number of decision criteria considered, and be more responsive to changes in the personnel and operational situation. Although designed for use in a decentralized distribution office environment, the system can be easily modified to operate efficiently in a centralized distribution function.

14. KING, W.R., "A Stochastic Personnel-Assignment Model," Operations Research, 13(1), January-February 1965. This paper was presented at the 1964 CORS/ORSA Joint Conference in Montreal, Canada in May 1964.

Personnel assignment decisions involve performance prediction of job success using test results, etc., and the determination of optimal allocations of individuals to jobs. A model is developed that integrates these two phases and obviates the theoretical difficulties introduced by their independent application. One form of the model requires value measurements that are beyond the scope of current techniques, making it necessary to present "information conditions" that may reduce the level of the required value measurements.

15. EASTMAN, C.M., and KORTANEK, K.O., "Modeling School Facility Requirements in New Communities," Management Science, Vol. 16, No. 12, August 1970.

This is an exploratory paper developing new formulations for modeling selected social and economic phenomena in a new or existing community. The demand for educational facilities is shown to be dependent on the mix of housing designs and their sequence of construction. A Markov model, in a linear programming format, is developed that explores the relation between alternative growth curves of the student population and the housing mix and construction sequence. Objective functions and constraints are formulated that allow for a wide variety of school planning objectives to be related to the housing mix and schedule as defined by market, social, economic, or administrative constraints. The use of linear programming models to facilitate the analysis of complex social phenomena is detailed.

16. PATZ, A.L., "Linear Programming Applied to Manpower Management," Symposium - Management of Human Resources, IMR, Winter 1970.

This paper describes the basic features of a linear programming model that can be used to analyze personnel policy combinations, in terms of their appropriateness, for maintaining a steady state flow of people into, through, and out of an organization. Personnel policies, however, cover so many aspects of human resource management that it is not feasible to include all of them in any one model, given the current limitations of applied mathematics and computer technology. The kinds of policies under consideration in this paper are shown in Figure 1. This figure presents a macroscopic view of a typical organization's personnel procedures. It shows the interrelationships among recruitment, distribution, training, and sustainment policies, and the effects of these policies on an organization's training programs and operating inventory of people. In the operating inventory of people, those who perform other than "in training" roles are referred to as the "organizational inventory." This inventory is the focus of almost all modeling efforts since the attainment and maintenance of a desired organization inventory is usually the crux of manpower management problems. The inventory greatly affects and is greatly affected by procurement, distribution, training, and sustainment policies, as indicated by the "closed loop" form of Figure 1.

17. SENGUPTA, J.K., "The Stability of Truncated Solutions of Stochastic Linear Programming," ECONOMETRICA, Vol. 34, No. 1, January 1966.

In an ordinary linear programming problem it is assumed that all the parameters (i.e., the coefficients of the objective function), the inequalities, and the resource availabilities are exactly known without errors. This assumption is relaxed in stochastic linear programming where some or all of the parameters are known only by their probability distributions. A distinction is generally drawn between the two approaches to stochastic linear programming; the passive (also termed "wait and see" approach) and the active (also termed "here and now" approach). In the passive approach, the probability distribution of the objective function is derived explicitly or by numerical approximations, and decision rules are based on some features of this distribution. In the active approach, additional decision variables are introduced indicating the amounts of various resources to be allocated to different activities. This paper analyzes a method of characterizing the distribution of the objective function values corresponding to the set of extreme points in the solution space for both these approaches of stochastic linear programming. Truncation refers to the selection of extreme points that are neighbors, so to say, to the optimal extreme point. The sensitivity of objective function values corresponding to truncated solutions is analyzed here in terms of stability properties, stability being measured in terms of variance. An application to an empirical economic problem where there are parametric variations in the coefficient matrix only, is presented to illustrate the numerical problems and approximations involved in estimating the statistical distribution of the objective function. From an economic point of view, the approach outlined here offers a theory of the second best, since it specifies the set of conditions under which a value of the objective function that corresponds to the optimum solution on the average may have higher instability than another value of the objective function that corresponds to a truncated solution, under the assumed conditions of stochastic linear programming.

18. BRUNO, J.E., "The Function of Operations Research Specialists in Large Urban School Districts," IEEE Transactions on Systems Science & Cybernetics, October 1970.

The high cost of public education has stimulated interest in applying the techniques of operations research and systems analysis to the management of schools. These applications are generally intended to promote greater efficiency in school operations and insure more effective use of educational resources. Due to the socio-political nature of public elementary and secondary educational institutions, the role of the Operations Research (OR) specialist-systems analyst in the education sector might be considered different from his counterpart in the military and industrial sectors. The function of the OR specialist in a large urban school district is particularly affected or influenced by political action groups, both in the school itself, e.g., teacher organizations, and by the community. Yet it is in these large urban districts where problems are most serious and the skills of the OR specialist-systems analyst are in greatest need.

An attempt is made to demonstrate the role of the OR specialist in large urban school districts by using a problem situation which concerned itself with the politically sensitive question of developing an alternative to the fixed step salary schedule. A model is developed and analyzed, showing in a scenario fashion the functions of the OR specialist. The highly political nature of certain school district planning problems, such as salary evaluation, strongly suggests that the OR specialist in school districts be highly skilled in working with political action groups and possess communications skills to articulate various aspects of the planning effort, in addition to possessing the usual mathematical competencies. Graduate programs in OR at colleges and universities should reflect these special needs in training OR specialists for public institutions.

19. WILLINGHAM, D.G., Determining the Optimal Flow of Student Sections at the Naval Guided Missile School. Monterey, Calif.: Naval Postgraduate School, Masters Thesis, September 1971.

The problem of determining the capacity of a facility, such as the Fleet Ballistic Missile School, to train sections of students attending numerous distinct courses was considered as an optimizing problem, approachable in two phases. In the first phase, a linear programming model was developed for determining the maximum number of courses and the optimal mix of these courses which the school can convene in one year. This model incorporates resource constraints, course content requirements, and the requirement to graduate a specified number of trainees over a period of time. In the second phase, criteria were developed to sequence the Phase I optimal number of convenings of each course into an annual schedule. A heuristic approach was presented to test such a schedule for feasibility.

20. MAKI, D., "A Programming Approach to Manpower Planning," Industrial & Labor Relations Review.

A manpower planning model utilizing soon-to-be available data on job vacancies is proposed by the author. The program is a fixed-horizon type planning model for the nation as a whole, but permits regional disaggregation. The proposal model is based on a recursive programming technique.

21. THELWELL, R.R., "An Evaluation of Linear Programming and Multiple Regression for Estimating Manpower Requirements," The Journal of Industrial Engineering, XVIII(3), March 1967.

This article describes an analysis of linear programming and multiple regression as alternative estimating techniques for manpower requirements. The applicability of the usual regression model's assumption concerning a constant variance when applied to a work measurement situation is discussed. An alternative LP formulation, which makes better use of the observations, and one which provides a better fit to models with a constant term, is presented. The use of additional managerial information to supplement the traditional information on resources used and units completed is suggested for LP. Included is a discussion of the applicability of dummy variables to both techniques permitting the analysis of variables which can only be classified and not measured on a continuous scale.

22. HENDERSON, A., and SCHLAIFER, R., "Mathematical Programming: Better Information for Better Decision Making," Harvard Business Review.

This is a two-part article devoted primarily to optimization of delivery schedules and facilities usage via linear programming. Part I is an executive level survey, Part II deals with specific examples.

23. MCNAMARA, J.F., Applications of Mathematical Programming Models in Educational Planning: An Overview and Selected Bibliography. University of Oregon, Council of Planning Librarians - Exchange Bibliography #271.

This paper contains a summarization of major conclusions based on the synthesis of literature on the application of mathematical programming models in educational planning. It also contains a list of criteria in the form of questions to evaluate operations research models.

B. NETWORK FLOW MODELS

Network flow models are employed in the solution of a variety of problems concerned with the actual or conceptual movement of commodities, information, or personnel. The mathematical technique for solving network flow problems is somewhat related to the Simplex algorithm for solving linear programming problems. Specifically, all three of the documents noted in this section [24,25,26] refer to the out-of-kilter method for minimal-cost flow problems developed by Fulkerson in 1961. The approach consists of an iterative procedure progressing from one feasible solution to another (improved solution) until an optimal solution is reached. The report by Decisions Systems Associates [24] states as its objective, the development of an optimal network flow algorithm which is more efficient than the current state-of-the-art. In addition to a review of related algorithms and a survey of application areas, a comprehensive description of the flow algorithm, a modification of the Fulkerson approach, is contained in the report. Hayter and Conner [26] describe a Navy application of the network flow model to personnel planning problems. This application considers five major controllable personnel variables; requirements, on-board, attrition, advancement, and non-petty officer base. Gorham [25] presents a slightly different approach to the same problem. His goal is to determine a set of training and retraining flows which will maximize the achievement of manpower requirements. The network flow technique should be further investigated for application to the aggregate training process flow model identified in Section VII.

24. HATCH, R.S., NAUTA, F., and PIERCE, M.B., <u>Development of Generalized Network Flow Algorithms for Solving the Personnel Assignment Problem</u>. Decision Systems Associates, Inc. for Office of Naval Research, April 1972, (Final Report - Contract Identification Number NR 151-328).

This report describes research designed to develop efficient solution approaches applicable to the personnel assignment problem. The research resulted in methodological enhancements to Ford and Fulkerson's primal-dual network flow algorithms -- enhancements which provide a manyfold increase in efficiency. The enhanced solution methodology is described in detail. Benchmarks are included to demonstrate the increased efficiency of the enhanced algorithms over original versions of the Ford-Fulkerson algorithms. In addition, the superiority of the enhanced algorithms over assignment algorithms employed by the U.S. Air Force, the U.S. Army, and the U.S. Navy is demonstrated via computer benchmarks.

Application of the algorithms to the personnel assignment problem is discussed, including a comparative benchmark of the USMC Computer-Based Recruit Assignment (COBRA) model with the old and the new algorithms, using operational recruit assignment data.

Although the enhanced algorithms are hardware independent, their efficiency is still somewhat dependent on the basic computational speed and instructional repertoire of the hardware used. Benchmarks are provided to compare the relative efficiency of the enhanced algorithms on large, scientific computers manufactured by IBM, CDC, and UNIVAC.

25. GORHAM, W., "An Application of a Network Flow Model to Personnel Planning." IEEE Transactions, EM 10, 1963.

In this paper, a network flow model is applied to the problem of choosing the best pattern of training and retraining activities undertaken to insure that properly trained personnel are available when and where needed at minimum cost. Although developed and discussed in the context of programming training in the U.S. Air Force, where the "employer" trains most "employees" for specific military skills, the model is appropriate for other applications where employers must engage in large scale training and retraining activities. First the problem is defined, and the general model formulated. Then the details of tailoring the model to the characteristics of the particular type of problem are discussed. An example using hypothetical data is presented.

26. HAYTER, D.F. and CONNER, R.D., A Network Flow Technique for Optimizing Personnel On-Board by Pay Grade, San Diego, Calif.: U.S. Naval Personnel Research Activity, February 1966, SRR 66-12.

This modeling technique is based upon a network flow model uniquely designed for allocating present and future enlisted manpower resources within the limits of constraining factors, in a manner that will meet manpower requirements as closely as possible. In short, it is a planning technique for optimally allocating personnel on-board at all pay grades of a rating for the next five years.

The model considers the present number of personnel on-board at each pay grade of a rating and will attrite and advance them realistically in future time periods. The future allocation of personnel among pay grades is optimized for a five-year period relative to the pay grade requirements with the constraints of predicted (exponential smoothing) attrition, advancements, reductions, and non-petty officer base.

C. LINEAR REGRESSION MODELS

The Linear Regression model is concerned with the estimation of the coefficients $b = (b_1 \ldots\ldots b_n)$ of a linear relationship between a dependent variable y and a set of independent variables $x = (x_1 \ldots\ldots x_n)$ having the form:

$$y = b_1x_1 + b_2x_2 + \ldots\ldots + b_nx_n$$

The estimation is performed on the basis of a set of multivariate observations on the variables y and x. Both Bottenberg [27] and Wegner [28] provide a shortened textbook description of the linear regression process. Bottenberg's dissertation addresses the application of regression analysis to the prediction of personnel related criteria such as training success, job performance, etc. He also presents an iterative computational technique for solving large scale regression problems. Wegner discusses the overlap between the two disciplines, multivariate statistics and mathematical programming. Both linear regression and linear programming are described in detail as techniques requiring concepts from both disciplines.

A conceptual model of a generalizable educational system which hierarchically and categorically organizes specific system inputs is described by Copa [29]. Multiple linear regression is proposed as a means of implementing the conceptual model by separating relevant and non-relevant inputs. The Marlowe, Escobar, Rowland report [30] describes the application of regression analysis to the prediction of naval flight student training success. Phillipa [3] investigates a similar problem - the assignment of personnel to training schools in a manner that will result in optimum use of human resources. Phillips proposes use of a multiple discriminant model to solve the problem. Discriminant analysis differs from regression analysis in the nature of the dependent variable. Regression analysis uses a quantitative dependent variable; whereas discriminant analysis uses a qualitative dependent variable.

27. BOTTENBERG, R. A., The Exploitation of Personnel Data by Means of a Multiple Linear Regression Model. Lackland Air Force Base, Texas: Wright Air Development Center, December 1960, WADD-TN-60-266.

One broad class of personnel problems involves predicting a criterion (training success, job performance, job knowledge, reenlistment decision) from available predictor information. Effectiveness of personnel utilization depends to a large extent upon effective prediction systems for such criteria. This report describes an iterative procedure for determining weights in a multiple regression problem, programmed for an electronic computer. Large-scale regression problems can be economically computed while avoiding, altogether, the question of singularity. The procedure also permits precise tests of hypotheses, enabling the investigator to express his hunches in full detail in formulating the regression model.

28. WEGNER, P., "Relations Between Multivariate Statistics and Mathematical Programming," Applied Statistics.

Both types are subfields of multivariate analyses which is concerned with linear, quadratic, and non-linear relations. Multivariate statistics is concerned with the estimation of parameters and the determination of the structure of relations between variables. Mathematical programming assumes a mathematical model of known structure and is concerned with the determination of optimal policies subject to known structural restrictions.

29. COPA, G. H., Identifying Inputs Toward Production Function Application in Education, Technical Report; Research Coordinating Unit for Vocational Education, University of Minnesota, April 1971.

The major purpose of this report is to deal with the problems of identifying educational system inputs. This does not subjugate the problem of identifying educational systems outputs nor imply that inputs should be considered before outputs.

As with other productive processes, education uses inputs to produce outputs and, thereby, achieve production objectives. Production objectives should indicate output measures which can be used as valid gauges of production. When considering production function development, the other measures needed are of the inputs. The objective of this report is to describe a generalized model for identifying educational system inputs. Only after conceptualizing such a model can the iterative problem of accumulating a data bank be fully elaborated and pursued.

30. MARLOWE, E., ESCOBAR, C., and ROWLAND, G. E., Annual Report in Support of Advanced Development Objective 43-13, Human Factors Technology. Haddon Field, N. J.: Rowland and Co., Annual Report No. 1, November 1970.

This report describes the approach used and the progress made in the application of existing knowledge and technology to the test of computerized techniques which incorporate adaptive training concepts and improved techniques for the prediction of Naval Flight Student Training success. Because these computerized techniques require a unique combination of special data inputs, data file organization, and specific computer software routines to process the file data, this combination is called a data management system. The system will consist of a newly defined data bank and file organization of student pilot selection, performance and administrative data; computerized techniques for processing these data are developed to support a series of 14 system modules. When implemented, the data management system is expected to provide improved procedures for the handling of student pilot training. These improved procedures can be expected to result in reduced attrition in the flight syllabus, more effective placement of students in the pipelines, possible changes in the flight syllabus content, flight hours, and syllabus duration for certain students.

31. PHILLIPS, P. J., MAJ., USAF., An Evaluation of the Discriminant Assignment Model. Wright Patterson Air Force Base, Ohio: Air Force Institute of Technology, August 1966, Research Report GSM/SM/66-14.

A solution to the problem of assigning personnel to training school in a manner that will result in optimum use of human resources might be in the use of the discriminate assignment model. The model makes a probabilistic prediction that an airman's assignment to a given school is desirable by using Bayes Theorm and historical data of past school performances. Results of a rank correlation test indicate that the model predictions have a significant rank correlation with counsellor assignment ratings.

D. MARKOV MODELS

A Markov process represents a particular class of stochastic process in which the conditional distribution of any future state, given the past states and the present state, is independent of the past states, and depends only on the present state. Holdrege [32] presents a non-technical description of an Air Force system called OSCAR - Optimum Selection, Classification, and Assignment of Recruits. The system consists of three independent models; the Trend Information Projection model utilizes the Markov technique (a major portion of the paper is devoted to the presentation of an analog describing the Markov process) to address the training school assignment problem, the Selection and Assignment model uses an iterative multiple regression technique for determining optimal school assignments based on aptitude scores, and the Grouping Evaluation Technique uses regression analysis to determine the predictive efficiency resulting from considering schools not as entities but as groups of schools.

Merck [33] and Durbin [34] both use the Markov process to describe the flow of individuals through a system to provide projections of a population at some point in the future under existing policy conditions. Major problems faced in both situations were the state description of the system and the derivation of state transition rates. Merck's state description of Air Force personnel is based on career field and enlistment term. Career field is subdivided into highly technical, technical, and semi-technical. Enlistment term is divided into first, second, and three or more. Thus, Merck uses a total of nine states to totally describe Air Force personnel. The transition matrix was generated as a result of an analysis of personnel records.

Clough, Dudding, and Price [36] use a different approach to analyze the assignment problem in the Canadian Air Force. A Markovian state description based on rank, aircraft qualification, and state (or current assignment) is used to describe the manpower system. Then, based on this system definition, several mathematical programming models are formulated in terms of objective functions and constraints; Cost Minimization, Selective Promotions Maximization, Assignment Preference Maximization, and Mission Effectiveness Maximization.

The Russian authors [35] propose a Markov model of the educational system at the national level to assist planning agencies during the process of planning and control of the educational system.

Merck and Ford [37] describe a feasibility test on the application of the Markov chain model to personnel system policy planning, which was conducted in 1959. This paper represents a pioneer effort in the application of the Markov technique to the study of the personnel flow problem. The authors employed three variables to characterize the airman population - career field, grade, and total years of active service. On the basis of the feasibility test, Merck and Ford recommended that application of the technique on a larger scale would be practical and would provide personnel planning agencies with valuable information. The authors recommended the development of an information system which would provide the basis for the establishment of the state transition rate matrix.

32. HOLDREGE, F.E., COL., USAF., OSCAR: Optimum Selection, Classification, and Assignment of Recruits: Lackland Air Force Base, Texas: 6570th Personnel Research Laboratory, July 1962, PRL-TDR-62-13.

Three mathematical models, adaptable for electronic processing machines, are described in non-technical terms and illustrated by applications to personnel procurement and assignment problems. Emphasis is on capability for providing management with meaningful information for controlling a complex personnel system.

33. MERCK, J.W., A Markovian Model for Projecting Movements of Personnel Through a System. Lackland Air Force Base, Texas: Personnel Research Laboratory, March 1965, PRL-TR-65-6.

A large, centrally controlled organization needs an accurate projection of future personnel requirements. A computer-processed mathematical model is developed which simulates movements of personnel through the system with the movements based on empirically derived probabilities, the transition rates. Significant variables are selected (career field, LOS, grade) that distribute the system members in a vector of states upon which a probability matrix operates to produce the estimated distribution of personnel at the end of the next time interval. Proposed policy changes can be entered into the system to forecast their effects. In establishing a model, the basic decision is the selection of variables that will characterize the members. The first requirement is that reliable input data be available for the current and preceding time intervals.

34. DURBIN, E.P., Manpower Programs as Markov Chains. Santa Monica, Calif: Rand Corp., October 1968, RM-5741-OEO.

This report indicates how manpower programs (OEO) can be viewed in terms of personnel movement through defined stages of the program. This dynamic process leads to a characterization of movement through the program as a Markov process. The objective of such a characterization is to provide a simple informational framework which may facilitate comparison of programs.

35. BERMANT, M.A., SEMENOV, L.K., and SULITSKIY, U.N., Mathematical Models and Educational Planning. Arlington, Va.: Joint Publications Research Service, April 1973, JPRS 58793.

This translation of a Russian-language book discusses the problems of the application of mathematical methods to the planning and control of the personnel training process. A study has been made of methods of assigning the requirements for specialists and the methods of educational planning for the satisfaction of these requirements. An approach is proposed for the construction of the mathematical model (utilizing Markov chain technique) of the planning and control of the process of meeting the requirements for specialists in any branch of the Soviet economy. The authors point out that because of "the planned nature of the national economy based on objective economic laws of Socialism," the task of creating mathematical models of the education process is less difficult in the USSR than in capitalistic societies. A survey of various "foreign" models of educational planning is included.

36. CLOUGH, D., DUDDING, R.C., and PRICE, W.L., Mathematical Programming Models of a Quasi-independent Subsystem of the Canadian Forces Manpower System. Waterloo, Ontario, Canada: University of Waterloo, Dept. of Management Sciences, September 1969.

This paper presents a fairly detailed treatment of a possible flow/cost model for pilot training in the RCAF. The model was never actually used but might be applicable to some portions of the Navy Training System.

37. MERCK, J.W. and FORD, F.B., Feasibility of a Method for Estimating Short-Term and Long-Term Effects of Policy Decisions on the Airman Personnel System. Lackland Air Force Base, Texas: Personnel Laboratory, Wright Air Development Center Air Research and Development Command, June 1959, WADC-TR-59-38.

This report describes a model which simulates the flow of airmen through the Air Force personnel system under a given set of policies. The model makes it possible to estimate the effects of that set of policies at future points in time. These effects may be gauged in terms of the future distribution of grade levels, career fields, or other pertinent information which may be built into the model.

E. MATHEMATICAL ANALYTIC MODELS

Mathematical Analytic models represent a subset of the total class of deterministic models (other subsets include linear programming, regression analysis, game theory) in which the relationships between dependent and independent variables can be expressed in the form of mathematical equations.

Models and model applications covering a wide range of aggregation and complexity and ranging from conceptual formulations to operational systems are included in this section. One end of the spectrum is represented by Reisman [38] who describes a conceptual model to study (at the national level) the production of college degrees and their feedback into education. The model is described through a set of approximately 50 differential equations. Implementation seems unlikely since qualitative data for several variables is non-existent while other variables remain undefined. Dieterly's Air Force manpower management model [39] consists of seven indices, each representing various proportions of personnel strength figures. Interpretation of these indices by personnel managers theoretically pinpoints problem areas and suggests courses of corrective action.

Bowles [40] and Siegel [41] both discuss macroeconomic models of the educational system. Bowles proposes a constrained maximization model with an objective function representing the contribution of the educational system to future national income, measured by the increment in discounted lifetime earnings attributable to additional years of education. Siegel attempts to construct a theory of enrollment supply based on institutional utility functions. A sea/shore rotation model somewhat analogous to an economic model of supply and demand has been constructed by Borgen, Segal, and Thorpe [42] to assist personnel managers in establishing sea tour lengths in appropriate relationships to policy prescribed shore tours.

Gladston and Swerdlow [43] discuss a Navy version of a computerized personnel projection model which was initially developed by the Office of the Assistant Secretary of Defense. The Enlisted Grade Projection model focuses attention on the way in which changes in the force structure, at a period of time assumed to be representative of the predicted near future, will influence a short-term projection of the force in an aggregate form.

Sands [44,45] describes a Navy application of an analytical technique to determine optimal recruiting-selection strategies. The basis for the development of the CAPER model is that the utility of a selection test is a function of three considerations: (1) a base rate; (2) the validity of the test; and (3) the selection ratio. Relationships between these variables are expanded and expressed through a series of 20 equations.

The Billet Cost Model (BCM) [46] is a life cycle approach to manpower costing developed by B-K Dynamics, Inc. The BCM computes the costs of manning authorized billets with people having requisite skills, in terms of the investment and operation cost to the U.S. Government. This costing capability is tied to the ADSTAP system through the Interim Per Capita Cost Model (INPER) [47] which was also developed by B-K Dynamics, Inc. INPER utilizes ADSTAP-generated force structure matrices and BCM-generated cost data to compute per capita unit cost matrices for each rating.

The Computerized Advance Personnel Requirements and Inventory (CAPRI) System [48,49,50] represents one of the more complex and sophisticated systems (with the exception of ADSTAP) encountered in the course of this technological data review. Although the system is reported to be operational, this fact could not be verified since the model users could not be located in the course of an extensive review of operational Navy models. The CAPRI System objective is to forecast time phased personnel and training requirements. CAPRI consists of two major subsystems; the Network Planning and Analysis Subsystem, which is an adaptation of the Program Evaluation and Review Technique (PERT) to personnel program management functions, and the Billet and Inventory Subsystem which is utilized in support of the Personnel Subsystem production phase management functions by providing both current and projected status through a determination of billets vs personnel inventory information on a weapon system basis.

Spirer's doctoral dissertation [51] develops a systems-matrix technique for describing time-dependent organization information flows. Current techniques employed by systems analysts to describe information flow are the tabular description, graphic flow chart, and the adjacency matrix. Spirer extends the matrix model concept to time-dependent information systems, developing an algorithm which generates results for flow path enumeration, path specifications, and flow transmission times. The Navy training system has been analyzed and functionally described in Phase I of this training systems project. This functional description could be supplemented by an analysis of the information flow within the training system utilizing the matrix techniques developed by Spirer.

38. REISMAN, A., "Higher Education: A Population Flow Feedback." Science, 153(3731): July 1966, pp. 89-91.

This paper discusses a conceptual mathematical model to study the production of doctorate, master's and baccalaureate degrees and their feedback into higher education. The author develops a series of differential equations based on the premise that the total rate of flow into a category (e.g., master's degree program), less the rate of outflow, is equal to the rate of accumulation or growth of a given category. The resulting model is highly theoretical; several variables are not defined and the quantification of those variables that are defined does not appear to be an easy task.

39. DIETERLY, D.L., CAPT., USAF., Simplified Approach to a Manpower Management Model. Lackland Air Force Base, Texas: Personnel Research Laboratory, December 1968 (TR 68-116).

A manpower management model was designed to reflect four factors of concern to personnel managers; procurement, training, reassignment, and retention. Within the framework of this model, seven basic indices were developed to yield simple, reliable, descriptive data by which a manpower structure could be assessed. By means of the simple ratio indices, specific manpower problem areas can be identified and force strength can be compared across seven dimensions (loss, retention, gain, flow, transfer, utilization, and stability) at various levels within an organization.

40. BOWLES, S., "The Efficient Allocation of Resources in Education." Quarterly Journal of Economics. pp. 189-219.

This paper discusses a macro-level model which addresses the question of optimal resource allocation in education. The model maximizes a weighted function of enrollments in various types of educational institutions over time, subject to constraints based on an educational production technology and given resource availabilities.

41. SIEGEL, B.N., Toward a Theory of the Educational Firm. Center for the Advanced Study of Educational Administration, University of Oregon: Revised 1971.

The author discusses the interrelationship of the factors affecting enrollment supply, price control, and federal subsidy in relation to institutions of higher learning.

42. BORGEN, N.I., SEGAL, J.A., and THORPE, R.P., An Equilibrium Flow Model of the Navy's Enlisted Rotation System. San Diego, Calif.: Naval Personnel and Training Research Laboratory, November 1972. Paper presented at the Joint National Meeting, Operations Research Society of America, The Institute of Management Science, Systems Engineering Group of AIIE; Chalfonte-Haddon Hall, Atlantic City, New Jersey.

The periodic rotation of enlisted personnel between sea duty and shore duty assignments is a firmly established Navy policy. The efficiency with which rotation is carried out, however, can have an effect on both the personnel readiness of operating units and the morale of the individual Navy man. This paper describes the development of a computer based equilibrium flow model of the rotation system which enables personnel managers to test and evaluate policies and procedures related to improved planning and control of personnel movements. Examples of actual management applications of the model are also given.

43. GLADSTON, K.M. and SWERDLOW, D., The Enlisted Grade Projection Model (PROMOD): A Management Tool for Navy Personnel Planners. Washington, D.C.: Naval Personnel Research and Development Laboratory, December 1970 (WRM 71-24).

A Navy enlisted aggregate personnel projection model has been developed to analyze various relationships of changes in force structure to changes in personnel inventory. This model examines a variety of personnel policies and changes in force structure variables. It is specifically designed to test the future ramifications of short-term personnel policies and portray the trade-off between short and long-term objectives. Statistical extrapolition, econometric, and mathematical logic have been accomplished on such variables as loss rates and promotion ratios to provide a more exact specification of the model in addition to a better projection capability.

44. SANDS, W.A., A Bivariate Normal Version of the Cost of Attaining Personnel Requirements (CAPER) Model. Washington Navy Yard: Naval Personnel Research and Development Laboratory, April 1973 (Report No. WTR 73-18).

Managers of military and civilian personnel systems justifiably demand an estimate of the payoff which may be expected to result from the implementation of a proposed selection program. The CAPER models provide the manager with the information needed to formulate an optimal personnel recruiting-selection strategy. This strategy will minimize the expected total cost of recruiting, selecting, inducting, and training of a sufficient number of persons to meet a specified quota. The original version of the model (CAPER I) employs raw data and evaluates the experimental selection strategy at each possible cutting score on the new selection test. The data preparation task for CAPER I is tedious. This report introduces a bivariate normal version of the model CAPER II. CAPER II requires more statistical assumptions than the original, but drastically reduces the work involved in input data preparation.

45. SANDS, W.A., A Handbook for the Bivariate Normal Version of the Cost of Attaining Personnel Requirements (CAPER) Model. Washington Navy Yard: Naval Personnel Research and Development Laboratory, April 1973 (Report No. WTR 73-19).

Managers of military and civilian personnel systems justifiably demand an estimate of the payoff which may be expected to result from the implementation of a proposed selection system. The CAPER models provide the manager with the information needed to formulate the optimal personnel recruiting-selection strategy. This strategy will minimize the expected total cost of recruiting, selecting, inducting, and training a sufficient number of persons to meet a specified quota. This report provides a detailed explanation of the steps involved in using the CAPER II model. Application of model equations is illustrated using an example problem. A FORTRAN IV computer program listing is also presented.

46. B-K DYNAMICS, INC., Billet Cost Model Users Manual. Rockville, Md.: B-K Dynamics, Inc., September 1970 (TR-3-159). Prepared for Bureau of Naval Personnel.

The Billet Cost Model (BCM) was developed in order to provide the Navy with a current means, by use of computer techniques, of computing reasonable accurate manpower resource costs on the basis of standard uniform cost formulae. This report describes BCM program operation, details the cost and statistical data employed in generating career costs with the BCM, and describes the preparation of the data and card decks for input to the BCM. Descriptions of the data elements, their sources, and where appropriate, computational methods, and instructions are included.

47. B-K DYNAMICS, INC., INPER: Interim Per Capita Cost - Computation Methods and Operational Controls: Rockville, Md.: B-K Dynamics, Inc., January 1971 (TR-3160).

This report develops Interim Per Capita Cost detailed computation methods and operational controls for obtaining useful (first order approximation) per capita cost values by grade and year of service. INPER costs are applied to the force size as defined by the ADSTAP system thus enabling evaluation of policy and planning decisions as they affect the long-run costs of the force. INPER utilizes the operational Billet Cost Model which computes the cost of manning the authorized billets with requisite skills in terms of the investment and operation cost for each year of the experienced longevity of a given rating.

48. PULSCAK, M.W., RAPHAELSON, E[illegible] R.W., and CLEVELAND, R.H., The CAPRI System for Naval Pe[illegible] Program Management: Volume I - Description and Operation. S[illegible]prings, Md.: Operations Research Incorporated, May 1965 [illegible] No. ND 65-28).

The Computerized Advance Personnel Requirements and Inventory (CAPRI) System described in this report was developed in order to provide the Bureau of Naval Personnel (BUPERS) with a management tool for efficient and effective planning, development, production, and control of personnel required to support both new and operational naval weapon systems. The system was designed to be compatible with and, to the greatest extent possible, to utilize the existing systems, procedures, and

data banks available within the Bureau of Naval Personnel. The CAPRI System design encompasses the manpower management functions involved in the complete life cycle of a PS for a new naval weapon or support system. This life cycle spans the period from the issuance of a GOR for the new naval system development through the final phase-out of the last operational model of the system. The total cycle can be considered as having two distinct phases; the PS development phase and the PS production phase. In order to carry out effectively the management and control functions required in each of these phases, two distinct CAPRI subsystems are utilized - the Network Planning and Analysis (NP&A) Subsystem and the Billets and Inventory (B&I) Subsystem.

49. PULSCAK, M.W., et al., The CAPRI System for Naval Personnel Program Management: Volume II - Data Processing Manual. Silver Springs, Md.: Operations Research, Inc., May 1965, ORI TR 322 Vol. 2 (Report No. 65-29).

A description is provided of the data processing operation of each of the CAPRI subsystems; Network Planning & Analysis (NP&A) and the Billets and Inventory (B&I) Subsystems. The emphasis is on electronic data processing production scheduling procedures required for operation. A description of each computer program is provided including purpose of the run, inputs, and outputs. Detailed procedures describing the operational requirements of the system are included in the appendices.

50. PULSCAK, M.W., et al., The CAPRI System for Naval Personnel Program Management: Volume III - Advanced Development. Silver Springs, Md.: Operations Research Incorporated, May 1965, ORI TR 322 Vol. 3 (Report No. 65-30).

A program of advanced development is being pursued concurrent with the implementation phase of the operational program. This report describes four areas of advanced development: (a) the refinement of the utility of the inventory projection model; (b) the extension of the parameters of the CAPRI System to include information on recruit and "A" school requirements and inventory for technical ratings; (c) the design of a CAPRI cost system to provide information on personnel subsystem costs including training aids and facilities, and (d) the extension of CAPRI capability to include officer data, by weapon system.

51. SPIRER, H.F., Structural Models for Time-Dependent Information Systems. Phd Dissertation, N.Y.U., School of Engineering and Science. January 1970.

Analysis of information flow has been accomplished by systems analysts using tabular charts, flow charts, and more recently, matrix models. The purpose of this thesis is to generalize the concept of matrix model and extend it to time-dependent information systems.

Social scientists introduced matrix models for organizations over 20 years ago. Subsequently, Lieberman introduced matrix models for a limited set of information systems. Homer developed a more general systems-matrix model. Neither model deals with cyclic systems, nor provides solutions for time-dependent systems.

This thesis gives two methods for dealing with cyclic information systems; one by an ordering algorithm, the other by a matrix model based on reachability concepts.

A matrix model for elementary time-dependent systems is presented. Redundancy, as applied to information systems, is defined relative to the "release" of information from a given system component. Zero redundancy is where only one receipt of an item of data is required before release; total redundancy is where the data must be received through all paths before release. Partial redundancy concerns intermediate cases, where some, but not all, receipts of an item of data are required. Solutions for the two extreme cases are obtained from the matrix model for the elementary time-dependent system.

A generalized systems-matrix model for time-dependent information systems is developed. This model not only solves the elementary time-dependent system, but has, as particular solutions, the results for path enumeration and specification of the prior matrix models.

The generalized model is extended to the time-dependent system with filtering, in which logical functions determine the transmission of information between components. This includes a large set of complex practical situations. Solutions of the generalized systems-matrix model with filtering are obtained for zero, total, and partial redundancy. The direct application of the generalized model to the system including partial redundancy produces solutions which can be simplified by theorems given in this thesis.

F. SIMULATION MODELS

Simulation is essentially a technique that involves setting up a model of a real situation and then performing experiments on the model. In the context of this project, the definition of simulation will be restricted to experiments on logical and mathematical models only. Hence, all physical, verbal, pictorial, and analog models are excluded from our now restricted definition of simulation. Mathematical simulation models can be arbitrarily classified as deterministic, stochastic, static, or dynamic. These classifications are by no means mutually exclusive. In deterministic models neither the exogenous (independent or input) variables nor the endogenous (dependent or output) variables are permitted to be random variables, and the operating characteristics are assumed to be exact relationships rather than probability density functions. Those models in which at least one of the operating characteristics is given by a probability function are said to be stochastic models. Static models are those models which do not explicitly take the variable time into account. Mathematical models that deal with time-varying interactions are said to be dynamic models. The majority of models discussed in the section can be classified as dynamic and stochastic.

Rubin [52] and Mormile [53] of Research Analysis Corporation, describe the result of Phase I and Phase II efforts to develop a Personnel Inventory Analysis (PIA) system for the U.S. Army. Four models are detailed in the Phase I report [52], projection and distribution models for both enlisted and officers. These models accept information concerning manpower authorizations dimensioned by time and place, and further accept or develop personnel asset data, rates, factors, and policies from current Army records and historical files. Based on data accumulated or developed, the models produce reports providing a projection of worldwide assets based on established priorities and distribution guidelines. Only the Officer Inventory Projection model is stochastic; the other three are deterministic. All are dynamic. The Phase II report [53] discusses four additional deterministic models. The Condition Determination model determines the condition of manpower categories after assets have been distributed to command elements, ranking personnel problem areas in order of criticality. The Cause Identification model determines causes for those categories found to be in critical condition. Models exist for both enlisted and officer categories.

A dynamic stochastic entity simulation model is described by Groover [54]. This model, a generalized military personnel system simulation capable of addressing both the officer and enlisted components of all four military services, was developed through the Office of the Assistant Secretary of Defense.

Procurement, assignment and reassignment, and promotion and loss are simulated in individual system modules. The one drawback of the generalized approach, as noted by the author, is that a substantial (two man-month minimum) one-time effort must be invested in model implementation. The bulk of this effort would be associated with data definition.

A Simulation Model of Personnel Operations (SIMPO) [55] and [56] is a comprehensive set of simulation models developed by the U.S. Army Behavioral Science Research Laboratory. These models simulate several segments of the Army personnel system and are designed as tools to enable Army management to examine the effect of policy change. The system consists of a combination of aggregate and entity flow models, all of which can be classified as dynamic, stochastic simulations. Although developed in the 1968 and 1969 time frame with a reported ten man-year effort, the system is now reported as "retired" by the Army. Several models were noted to be no longer useful while others were reported to have been replaced by more sophisticated unnamed models.

Gaylord, Farina and Spector [57] describe the Phase I efforts of an operational analysis of the Naval Personnel System performed in 1959. The approach used in this analysis of the personnel system is very similar to that used in the current Training System Analysis project. The report presents a top level functional description of the Naval Personnel System. The report does not, however, describe functional interactions; also functional descriptions are not provided beyond the top level. The authors define a conceptual model of the system encompassing recruiting, classification, training, distribution, utilization, and promotion. A deterministic simulation model capable of providing estimates of future personnel availability under alternate modes of personnel operations was designed, based on the conceptual model. The Phase II report [58] authored by Gaylord and Knetz, describes the development of a computerized personnel production model which was designed in Phase I, tests of its simulation fidelity, and illustrations of its use. This simulation model is intended to be used to evaluate the potential impact of specific personnel programming decisions affecting such directly controllable endogenous variables as procurement and training ratios, school duration, graduation standards, etc. An additional objective of the simulation is to determine the impact of predicted changes in reenlistment rates and other indirectly controllable endogenous variables about which predictions can be obtained.

Unlike the papers described above, Dellheim [59] does not describe a real-world application of the simulation technique, but presents a user interface between the modeler and existing computer simulation languages, such as GPSS (General Purpose System Simulation). Dellheim's Modeling Control Language is model implementation language independent.

52. RUBIN, A., The Personnel Inventory Analysis System: Part I - General Description. McLean, Va.: Research Analysis Corporation, August 1968 (Interim Report).

The overall objective of the Personnel Inventory Analysis (PIA) System is the development of a methodology to permit rapid qualitative and quantitative analysis of the personnel aspects of force structure plans. The models discussed in this report project the distribution of personnel resources against projected authorizations by MOS for enlisted, and by grade/branch for officers, based upon established priorities and distribution guidelines for use by personnel planners in manpower capability and analysis studies of alternative plans. The model is used to project training input requirements necessary to bring the MOS total up to operational strength based on training time and attrition rates.

53. MORMILE, G.T., Personnel Inventory Analysis System: The Evaluation Phase. McLean, Va.: Research Analysis Corporation, October 1969 (RAC-TP-378).

The overall objective of the PIA system is the development of a methodology to permit rapid qualitative and quantitative analysis of the personnel aspects of force structure plans making maximum feasible use of computers. This paper describes a methodology to evaluate the Army manpower situation within the PIA system. The evaluation phase consists of two parts; determining the manpower condition of both officer branch/grade and enlisted MOS categories, and determining the cause of any critical condition.

54. GROOVER, R.O., PERSYM: A Generalized Entity - Simulation Model of a Military Personnel System. Paper presented at the NATO Conference on Mathematical Models for the Management of Manpower Systems, Oporto, Portugal, September 1969.

PERSYM is an operational entity-simulation system designed to permit observation and selective control of system dynamics of a military personnel system under a variety of policy alternatives. The system functions simulated are procurement, assignment and reassignment, and promotion and loss. Necessary training outputs and transients are identified and reported. Samples of reports are presented and plans for further development are discussed.

55. NIEHL, E. and SORENSON, R.C., SIMPO-1 Entity Model for Determining the Qualitative Impact of Personnel Policies. Washington, D.C.: U.S. Army Behavioral Science Research Laboratory, January 1968 (Technical Research Note 193).

The entity model was designed for integration into the more generalized SIMPO-1 simulation package for evaluation of personnel and man-

power policy alternatives. The entity model concentrates on the procurement, selection, and allocation aspects of the personnel system. Other models to be developed which will interface with the entity model, will be concerned with distribution, tour rotation, promotion, and training.

56. OLSON, P.T., SORENSON, R.C., HAYNAM, K.W., WITT, J.M., and ABBE, E.N., Summary of SIMPO-1 Model Development. Arlington, Va.: U.S. Army Behavioral Science Research Laboratory, March 1969 (Technical Research Report 1157).

The SIMPO-1 effort has been directed towards development of a simulation package for assessing, quantitatively, the cumulative impact of personnel policy changes on the allocation, distribution, and utilization of Army personnel, with special attention to effects of policies on deployability. This publication reports on progress in the production and planning of the following models.

DYNAMOD - mass flow models of rotation system; ACCMOD - dynamic mass flow model on non-career enlisted; DYROM II - a dynamic mass flow model of the upper five enlisted grades; SIMPO-1 Quality Input Model - an entity simulation model.

57. GAYLORD, R.H., FARINA, A.J., SPECTOR, P., Operational Analysis of the Naval Personnel System: Part I. Development of a Personnel System Model. Washington, D.C.: American Institute for Research, December 1959 (AIR-33-59-FR-218).

This report represents a pilot application of the techniques of operations research to the analysis of the Naval Personnel Systems (including training). The study addresses the development of a personnel system model based on a functional analysis of the system and a conceptualization of the system's major processing elements. A quantitative model was devised which permits the estimation of personnel system effectiveness under alternate programs of personnel action.

58. GAYLORD, R.H., and KNETZ, W.J., Operational Analysis of the Naval Personnel System: Part II. Development and Testing of a Machine Simulation of Personnel Operations. Washington, D.C.: American Institute for Research, July 1961 (AIR-C3-60-FR-232).

This report discusses in detail, the conversion of a set of general specifications for a mathematical model of the personnel production process to an operational computer simulation of the process. The simulation provides estimates of the personnel inventory that will be available at each date of a planning period under the constraints of various selected personnel policies. Included in the report is a step-by-step description of the development of simulation computer program and of the validation and accuracy testing performed. Data sources and conversion routines are provided in the report appendix.

59. DELLHEIM, J.L., A Modeling Control Language. Poughkeepsie, N.Y.: International Business Machines Corporation, June 1972 (TR 00.2325).

MCL, Modeling Control Language, is JCL-like, simple to learn, and easy to use. The model user, regardless of his degree of input stream stipulations or of modeling sophistication, will be able to control his unique model run requirements with minimal training. A design point for MCL is a common modeling control language for use with the VS1, VS2, and EDOS operating systems and operational environment system models.

G. MODEL SURVEYS

In the process of compiling this technological data base, several papers were encountered which either presented assessments of the impact of mathematical modeling applications in the field of education and training or simply surveyed existing educational system models. Hammond [60] presents an indication of the types of models that have been constructed, the variety of purposes for which models have been used, and the difficulties of adequately modeling educational systems. Although the models surveyed were developed outside of the military, the modeling concepts are applicable to all areas of educational research. Hammond states that because of the complexity of education and training systems, mathematical models can be used effectively to explain the behavior of educational systems and to assist in making decisions relative to better design and operation, improved cost-effectiveness, capacity, and quality. In his concluding remarks Hammond reiterates the following point which has been stressed by several individuals in the modeling business; recent modeling efforts have had an important impact as an aid to data collection, in pointing out what kinds of data are needed, and in encouraging a systematic approach to data collection. Durstine [61] presents a brief survey of the role of technical methods of management as applied to educational processes, which highlights the accomplishments, promises, limitations, and perils of those methods. Durstine cautions against a wholesale application of modeling techniques in the educational field. He points out the existence of a tendency toward overexpectation from these methods, and a corresponding tendency on the part of practitioners to oversell them. Durstine also notes that there is a gap between the technical sophistication of much that is proposed to aid management of educational processes, and the ability of the managers to use these aids. Weitz [62] reviews fifty-six documented applications of operations research techniques in the educational field. Because Weitz believes that educational system planning models are of particular significance and hold the most promise for assisting the educational administrator, the majority of applications reviewed are in this category. That Weitz is more bullish than either Hammond or Durstine regarding the application of operations research techniques to educational problems is evidenced by his concluding remark, "Decisions will be made in any event, hence why not make the assumed relationships explicit by incorporating them in a decision mode."

Item 63 consists of three chapters from the <u>Review of Educational Research</u>. In the first (Chapter V), "Concepts and Techniques of Educational Planning," Chirikos and Wheeler review some of the aggregate models and techniques that have been either suggested or actually used for the preparation of national educational plans. The second chapter (Chapter VI), "Strategies for Allocating Human and Material Resources" by Nystrand and Bertolaet, reflects on allocative strategies in which pupils, staff members, materials, and facilities are considered resources which can be organized in various mixes to produce educational experiences. Literature reviewed in this chapter includes sources which report current patterns in the allocation of such resources, and studies which comment upon the outcomes associated with particular allocative patterns. Benson, in the third chapter (Chapter VIII) included in item 63, reviews several economic dissertations dealing with the measurement of the economic benefits of education, educational planning, efficiency criteria, and adequacy of revenue sources.

Hutchins, et al.[64, 65], describe a technical review of available manpower/personnel management planning and resource management computer models. The report emphasizes operational Navy models but includes nearly 130 models from the Army, Air Force, Marine Corps, Federal Government agencies, State and local government agencies, and private industry. Since training is an integral part of personnel management, several training related models were documented in Hutchins' model compendium. However, as pointed out Appendix B, the model compendium also illuminates the fact that of the few existing training related models which are identified, none is operational within the CNET organization.

Prior to the release of Hutchins' computer model compendium, the IBM study team had conducted an independent model survey with the singular objective of identifying operational training related models and existing data bases. Several of the characteristics of the Navy modeling environment noted by the IBM team were also noted and identified in the Hutchins' report. Among the most important of these:

- With the exception of some personnel data files which have been preserved by NPRDC, very few historical data (manpower requirements, staffing criteria, performance standards) are available within the Navy.
- Of the existing models, training-oriented as well as those dealing with other aspects of the personnel system, there was no common organizational approach. All models were apparently created in a vacuum.
- While very few models exist in some areas, such as training, other areas, such as personnel inventory projection, exhibit numerous models which solve similar if not identical problems.
- A serious communications gap exists in the manpower/personnel management community with regard to modeling applications.

60. HAMMOND, A., Mathematical Models in Education and Training. Santa Monica, Calif.: The Rand Corporation, September 1970 (Report No. RM-6357-PR). Prepared for the U. S. Air Force Project Rand.

A nontechnical introduction to the state-of-the-art in modeling education systems, prepared for Rand's Air Force technical training study. Input-output models are convenient for examining voluminous data on student flows for short periods or for relatively static institutions. Manpower planning models seem least useful. Optimization and simulation models are complementary. Optimization models show resource allocation choices explicitly, yield plans and priorities, and stimulate policy-level discussion. Simulations can help in management and short-term planning if enormous quantities of data are available. A model need not be realistic if it gives useful answers, nor is there one best way to model a situation. Simple models are best at our present level of understanding of the educational process. Included are a review of the literature and a selective bibliography. Mathematical details are given in an appendix.

61. DURSTINE, R.M., "Technical Trends in Educational Management: Opportunities and Hazards." Management Comparative Education Review, October 1970, 327-334.

An extremely general, philosophical paper on the benefits and problems encountered when using models of any kind as management aids in education.

62. WEITZ, H., An Assessment of the Contribution of Operations Research to Educational Planning. Paper presented at the Joint National Meeting of American Astronautical Society (15th Annual) and Operations Research Society (35th National), Brown Palace and Cosmopolitan Hotels; Denver, Colorado, June 1969.

During recent years, the methods of operations research and systems analysis have been increasingly applied to problems of education. The developments considered fall into the categories of, a) educational research, b) program planning and budgeting, c) gaming for instruction and administrative training, d) design of instructional systems, e) the evaluation of computer systems for administration and instruction, and f) educational system planning models. Major emphasis in this paper is given to identification of a pattern in development of models for educational system planning; projection of enrollment populations, structuring of resource requirements, allocation and assignment of resources, and evaluation.

63. CHIRIKOS, T. N., NYSTRAND, R. O., and BENSON, C. S., Review of Educational Research CH. V, Vol XXXVIII, No. 3, June 1968; CH. VI, Vol XXXVII, No. 4, October 1967; CH. VIII, Vol XXXVII, No. 1, February 1967.

While these chapters purport to cover "Concepts and Techniques of Educational Planning," "Stragegies for Allocating Human and Material Resources," and "Economics and Education," they are high level, philosophical treatments of these topics. Many references are made to other works which may or may not be at the same level of generality.

64. HUTCHINS, E.S., Jr., FLINT, B.D., PARTHER, R.C., BAREFOOT, D.B., and LETSKY, M., Computer Models for Manpower and Personnel Management: State of Current Technology (with Emphasis on Navy Operational Models). Washington Navy Yard: Naval Personnel Research and Development Laboratory, April 1973, Report WTR 73-25.

Within the selected field of manpower and personnel management over 230 computer models are reported and a significant number are exposed to an examination of their techniques and areas of application. In addition, 102 related studies and programs are identified. A strategy for performing a technical evaluation is developed and reported, and a functional taxonomy of computer models in this selected discipline is designed and applied. A review of the questionnaire technique employed in the data acquisition phase of the project, with appropriate recommendations for improvement, is also included. The analysis of acquired model data within the taxonomy framework provides both quality and quantity appraisals with respect to application areas covered and techniques employed. An expanded glossary of selected modeling terms and a bibliography of considerable size which resulted from this research effort should prove most beneficial to interested model developers and users. Guidelines for future, needed endeavors are also presented. A by-product of this research is the sizable Compendium of Models and Related Manpower/Personnel Programs and Studies (listed as Appendix "A" and published under separate cover as WTR 73-25A).

65. HUTCHINS, E.S., Jr., FLINT, B.D., PRATHER, R.C., and BAREFOOT, D.B., Computer Models for Manpower and Personnel Management: State of Current Technology (with Emphasis on Navy Operational Models) - Appendix "A" - Compendium of Models and Related Manpower/Personnel Programs and Studies. Washington Navy Yard: Naval Personnel Research and Development Laboratory, April 1973, Report No. WTR 73-25A.

This document is a supporting appendix to a NAVPERSRANDLAB research study which was conducted in response to the desires of the Deputy Chief of Naval Operations (Manpower) to ascertain the current state

of computer modeling technology in the Navy, specifically, the area of manpower/personnel management planning and resources management. Computer model information acquired in the study was obtained through literature searches and a questionnaire process. Data were gathered on Navy, other services, and selected models from industry and other government agencies. The acquired information has permitted the development of a very important by-product, "Compendium of Models and Related Manpower/Personnel Programs and Studies." The Compendium has immediate use and application for the research community as well as operating managers. Because of its size and uniqueness, the Compendium has been separately bound and tailored to stand alone. The level of detail obtained in the Compendium makes it the most complete systematic display of computer model information available in the selected field of manpower and personnel planning. Its uniqueness lies in its ability to display models within a basic model taxonomy framework (the model taxonomy concept employed is summarized in the Compendium and discussed at length in the research report), and the functional attributes of models are thus grouped to permit tracing of the logical flows between model classes.

III. EDUCATIONAL TECHNOLOGY

The reports and articles reviewed in this section discuss selected topics from nearly all training system functions outlined in Section VI. The literature has been classified according to subject matter, which did not result in a one-to-one correspondence with the training functions. For example, three of the topic classifications; Educational Planning, Systems Approach to Education/Training, and Task Analysis, all relate to Function 3.0 Analyze and Plan Training. Four of the topic sections; Counseling, Educational Information System, Training Technique/Media, and Course Design, refer to Function 4.0 Implement Training. The classifications included in this section are:

- Counseling
- Educational Information Systems
- Educational Planning
- Training Techniques/Media
- Training Feedback
- Course Design
- Learning Process Analysis
- Systems Approach to Education/Training
- Task Analysis
- Training Cost Analysis

A. COUNSELING

Counseling, as pointed out by Mims and Gains, who are both members of the research branch of the Naval Technical Training Command, plays an important role in the education of an enlisted man.

Mims and Gaines [66] describe the effects of intensified counseling administered to potential failures versus the normal post-failure counseling. They found that intensified counseling proved to be better than the normal counseling. The number of failures were significantly reduced.

They also performed a study on prescriptive remediation versus the normal one-week remediation. Prescriptive remediation consisted of a one-hour programmed text of remedial instruction covering a review of the units most often misunderstood content areas. The normal one-week remediation consisted of a review of the material covered in a unit of instruction. Their conclusions were that there was no significant difference in the number of failures after taking either remediation. The only significant conclusion was the fact that one method was a week long and the other was only an hour long.

Gaines [67] also performed a study on counselor effectiveness as a function of a personality variable. His study resulted in four conclusions:

1) Counselors with low scores on the California F-scale, a measure of authoritarianism, are more effective than counselors with high F-scale scores.

2) Counselors with low scores on the California F-scale are more efficient in terms of evaluation by students.

3) There is a positive correlation between authoritarianism on the California F-scale and authoritarianism of the counselors as measured by the authoritarianism items of the counseling evaluation questionnaire.

4) The students' estimates of help received and performance change criteria is positively correlated.

66. MIMS, D. and GAINES, R. N., Preventive Counseling and Prescriptive Remediation. Millington, Tenn.: Chief of Naval Technical Training, Research Branch Report 9-73, March 1973.

This report evaluates the effects of redefining the role of a counselor in the AV(A) School so that intensified counseling is administered to potential failures before the trainee takes the unit examination, as opposed to normal post-failure counseling. In addition, two types of remediation were evaluated. An existing system of one-week setback review remediation was compared with a self-paced programmed instruction.

Intensified preventive counseling was found to be significantly better than the normal post-examination counseling, resulting in an increased proportion of students completing the course. The one-hour remediation program was not found to be significantly different from the one-week setback program. Trainees did better on a post-remediation examination than they did on an examination given immediately prior to the remediation program.

67. GAINES, R. N., Counselor Effectiveness as a Function of a Personality Variable. Millington, Tenn.: Chief of Naval Technical Training, Research Branch Report 12-73, June 1973.

In military technical training and educational establishments, the large number of students compared with the number of professionally trained counselors, psychologists, and psychiatrists has resulted in the military services' reliance on their senior enlisted men to perform as counselors in many situations. These men have little formal training as counselors but are experienced instructors/

supervisors, as well as having much experience in their own technical specialty. This study investigates the role of a personality variable in military designated counselors in relation to the subsequent grade performance of the students counseled. The counselors were also evaluated on the basis of counseling evaluation forms filled out by the students. It was hypothesized that counselors with low scores on the California F-scale would be more effective as measured by both measures.

Twenty-five Chief Petty Officers and Marine Corps Senior Non-Commissioned Officers from the Avionics Technician School at the Naval Technical Training Center, Memphis, working as counselors, volunteered for this study. The counselors filled out the California F-scale and subsequently recorded the name of each student that they contacted during a specified period of time.

The study was cross-sectional in that it sampled all participating counselors and their student contacts during one unit or phase.

Results of the study support the hypotheses that counselors that scored lower on the F-scale were better counselors in that their students did better or had positive changes in grades, where counselors with higher F-scale scores had students that did not improve or got negative grade changes.

B. EDUCATIONAL INFORMATION SYSTEMS

An example of an educational information system already in use is described by Wright [68]. The system is used as a pupil tracking/teacher monitoring system. Braunfield and Fosdick [69] describe an automatic teaching device designed to teach a number of students concurrently, but independently, by means of a single, central, high speed computer. Bushnell and Borko [70] describe information retrieval systems and the role they can play in education.

68. WRIGHT, D.L., "The Mesa Arizona Pupil Tracking System," JPL Quarterly Technical Review, Volume 2, Number 4, January 1973.

A computer-based Pupil Tracking/Teacher Monitoring System was designed for Mesa Public Schools, Mesa, Arizona. The established objectives of the system were to:

1) Facilitate the economical collection and storage of student performance data necessary to objectively evaluate the relative effectiveness of teachers, instructional methods, materials, and applied concepts.

2) Identify, on a daily basis, those students requiring special attention in specific subject areas.

The system encompasses computer hardware/software and integrated curricula progression/administration devices. It provides daily evaluation and monitoring of performance as students progress at class or individualized rates. In the process, it notifies the student and collects information necessary to validate or invalidate subject presentation devices, methods, materials, and measurement devices in terms of direct benefit to the students. The system utilizes a small-scale computer (e.g., IBM 1130) to assure low-cost replicability, and may be used for many subjects of instruction.

69. BRAUNFELD, P.G. and FOSDICK, L.D., The Use of an Automatic Computer System in Teaching. Urbana, Illinois: University of Illinois, September 1962.

Plato II is an automatic teaching device designed to teach a number of students concurrently, but independently, by means of a single, central, high speed computer. Only two student sites have been constructed thus far, but, in principal, the number of students that can be taught by Plato II is limited only the capacity and speed of the central computer. The power of such a computer based teaching system stems from its ability to ask complex questions, judge the students' answers to these questions, and take an appropriate course of action on the basis of student responses. The computer also keeps detailed and accurate records of student performance, which are extremely useful guides to improving course content. The paper reports in some detail, a study using Plato II to teach nine undergraduate students a portion of a course in computer programming. Some analysis and interpretation of data gathered by the computer during the study are represented. The apparent effectiveness of Plato II as a teacher, as well as the kinds of problems encountered in preparing lesson material for an automatic system, is discussed.

70. BUSHNELL, D. and BORKO, H., Information Retrieval Systems and Education. Presented at the American Psychological Associated Convention, St. Louis, Missouri, September 1962.

An information retrieval system is defined as a man-machine system combining human intelligence and electronic and photocopying equipment for the purpose of gathering, classifying, and storing of factual and textual material, and for retrieving and disseminating this information upon demand.

C. EDUCATIONAL PLANNING

The planning stage of an educational system is the key to its success or failure. Kraft [71] points out the need for predictive models which will help educational administrators in decision making. With such models, educational administrators could predict the success or failure of an educational system before it was implemented. Bailey [72] describes the role of human factors in an educational system, and how proper planning should account for these factors. Thompson and Harrison [73] describe a self audit system. No matter how well an educational system is planned, the variables used in planning are constantly changing. These changes should be absorbed by the educational system through a self audit system.

71. KRAFT, R.H.P., "Manpower Planning and Its Role in the Age of Automation," Review of Educational Research, Volume 40, Number 4.

The author discusses the kind of occupational training and technical education the American school system should supply, and the constant renewal and development of that education by changes in knowledge and in the manpower needs of industry.

72. BAILEY, S.K., "Educational Planning: Purposes and Power," Public Administration Review. May/June 1971.

The author enumerates five subpurposes or instrumental goals of educational planning in an urban context and discusses the means of achieving these goals.

1) Mastery of basic language tools
2) Exposure to variety of domains of work and pleasure
3) Experience in multiple contacts with a variety of peoples
4) Mastery of (or appreciation of) manipulative skills
5) Knowledge of consequences in the field of both ecological and human relationships.

73. THOMPSON, B. and HARRISON, C., Educational Self Audit. Orlando, Florida: Naval Training Equipment Center, July 1972.

The training self audit is used by an activity to determine where it is; where it is heading under present policies, procedures and programs; what its goals should be; and whether revised plans or actions are needed to meet those goals.

The self audit has been developed into a systematic and detailed procedure through similar studies of Naval training programs. For clarity and simplification, the program has been divided into the following six separate but related segments:

1) Philosophy and Goals
2) Buildings and Facilities
3) Management
4) Staff and Faculty
5) Curriculum
6) Instructional Support.

D. TRAINING TECHNIQUES/MEDIA

The papers reviewed in this category included one survey paper, one paper dealing with performance prediction, two studies comparing Computer Assisted Instruction (CAI) with Programmed Instruction (PI) and conventional classroom, and nine papers and reports dealing with the design selection and implementation of training media.

Since media implementation and training methodology are often indistinguishable, no attempt was made to separate techniques from media where both were discussed in the same paper or report.

Seidel [74] contends that the introduction of the computer with its attendant capability for student interaction (e.g., CAI) requires that the traditional training process be reviewed in order to take full advantage of these capabilities.

Long, O'Neal and Schwartz [75] and O'Neal [76] present data indicating that mere replacement of conventional instruction with CAI does not automatically reduce completion times or improve learning performance or student attitudes. Their findings show that extensive course revision should accompany the introduction of CAI and that similar course revision might produce comparable results when applied to conventional instruction.

In the realm of training media and selection, a rough division can be made between those studies concerned with the Physics of Learning in an artificial environment and those directed at improvement or replacement of existing training systems and the design of new operational training systems.

Brown and O'Neil [77] discuss the problem of media selection (in this case teletype vs CRT terminals) when rapidly changing technology may remove cost differentials between media. Individuals tasked with media selection must remain cognizant of all advances in instructional technique regardless of current media cost because of the condition of constant change.

Parker [78] and Braby, et al., [79], each present formal methods for media selection where a large number of potential media may be applicable. Parker concentrates on translation of learning objectives into media characteristics and aims at the nonspecialist. Braby, et al., propose a system requiring expertise on the part of the user but one which includes a computerized cost optimization module.

Attempts to measure the effectiveness of particular training techniques and the use of measured data in system design and prediction of performance, represents an important sub-set of the general topic of media selection and system design. Hansen [80] discusses the application of various measurement techniques specifically to CAI courses. Difficulties in measurement of CAI vs conventional instruction, are enumerated, again indicating that the two instructional methods are not amenable to direct comparison. Caro [81] presents a formal method for evaluation of the general learning objectives which can be achieved using different devices with the intention of measuring the potential of any device if applied to a training situation for which it was not specifically designed. The study indicates that such substitution is often employed without adequate prior analysis, resulting in inferior training. Predictions of performance in a learning situation, based on mean task scores and quantitative task index values, is discussed by Whaton [82]. Findings indicate that the proposed methodology is more effective early in the learning cycle, but results were deemed sufficiently successful to warrant further investigation; a conclusion which was not shared by the reader.

Application of task analysis and analysis of human factors in training devices and in performance aids, are considered by Smode [83] and Folley [84]. Smode postulates a formal method for evaluating the human factors aspects of a synthetic training system and discusses the application of the proposed method to an existing training system. Similar methods are required in the design of performance aids which can be considered as special types of training equipment to be used on a continuing basis in an operational environment.

A nine-year program of research into maintenance of electronic equipment is synopsized by Rigney [85]. The subject matter, which ranges from panel design to high order languages for development of CAI modules, does not permit further condensation. This is an excellent, broad spectrum reference. Adaptive training, in which the system automatically adjusts task difficulty to student proficiency, is discussed by Kelley [86]. Three methods of adaptation are discussed, but no generalized inferences concerning the application of adaptive training are drawn.

Generic methods for student motivation, not necessarily related to instructional methodology, media, or technique, are covered extensively by Ugelow [87]. This report is more applicable to instructor training at a theoretical level than to design of media-oriented systems.

74. SEIDEL, R.J., "Computers In Education - The Copernican Revolution in Education Systems." Computers and Automation; March 1969.

The exploitation of the computer as a tool remains to be accomplished. Educational research is at the very beginning of establishing the new premises for instructional theory development and revolutionizing the horizons of education and training. In the past, research in psychology had been directed toward describing the learning process, and subsequent to this, attempts had been made to prescribe for the instructional process.

The author concludes that, with the computer and the environments it makes possible, man stands at the threshold of being able to coalesce the study of learning and the prescribing of instruction.

To accomplish this, however, man has to relinquish his egocentric role as usually understood in teaching. Instead, interdisciplinary teams will produce instructional materials. The interdisciplinary instructional team of the future will design the contents of courses, but not as it prevails in traditional instruction. The system for information exchange between learner and knowledge will become far more explicit, more efficient, and more reliable.

The use of computerized educational and training systems will produce astonishing successes.

75. LONG, H.S., O'NEAL, L.R., and SCHWARTZ, H.A. Exploratory Results from the Application of Computer Assisted Instruction to Industrial Training. Poughkeepsie, New York: International Business Machines Corporation, Systems Development Division, January 24, 1969, TR 00.1790.

Since late 1963 the Field Engineering Division of the International Business Machines Corporation has been investigating the feasibility of using computer assisted instruction to provide a means for solving a number of its training problems. As a part of this investigation, a series of four research studies was carried out by the authors. These studies were:

1) A Study of Computer Assisted Instruction in Industrial Training.

2) A Study of Remote Industrial Training via Computer Assisted Instruction.

3) A Model of a Nationwide Computer Assisted Instructional System.

4) Computer Assisted Instruction Applications Research in IBM Field Engineering Education.

This paper summarizes the studies by providing the setting for each, the intent, a systems description, and the major findings that have contributed to the implementation of a nationwide field instructional system in the Field Engineering Division. The implementation is based, in part, on the study results which indicated that employees taught via remote terminals developed favorable attitudes toward CAI and generally learned as effectively and efficiently as when taught via other forms of self-study or the conventional classroom.

76. O'NEAL, L.R., CAI Applications Research in IBM Field Engineering Education. Poughkeepsie, N.Y.: International Business Machines Corporation, Systems Development Division, April 17, 1968, TR 00.1726.

This paper summarizes Field Engineering Education's CAI applications research activity during 1967. It describes the rationale for the selection of specific CAI projects. It outlines the research procedure employed, including the development of measurement tools, establishing control and experimental groups, administration of tests, analyzation of data, and report preparation. A summary of the data from each project followed by a comparison chart for all projects is shown and the significant findings discussed.

Significant differences were found favoring three CAI courses in "time to complete" and two CAI courses in "attitude toward course." Significant differences were found favoring two conventional courses in "performance score," one conventional course in time to complete, and two conventional courses in attitude toward course. In the remaining course comparisons, no significant differences were found in performance score, time to complete, or attitude toward course.

77. BROWN, B.R., and O'NEIL, H.F., Computer Terminal Selection: Some Instructional and Psychological Implications. Tallahassee, Fla: Florida State University, 15 May 1971, Report No. CAI-TM-37.

Factors which have previously provided the basis for decisions as to the use of CRT or teletype terminals in computer-assisted instruction may be decreasing in importance. Specifically, differential cost factors and teleprocessing capability may no longer provide a basis for differentiating between CRTS and teletypes. In the paper, in which findings from several experiments are reviewed, instructional and psychological implications of instructional terminals are discussed. The major terminal characteristics discussed are cost, teleprocessing capability, presentation rate, and display mode. The major terminal characteristics discussed are cost, teleprocessing capability, presentation rate, and display mode. The major instructional and psychological implications discussed are device memory load factors and instructional time and efficiency. Student characteristics of intelligence and anxiety are discussed in relation to instructional terminal characteristics.

78. PARKER, J.F., Jr., and DOWNS, J.E., Selection of Training Media. Arlington, Va.: Psychological Research Associates, Matrix Corp., September 1961, ASD TR 61-473.

The selection of training media in support of military training programs represents an important area of concern. Training equipment exercises considerable influence on the way in which training programs are conducted, upon their effectiveness in accomplishing objectives, and upon the total cost of the program. This report is designed to assist a training analyst faced with the problem of selecting specific training aids and devices to be used in support of the development of the personnel subsystem of a military system. The translation of statements of desired personnel performances and capabilities, as presented in Qualitative and Quantitative Personnel Requirements Information and task analysis documents, into training objectives is discussed. The effectiveness of various training media in meeting specific training objectives is indicated and justified in terms of available objective evidence. An example is presented illustrating the manner in which training media are selected in support of a typical Air Force operator position.

79. BRABY, R., DR., MICHELI, G.S., DR., MORRIS, C.L., Jr., and OKRASKI, H.C., P.E., Staff Study on Cost and Training Effectiveness of Proposed Training Systems. Orlando, Florida: Training Analysis and Evaluation Group, Naval Training Equipment Center, 1972, TAEG Report 1.

This report describes the activities performed during a staff study on the cost and training effectiveness of proposed training systems.

Development of a Training-Effectiveness and Cost-Effectiveness Prediction (TECEP) model has begun. It will eventually contain the following elements; task description and analysis, characteristics of student population, training tasks and training stages, a method for the determination of useful media options, media cost factors, guidelines for substitution and transfer, training program of primary media and allowable substitutions, linear program to optimize for least cost, and a report including economic analysis and recommendations.

An application of the TECEP model using the TA-4 advanced jet training system was performed to test the feasibility of the model. Included in the discussion of the application are a training analysis, training media mix options, cost factors for the TA-4 aircraft and training media, and TA-4 training system cost/training effectiveness.

80. HANSEN, D.N., and JOHNSON, B.F., Measurement Techniques for Individualized Instruction in CAI. Tallahassee, Fla.: Florida State University, 15 May 1971, Report No. CAI-TM-35.

Individualized instruction presents problems in measurement which challenge the conventional measurement paradigms. Taking into consideration the problems of item variance characteristics of CAI, idiosyncratic learning sequences, and lack of a model for effectiveness assessment, the paper reviews various measurement techniques used at the Florida State University CAI Center. The R&D strategies focus on two major goals; measurement providing information on priorities for revision within the CAI course materials, and measurement speaking directly to the effectiveness of the instructional process. Measurement techniques are related to three levels of course characteristics; microframe, concept segments within a CAI course, and course effectiveness models. Foreseeable future trends are briefly discussed.

81. CARO, P.W., Equipment-Device Task Commonality Analysis and Transfer of Training. Alexandria, Va.: Human Resources Research Organization, June 1970, Report No. HUMRRO-TR-70-7.

Procedures were developed to enable training personnel, systematically and objectively, to determine the potential utility of training devices for teaching how-to-perform missions in operational equipment. The procedures allow comparison of operational task stimulus and response elements with corresponding elements in synthetic training equipment. On the basis of such information, training programs consistent with the psychological principles underlying transfer of training may be developed. The procedures, termed Task Commonality Analysis, were developed in connection with an Army rotary wing instrument flight training program.

82. WHATON, G.R., MIRABELLA, A., and FARINA, A.J., Trainee and Instructor Task Qualification: Development of Quantitative Indices and a Predictive Methodology. Darien, Conn.: Dunlap and Assoc., Inc., January 1971.

An exploratory study was undertaken as part of a program to develop quantitative techniques for prescribing the design and use of training systems. As a first step in this program, the present study attempted to compile an initial set of quantitative indices, determine whether these indices could be used to describe a sample of trainee tasks and differentiate among them, develop a predictive methodology based upon the indices, and assess that methodology using studies in the literature. The compilation included the display-evaluative index, a set of panel layout indices, and a set of task rating scales. These indices were applied to task analytic data, collected on Sonar operator trainers at Fleet Sonar

School, Key West, Florida. Application of the indices proved feasible, and differentiation among three training devices, and within four trainee sub-tasks (set-up, detection, localization, and classification) was possible. The predictive method which was generated was an adaptation of the standard multiple regression model. Mean task scores replaced the usual individual criterion scores, and quantitative task index values were used as predictor scores. This adaptation was tested using data from published studies on tracking. Significant multiple correlations using task indices were found for criterion data obtained during early stages of practice. A combination of task and training indices did predict later performance. This result supported the contention that a prescriptive method must include "training" as well as "task indices" in order to account for advanced levels of proficiency.

83. SMODE, A.F., Human Factors Inputs to the Training Device Design Process. Darien, Conn.: Dunlap and Assoc., Inc., September 1971.

The report presents guidelines for achieving human factors inputs to the design of synthetic training systems. It provides a method for design and organizes training concepts and data supportive to the human factors specialist in deriving the functional specifications for the design of any complex training device. Three major sections are provided. The first of these presents an organized method for achieving human factors inputs to training system design. Another section presents concepts and data applicable to the design of training devices. The final section provides a demonstration of the human factors design process for a complex training system.

84. FOLLEY, J.D., Jr., A Preliminary Procedure for Systematically Designing Performance Aids. Pittsburgh, Pa.: American Institute for Research, October 1961.

Performance aids are devices or documents that facilitate task performance by humans in a system. These supplementary aids to performance can enhance the overall quality of a system by assisting in achievement of more nearly optimal man-machine function allocation, by reducing the level of requirements on selection, training, and manning, or by raising on-the-job performance levels. Four steps in the design of performance aids are presented:

1) Identification of task elements for which aids should be provided.

2) Determination of appropriate functional characteristics of aids for these task elements.

3) Specification of the physical design characteristics of the aids to carry out the functions.

4) Evaluation, modification, and updating of the aids.

Supplementary data on capabilities of performance aids are presented for use with the procedure. The procedure is untried and of necessity uses stopgap solutions to problems on which much research or development is needed.

85. RIGNEY, J.W., Research in Electronics Maintenance and Maintainability, Multidimensional Scaling, Computer Personnel Selection, Technician Training. Los Angeles, Calif.: Southern California University, October 1969.

Research was performed in four major areas; maintenance and maintainability of electronic equipment, multidimensional scaling, computer personnel selection, and technician training. Examples of research results were criterion measures for computer programmers and systems analysts, and a job aid and troubleshooting manual for troubleshooting a transceiver. Other significant contributions were the development of quantitative models of the troubleshooting process, the development of an automated procedure for estimating time costs of serial tasks, the application of multidimensional scaling to identifying psychological variables in understanding electronic circuits and in threat evaluation in CIC, the development of job task performance tests for maintenance of communications and radar equipment, the specification of training objectives for this equipment, and the development of a program for implementing computer assisted performance training that generates the interaction with the student from models of the tasks to be learned.

86. KELLEY, C.R., What is Adaptive Training? Santa Monica, Calif.: Dunlap and Assoc., Inc., December 1969, Report No. P547-556. Presented at New England Psychological Association Annual Meeting, November 29-30, 1968.

Adaptive training is training in which the problem, the stimulus, or the task is varied as a function of how well the trainee performs. The concept and techniques of adaptive training are introduced and a comparison drawn between different methods of adaptation. The preferred method keeps measured performance constant by changing the difficulty of the task. Fundamental characteristics of adaptive trainers are enumerated and contrasted with fixed trainers. The implementation of an adaptive training system is then discussed under the following headings:

1) Choosing an adaptive variable

2) Measuring performance

3) The adaptive logic

4) Error standard and difficulty level

5) Knowledge of results displays.

A concluding section cautions against expecting adaptive techniques to correct training devices with inherently poor training validity.

87. UGELOW, A., Motivation and the Automation of Training, A Literature Review. Wright-Patterson AFB, Ohio: Aerospace Medical Division, 6570th Aerospace Medical Research Laboratories, March 1962, Report No. MRL-TDR-62-15.

Controlling the motivation of learners in their continuing use of the new auto-instructional devices could become a serious problem, since neither the devices themselves nor the performance knowledge they provide seems sufficient to maintain extended participation in the instruction. A selective review of the literature on knowledge of results, praise and reproof, competition, task interruption, and readability suggests techniques for better controlling such participation. Potentially useful applications are discussed, and limited try-out of variations, both within the program and instructional environment, is encouraged.

E. TRAINING FEEDBACK

Training feedback is a significant part of an educational system. Federico [88] describes the critique form method of obtaining useful information for training feedback. Standlee, Bilinski, and Saylor [89] describe the structured interview method of obtaining training feedback on the maintenance of Navy electronics systems. Bilinski and Saylor [90] show another example of the interview method of obtaining training feedback in a non-electronics, Class "A" curriculum environment. Angell, Shearer, and Berlinger [91] demonstrate that analytic techniques can be applied successfully in dealing with what often seems the hopelessly complex and disorderly business of training performance evaluation. In addition, new directions are pointed out which hinge on the development and application of computers to training tasks.

88. FEDERICO, P., Development of Psychometric Measures of Student Attitudes Toward Technical Training: Reliability and Factorial Validity. Brooks AFB, Texas: Air Force Human Resources Lab, November 1970, Report No. AFHRL-TR-70-37.

This investigation is the Phase I effort of a task which undertakes to develop a new student critique form for Air Training Command (ATC). Specifically, it deals with the identification of valid and reliable psychometric measures of student attitudes toward Air Force technical training. Two critique form prototypes were developed using a Likert-type and a Guttman-type configuration. These were administered in a counterbalanced order to samples of officers, NCO, and airmen enrolled in an ATC technical school. Multiple-factor analyses and multiple discriminant function analyses were performed for the scored responses of the subjects to these critique forms. Test-retest reliability and factorial and discriminative validities were established for each of the prototypes. On the basis of the statistical analyses of the two forms, the Likert configuration was recommended for further development. Eight Likert factors, or unidimensional scales, were defined; Instructor Competence, Training Management, Specialty Training, Training Impressions, Training Facilities, Repetitious Instruction, Intelligible Media, and Textbook Utility. Because of demonstrated differences between rater groups, it was also recommended that group-specific forms be developed.

89. STANDLEE, L. S., BILINSKI, C. R. and SAYLOR, J. C., Procedures for Obtaining Training Feedback Relative to Electronics Maintenance. San Diego, Calif.: Naval Personnel and Training Research Lab, January 1972, SRR 72-13.

This report compares different methods of obtaining training feedback; experimental, mail-out questionnaires, performance diary, analysis of existing records, rotation of Fleet and training personnel, and structured interview. The report describes how the structured interview is used to collect feedback information on six electronics systems. The field test results are summarized. The authors conclude that the structured interview is a "highly satisfactory method of obtaining training feedback information."

A bibliography covering previous field studies for obtaining training feedback information is included in the report.

90. BILINSKI, C. R. and SAYLOR, J. C., Training Feedback to the Navy Storekeeper Class "A" School. San Diego, Calif.: Naval Personnel and Training Research Lab, January 1972, SRR 72-114.

Data was obtained from Storekeepers, both from the Fleet and shore, concerning their experiences in performing assigned tasks. Findings include the most frequently performed tasks and those causing the most difficulty. Specific recommendations for training are included.

91. ANGELL, D., SHEARER, J. W., and BERLINGER, D. C., Study of Training Performance Evaluation Techniques. Palo Alto, Calif.: American Institute for Research, October 1964, NAVTRADEVCEN-1449-1.

This report discusses performance evaluation in the training environment, specifically in training situations involving the use of simulators and other complex training equipment. The important variables involved in developing a system of performance evaluation are seen as (1) types of behaviors, (2) types of measures or mensural indices, and (3) types of instruments for recording performance. Factors relating to these variables are discussed, and some of the interrelationships among the three variables are presented. An illustrative application of an automatic training evaluation system is given.

F. COURSE DESIGN

Rundquist [92] describes a systematic procedure for the design of training courses. It also has implications for the design of training programs. The procedure is developed in a manner which (1) takes account of principles from the many technical and professional fields contributing to training technology, (2) keeps course design completely job assignment oriented, and (3) puts the emphasis on the instructor's dealing directly with the student to facilitate his learning. Stern [93] points out that when subject-matter experts are used for developing or revising course content, care should be exercised in the selection of these judges. West and Rundquist [94] demonstrate that the course design procedure is flexible and can be adapted for effective revision of a high level officer training course.

92. RUNDQUIST, E. A., <u>Job Training Course Design and Improvement (Second Edition)</u>. San Diego, Calif.: Naval Personnel and Training Research Laboratory, September 1970, SRR 71-4.

The second edition of the course design manual is a thorough revision of earlier editions. The manual is designed to assist instructors in developing and improving job-related training courses. Major changes from earlier editions include more careful definitions of training and training related terms; a general clarification of concepts and procedures, especially those concerned with job and skill analysis for training purposes; more emphasis on principles of developing training exercises; a more thorough consideration of the importance and means of adapting individual differences; and more emphasis on the significance of the course mission for course design. Examples from a wide variety of duty assignments are included.

93. STERN, H. W., <u>The Reliability of Expert Opinion in Specifying Course Content</u>. San Diego, Calif.: Naval Personnel and Training Research Laboratory, December 1970, Technical Bulletin STB 71-4.

In the development and revision of curricula, subject-matter experts are frequently called upon to aid in specifying skill or knowledge requirements and to provide opinions on the degree of importance associated with the requirements for the establishment of a curriculum. If, however, these expert judgments are not reliable, their validity is automatically questionable. The effect of individual differences in reliability may not be given sufficient consideration.

In order to evaluate this problem, data from a previous study was supplemented and analyzed for rate-rerate reliability of a group of Navy subject-matter experts, including an analysis of individual differences.

The rate-rerate reliability for all 16 judges over a six-month period was .59. Absolute changes in rating averaged slightly over half a scalar unit on a 6-point scale. When four raters were selected on the basis of their individual reliability, their combined rate-rerate reliability was .68. Other measures indicate the selection of raters on an index of individual stability may increase relaiability, although the effect this has on validity is not known. These findings indicate that a large number of raters does not insure high reliability, and that selecting a subset may result in an increase in precision in overall reliability.

94. WEST, C. M. and RUNDQUIST, E. A., Exploratory Application of NPTRL's Course Design Procedure to Redesign of the Amphibious Command Orientation Course: A Proposal for Implementation. San Diego, Calif.: Naval Personnel and Training Research Lab, March 1972, Research Report SRR 72-16.

Describes how the course design procedure was applied to the redesign of a high level Navy officer training course. Contains a model for course organization, specification of example training tasks and methods of presentation, and enumeration of general developmental considerations.

G. LEARNING PROCESS ANALYSIS

Dyer [95] describes the problems of measuring the performance of an educational system using indicators such as student-teacher ratios, the physical plant, or system output as measured by achievement test scores. Pask [96] describes a two-part study of learning strategies and learning set. The first part involves experiments with real-life subjects. The second part is concerned with a computer simulated model of learning, which, when interpreted, constitutes a theory of learning. Tucker [97] gives a summary of activities which involved development and evaluation of theories and techniques for investigating the structure of individual differences in psychological phenomena. Taylor, Montague, and Hauke [98] describe a three-phase project to assess the impact of aptitude differences on learning performance. Thomas [99] describes her procedure for validating the basic test battery. The basic test battery was developed to predict performance in Navy schools. Narendra and Shapiro [100] and [101] discuss the concepts of automata theory and mathematical psychology learning theory in relationship to the usual notion of a performance index in a control system and as a method for the determination of optimal parameter values for control systems with multimodal performance criteria. Study of the actual process of learning remains one of the major problems facing educators today. The sampling of articles in this section brings this point home loud and clear. The first hurdle to be overcome is the identification of the variables which control the process. The majority of papers reviewed address this problem. There seem to be as many approaches to this problem as there are researchers. Everyone has solved a small part of the problem, yet no one has the total answer.

95. DYER, H.S., "Can We Measure the Performance of Educational Systems?" National Association of Secondary Schools, Bulletin 54, May 1970.

    This article deals, in general terms, with the problem of measuring the performance of an educational system. It points out faults in measurement by physical plant and student-teacher ratios, as well as problems using standard achievement tests.

96. PASK, G., Learning Strategies and Teaching Strategies. Richmond, England: System Research, Ltd., June 1960.

    Results are reported of human learning experiments and computer simulations. Experiments focused on - (1) how a subject directs his attention and explores the problem environment created by the task to be learned and (2) how the subject's learning process can be facilitated by conversational, or partially cooperative, teaching systems, in practice, CAI systems. In all experiments, the subject interacted with an automaton responsible for controlling the experimental environment. Under some conditions, the automaton was a procedural device and imposed behavioral constraints that represented rules of the task but permitted the subject freedom, particularly in his choice of a strategy. Under other conditions, the automaton was a simple adaptive teaching machine or a conversational machine. The simulation incorporated subprograms representing the subject and automaton respectively. The gross action of the metasystem is explained in terms of the theory of self-organizing systems. Different subjects exhibited different strategies for learning the same skill. The strategies may or may not be able to be fitted to aspects of mental organization of which the subject is often imperfectly aware. Results show that an adaptive metasystem is a better instructional instrument for the skill studied than either the attention directing process in a free learning subject or a more restricted, single strategy teaching system. The computer simulation of the learning process in the subject is a psychologically oriented artificial intelligence program, not a stochastic mode. It is heterarchic in that its structure involves several separable but interacting hierarchic systems.

97. TUCKER, L.R., Final Report For Contract U.S. Navy/00014-67-A-305-0003. Urbana, Illinois: Illinois University, Dept. of Psychology, February 1971.

A summary is given of activities which involve development and evaluation of theories and techniques for investigating the structure of individual differences in psychological phenomena. Particular areas of investigation were; differences in predictive systems for individuals, differences in psychological scaling, differences in learning and growth, factor analysis (including three-mode factor analysis), and analysis of binary data.

98. TAYLOR, J.E., MONTAGUE, E.K., and HAUKE, R., The Interrelationships of Ability Level, Instructional System, and Skill Acquisition. Alexandria, Va.: Human Resources Research Organization, December 1970, Presented at the symposium of American Psychological Association Convention, held at Miami Beach, Florida, on September 1970.

This paper describes an assessment of the impact of aptitude differences on learning performance. As a result of these tests, instructional strategies are being developed to make efficient training programs for men of differing aptitude levels. Observations were that the high level group did better when left without a structured training program; that the middle range was also able to work at its own speed. Low aptitude groups, however, required a complete structured program in which the instructional sequence is kept down to small steps presented on an elementary language level.

99. THOMAS, P.J., The Relationship Between Navy Classification Test Scores and Final School Grades in 98 Class "A" Schools. San Diego, Calif.: Naval Personnel and Training Research Laboratory, April 1972.

There are substantial correlations between the Basic Test Battery and "A" school grades. Ninety-five percent of the relatively low aptitude was graduated successfully. Changes (lowering or raising) of the cutting scores for certain schools should be considered.

100. NARENDRA, K.S., and SHAPIRO, I.J., The Use of Psychological Learning Theory Models in the Design of Adaptive Systems. New Haven, Conn.: Yale University, October 1969, Report No. P 103-7.

A method for the determination of optimal parameter values for control systems with multimodal performance criteria is based on the theory of finite-state automata. This method is discussed in terms of its implications in the dual context of learning models in mathematical psychology. The various mathematical models considered in the literature are described, the design and application of the optimal automaton are discussed, and the implications of this model in learning theory are considered.

101. SHAPIRO, I.J., and MARENDRA, K.S., Use of Stochastic Automata for Parameter Self-Optimization with Multimodal Performance Criteria. New Haven, Conn.: Yale University, Dept. of Engineering and Applied Science, October 1969, Report No. P 352-360.

The application of stochastic automata to adaptive parameter optimization problems is considered. The fundamental problem is that of relating the concepts of automata theory and mathematical psychology learning theory to the usual notion of a performance index in a control system. Consideration is given to a number of possible automata structures, linear and nonlinear. One particular linear model is derived with optimal rather than expedient properties of convergence. A basic feature of this model is that it is based on a system response set of rewards and inactions. The latter being substituted for the more common penalty responses. This choice of response set is directly related to the achievement of the desired behavior. Simulations are described for the maximization of multimodal performance functions intentionally constructed to demonstrate the use of the method in situations where relative extrema occur. An example is also given of the automaton as a direct adaptive controller for a third order control system.

H. SYSTEMS APPROACH TO EDUCATION/TRAINING

The great majority of papers in this category addressed very general questions in general terms.

Hartley [102] and Burgess [107] both issue caveats; Hartley against inappropriate use of systems analysis and too ready acceptance of results. Burgess warns against design faults resulting from failure of elements within a system design team to recognize the system, rather than subsystem, goals.

Three of the papers are tutorial in nature, intended to acquaint the now-expert with various phases of human and systems engineering. Mayer [104] deals with human engineering, gives a brief history of this discipline, and examples of applied human engineering techniques. Ammerman [105] describes the role of the human in complex systems and suggests that, in this context, the human must be considered in a different way from the traditional man-machine problem if his role in the system is to be optimum. Coulson [108] describes the application of systems analysis to educational systems, at a general level, and attempts to make more explicit some of the jargon used by systems analysts and misunderstood by educators.

Sisson [103] is concerned specifically with training in the Navy. He outlines an approach to the analysis of the naval training system and advocates the formation of a training engineering group. The goals and methods outlined by Sisson are very similar to ADO 43-03X.

The remaining two papers describe analysis done for, or on, specific training systems. Kodama [106] introduces a formal mathematical approach to training evaluation and describes the application of this technique to the training of crane operators. Hall [109] gives an overview of a study on Coast Guard air training, designed to optimize the mix of flight, simulator, and classroom training. Consideration is also given to training effectiveness evaluation in this context.

102. HARTLEY, H. J., "Limitations of Systems Analysis," Phi Delta Kappan, 50: 515-519, May 1969.

The primary objective of this article is to identify major limitations of the various systems approaches to educational planning. Most of the current systems literature tends to be descriptive rather than critical. It is Mr. Hartley's hope that the focus on limitations -- he lists twenty-five -- will provide a more realistic understanding of the advantages of systems analysis.

103. SISSON, R. L., Organizing and Planning for Engineering Improved Training Systems. Princeton, N. J.: Mathematica, Inc., March 1971, N00014-70-C-0382.

This is one of the studies which is directly related to ADO 43-03X. Several different kinds of models are discussed. A strong need is stated for the development of a Training Improvement Engineering Group in the Navy. Some of the suggested approaches are very similar to those being used in the current IBM approach.

104. MAYER, S. R., Human Engineering in the Design of Instructional Systems. Bedford, Mass.: Electronic Systems Division, Air Force Systems Command, September 1964.

A conceptual model is proposed for use in the application of human engineering principles and techniques to the design of instructional systems. The trainee and instructor are viewed as operators within an information system. To illustrate this model and its application, examples are drawn from the literature and from current research on instructional systems. A preliminary human engineering guide is outlined which presents factors critical to design decisions for instructional systems. The model and guide attempt to counteract current tendencies toward premature standardization of instructional system structure, and to bring instructional system development into the main stream of the applied science of human engineering.

105. AMMERMAN, H. L., and MELCHING, W. H., Man in Control of Highly Automated Systems. Alexandria, Va.: Human Resources Research Organization, May 1971. Presented at the annual Army Human Factors Research and Development Conference (16th), Fort Bliss, Texas, October 1970.

The identification of what man should do as a decision maker and controller in the newly evolving man-machine systems is considered. Among the topics discussed are man's underlying basic functions in a complex system, task activities for individual jobs and their analyses, and training and the design of operational job positions.

106. KODAMA, F., "An Approach to the Analysis of Vocational Education and Training Requirements," Management Science, Vol. 17, No. 4, December 1970, Report No. PB178-B191.

Systematic approaches to the problems of education and training are difficult because so many social and psychological variables are involved.

As education and training can be viewed as a system, system analysis can be applied. Therefore, in this study, the education and training system is formalized in the form of a matrix which shows the

relationship between curriculum and the behavior of the skilled worker who is adequately educated and trained. Based on the matrix, the optimal time allocation in the curriculum was solved. Crane work in the Japanese steel industry was selected as the subject of the study and the procedures by which the formalization can be applied to a practical problem were developed.

107. BURGESS, J. H., "Ego Involvement in the Systems Design Process, Human Factors, 12(1), 7-12, February 1970, Report No. P7-12.

Psychological interactions among members of a systems design team are frequently of major importance in the design process. Problems arise from specialized design interests as well as failure in systems discipline. Such problems can be resolved only by understanding the nature of the individual and his involvement in interpersonal design conflicts. Several areas may be considered for improving interpersonal relations in the systems design effort. Through increasing emphasis on significance of systems design, greater personal and professional involvement in the systems approach may be possible. Attention is required at the corporate-management organizational level to orient individual engineering professional goals in terms of total system perspective. Indoctrination and discipline in systems philosophy and practices also require increased emphasis. Comprehensive design team training might be considered as a means for improving the systems design process. Further study is suggested.

108. COULSON, J. E., and COGSWELL, J. F., Systems Analysis in Education. Santa Monica, Calif.: System Development Corp., January 1965.

The paper is concerned with systems analysis in education, which certainly includes some highly complex man-machine systems. To make these words more than a catch phrase, the system analysis process is described in fairly concrete terms, giving specific examples of the procedures and products of such analyses. At the conclusion of the paper, some possible implications of systems analysis procedures for educational data banks are discussed.

109. HALL, E. R., and CARO, P. W., System Engineering of Coast Guard Aviator Training. Alexandria, Va.: Human Resources Research Organization, August 1971. Presented at the Psychology in the Air Force Symposium held at Colorado Springs, Colorado, April 1971.

This paper describes a total-program application of the systems engineering concept to the U. S. Coast Guard Aviation Training Programs. The systems approach used treats all aspects of the most cost-effective integration of academic, synthetic, and flight training for the production of graduate Coast Guard aviators. The paper describes the techniques used to develop job-relevant terminal behavioral objectives (the Coast Guard Search and Rescue Flight Mission provides the operational context), the assignment of objectives to academic, synthetic, and flight training, the integration of these components into a systems-engineered training program, the development of relatively objective proficiency assessment techniques, and the development of a flying training quality control system for maintaining and enhancing instructional efficiency and management of the training system.

I. TASK ANALYSIS

With the single exception of Reardon [114], all of the reports reviewed in this classification fall into two categories; methods for collecting task analysis data or task analysis for a specific job type. Generally, those reports that deal with data gathering methods also include an anlysis of a specific job type, but such analysis was not the primary thrust of the research. Ancillary support systems such as computerized data retrieval systems are also covered in some cases.

The only general conclusion that can be drawn from these reports is that task analysis is not done in any uniform, systematic manner. Methods described vary from job-type to job-type and from service to service. While some of the reports do postulate the extension of a particular task analysis methodology to a broad spectrum of job types, no data are presented which indicate that this is being done.

Cullison [110] covers three methods of questionnaire administration, and describes the use of the Computerized Occupational Data Analysis Program (CODAP/370) in the analysis of the Aerographer Mate and Air Controlman ratings.

MacAlister [111] deals specifically with the Boilerman (BT) rating, but the research was also intended to demonstrate the task analysis approach developed by the Naval Personnel Research and Development Center (NPRDC).

Perhaps the most generalized approach is taken by McDowell [112]. Here the emphasis is on the basic problems of common course development and rating restructuring for the Engineering and Hull ratings.

Wilson [115] and Ellis [116] are both concerned with task analysis applied to derive human factors data to be used in system design, although Ellis deals with a much more specific methodology.

Sass [113] and Shriver [117] both deal with task analysis for a specific rating (or in the case of Shriver, a Military Occupational Specialty) where the analysis is done primarily to improve the training for, or structure of, that rating. Shriver treats electronic maintenance training and does so in a more general fashion than the approach taken by Sass. Though the word forecasting is used to describe the purpose of Shriver's research, this is somewhat misleading because forecasting, as used in this report, means to derive those attributes of a proposed system that will shape training needs.

110. CULLISON, M.D., Occupational Analysis: Report on Data Collection of Navy-Wide Test of Group IX Ratings. Washington Navy Yard: Naval Personnel Research and Development Laboratory, June 1972, WRM 72-35.

Data gathering techniques and data gathering instruments were tested in the Aerographers Mate (AG) and Air Controlman (AC) ratings to determine their feasibility in the building of a Navy enlisted occupational data bank. A 20-page response packet was developed to accommodate responses to a questionnaire concerning specific task statements, items of equipment, watches, types of aircraft, and worker characteristics. Three methods of questionnaire administration and participation by billet incumbents revealed most and least desirable methods. Computerized Occupational Data Analysis Program (CODAP/370) is described and its usage for providing occupational data for analysis is stressed.

111. MCCALISTER, E.H. and MCCUTCHEON, R.E., JR., The Development of a Task Inventory for Training Purposes for the Boilerman Rating. San Diego, Cal.: Naval Personnel and Training Research Laboratory, Nov. 1971, Research Report SRR 72-10.

The report presents a detailed task inventory of the Boilerman (BT) rating. The inventory was developed at the request of the Naval Development and Training Center (DATC), San Diego. The reported inventory is an update of an earlier version. The purpose is to improve training and use as a basis for pretests.

112. MCDOWELL, H.C. and HULEGAARD, G.S., New Concepts to Improve Training and Shipboard Manpower Utilization in the Engineering and Hull Ratings: Statistical Analysis. San Diego, Cal.: Naval Personnel and Training Research Laboratory, June 1972, SRR 72-26.

This report describes the method used to utilize job analysis approaches to problems of; common course development, curriculum planning, rating restructuring, qualifications for advancement development, job satisfaction, billet restructuring, and distribution/assignment. Data was collected, analyzed, and displayed as computer printouts, which were published for each rating as SRM 72-13 through 72-22. A task commonalty is being published as SRM 72-26.

113. SASS, D.H. and SWERDLOW, D., The Ships Serviceman Rating: New Concepts to Improve Training, Assignment, Performance, and Utilization. Washington, D.C.: Navy Personnel Research and Development Laboratory, March 1972, WRM 72-23.

This report contains an analysis of the Ships Serviceman (SH) rating. It contains specific recommendations for improving performance, retention of personnel, assignment, and training. The report covers, in some detail, the sources of problems in the SH rating.

114. REARDON, S.E., Computerized Human Factors Task Data Handling Techniques: User's and Controller's Operating Guides. Dayton, Ohio: System Development Corp., March 1968, AMRL-TR-67-226.

Instructions are presented for the operation of an experimental computerized data handling system. These instructions were developed as part of the overall research into a user oriented computerized system to store, retrieve, and process human factors task data. These instructions are intended as a model for future operating guides.

115. WILSON, D.A., Application of Automatic Data Processing Techniques To Task Analysis Diagramming. San Diego, Calif.: Naval Personnel Research Activity, October 1967.

The purpose of this exploratory research is to develop a method which will make it economical to furnish a detailed, up-to-date picture of operator and technician tasks to a variety of personnel responsible for system design, equipment design, human factors, manning, and training.

This project is directed toward the application of automatic data processing (ADP) techniques to the construction and revision of task analysis diagrams during final development of a new system.

116. ELLIS, R.H., Task Analysis Reduction Technique (TART) for the Quantification of Human Performance. San Diego, Calif: Naval Personnel and Training Research Lab, September 1970, SRM-71-7.

A task analysis reduction technique (TART) for collecting human factors information was developed and applied to the anti-submarine warfare tactical data system. TART is a specific procedure for analyzing the man/machine interface which allows the researcher to analyze sequential properties of the man/machine interaction. The technique is based on an analysis of the interface at a task level and uses closed circuit television and video tape recording apparatus. A trial application was performed using four air detector/trackers who were presented a one-hour air scenario in the anti-submarine warfare tactical data system. The results section presents various breakdowns of the TART data and indicates that TART can provide valuable insight into man/machine design and training effectiveness decisions.

117. SHRIVER, E.L., A Procedural Guide for Technical Implementation of the Forecast Methods of Task and Skill Analysis. Washington, D.C.: George Washington University, July 1961, TP-61-4251.

The objective of Task FORECAST of the Human Resources Research Office is to develop methods for accurately forecasting the training demands imposed by new electronic weapon systems. The FORECAST maintenance method of electronic system analysis basically involves arranging the individual parts of the system into groups of parts termed "troubleshooting blocks."

J. TRAINING COST ANALYSES

Synder and Luchsinger [118] present a procedural technique which quantitatively evaluates an educational institution's degree programs in terms of costs and financial benefits to society. Weiher and Horowitz [119] describe a study to determine the relative costs of formal and on-the-job training for Navy enlisted occupations. Although the main results are far from conclusive, the findings have important implications for training policy. Henry [120] analyzes the circumstances and consequences related to reenlistment and non-reenlistment to determine pertinent cost factors and strength data required for a practical reenlistment/cost methodology. Clary and Creaturo [121] describe a study pertaining to the need for Navy manpower program managers to obtain up-to-date officer training and procurement cost data for such purposes as planning, budgeting, and the officer retention effort.

118. SNYDER, H. H. AND LUCHSINGER, V. P., A Systems Analysis Basis For Allocation of Resources in Educational Institutions. Presented at the third annual meeting of American Institute for Decision Sciences, October 1971.

This report presents a procedural technique which quantitatively evaluates an educational institution's degree programs in terms of costs and financial benefits to society. The evaluation is manifested in a "benefit-cost ratio" for each degree program, permitting a convenient base for comparing programs through a version of input-output analysis. The evaluation would result in greater effectiveness in the allocation of limited resources.

119. WEIHER, R. and HOROWITZ, S. A., The Relative Costs of Formal and On-the-Job Training for Navy Enlisted Occupations. San Ramon, California: Research Division, Aerojet-General Nucleonics, November 1971, CNA Professional Paper.

This report covers a questionnaire study of OJT vs "A" school graduate costs, trainability, and performance on tests for advancement in rating. Includes several pertinent variables that should be covered. It recommends more studies since some of the opinions gathered may be questionable. While results are not conclusive, it does show that all the ratings may be learned by OJT, but with varying degrees of success under the present approaches used.

120. HENRY, G.L., The Manpower Cost Implications Associated With Changes in Navy Reenlistment Rates: A Methodology. Washington, D. C.: Naval Personnel Research and Development Laboratory, July 1970, WRM 71-2.

The circumstances and consequences related to reenlistment and non-reenlistment were analyzed to determine pertinent cost factors and strength data required for a practical reenlistment/cost methodology. An effort was made to minimize the number of factors employed while maximizing output of useful information. The major costs associated with changes in reenlistment bonus, medical care of additional dependents, and retirement. The study concludes that the cost of retirement outweighs any measurable savings that are associated with reenlistment. None of the cost factors included in the study were time discounted.

121. CLARY, J.N. and CREATURO, J.T., Officer Personnel Costs: OCS, AOC, AVROC, NAVCAD, NROTC-C, NROTC-R, and Naval Academy. Washington Naval Yard: Naval Personnel Research and Development Lab., February 1971, Report No. WOS-71-4.

This report presents up-to-date officer training and procurement cost data for various Navy officer programs such as, OCS, AOC, AVROC, NAVCAD, NROTC-C, NROTC-R, and Naval Academy. The data is presented in three appendices: A - Surface, Submarine, Nuclear Power; B - Pilot Cost; C - Naval Flight Officer Cost.

IV. BIBLIOGRAPHY OF PERTINENT NAVAL INSTRUCTIONS AND REFERENCES

Numerous forms, reports, and non-numbered references are not included. References are grouped into broad general categories.

Curriculum Development and Review

Reference No. and Date	Title
CNTECHTRAINST 1540.2 13 September 1972	Technical Training Development
NAVAIRINST 1500.1 18 March 1968	Review of Navy Training Courses and School Curricula in Support of Naval Aviation
CINCPACFLTINST 1550.3 26 June 1971	Review of Navy Formal School Curricula and Instruction Literature
COMTRALANTINST 1550.1H 19 May 1972	Development and Processing of Curricula Within the Training Command, U. S. Atlantic Fleet
OPNAVINST 1550.6 7 January 1971	Review of Navy Formal School Curricula and Instructional Literature
MCOP 1510.23A 7 November 1972	Design of Courses of Instruction
NAVORD OD 23520 (Second Revision) 15 February 1973	FBM Training System Development, Production, and Support Requirements
NAVORD OD 45240 (First Revision) 20 November 1972	FBM Weapon System Curriculum Acquisition and Maintenance Plan
NPTRL Research Report SRR 71-4, September 1970	Job Training Course Design and Improvement (Second Edition)

Missions, Functions, Organizations

Reference No. and Date	Title
CNTINST 5450.6 11 January 1972	Naval Training Command Organization
CNTINST 5450.7A 17 May 1973	Chief of Naval Training Support; Mission and Functions
CNATRASTAFFINST 5400.1K 15 September 1972	Chief of Naval Air Training Staff Organization
OPNAVNOTE 5450 16 August 1972	Establishment of FITCLANT, Norfolk, Va. and FITCPAC, San Diego, Calif.
COMTRAPACINST 5400.1C 1 August 1969	COMTRAPAC Staff Organization
CNTINST 5450.4 26 October 1971	Missions, Functions and Tasks Assigned to Naval Training Command Shore Activities
CNTINST 5450.3A 14 September 1972	Chief of Naval Air Training Mission and Functions
CNTINST 5450.2 5 October 1971	Chief of Naval Air Reserve Training, Missions and Functions
CNTINST 5450.1 21 September 1971	Chief of Naval Technical Training; Missions and Functions
NAVDESCOLINST 5400.1E 16 August 1971	Navy Destroyer School Organization
NAVOFFTRACENINST 5450.1 1 July 1972	Naval Officer Training Center - Organization Manual
CNATRAINST B5452.1A 11 May 1970	Mission and Functions of NABATRACOM Air Stations
FCDSTCPINST P5400.1C	Fleet Combat Direction Systems Training Center, Pacific Organization Manual

Requirements

Reference No. and Date	Title
OPNAVNOTE 1500 26 April 1973	Naval Flight Officer and Air Intelligence Officer Training Program - FY-74 and FY-75
OPNAVINST 5300.3 2 August 1967	Development and Review of Enlisted Manpower Requirements in Naval Ships
OP 122F 18 December 1972	Enlisted Requirements Plan, Fiscal Years 1973-77
OP 991C/JSJ 9 March 1973	FY 74-78 NEC "C" School Input Plans (Sample Only)
OP 991	Six Year Training Requirement and School Capacity for USN Training (Sample Only)
OP 991C1/12 11 December 1972	FY 74-78 Class "C" (NEC) Training Input Requirements (Sample Only)
BUPERS 212-74 15 November 1972	Enlisted Class "A" School Training Plan (Sample Only)
BUPERS 213-74 31 October 1972	Enlisted Class "B" School Training Plan (Sample Only)

Implementation

COMTRALANTINST 1550.3A 19 December 1972	Centers of Excellence; Establishment of
COMTRALANTINST 3500.5H 3 April 1972	Quarterly Training Utilization Summary
CNATRAINST 5230.1 18 May 1972	Naval Aviation Training Information System (NATIS) Manual
CNATRA N-31 CNATRA Report 1542-7 & -3	Aviation Statistical Reports
CNATRAINST 1500.1A	Naval Air Training Instructional Procedures ((NATIP) (Formerly Pilot)
OPNAVINST 1500.24A 17 December 1971	Programmed Instructional Material
OPNAVINST 1500.21A 20 July 1966	Navy Formal Schools Catalog

Reference No. and Date	Title
OPNAVINST 1500.19B 23 June 1970	Authority and Responsibility for Shore-Based Surface/Subsurface Training Other Than Medical and Naval Reserve
NATTCMFINSTR 1080.5B 8 February 1973	Student Personnel Check-In/Check-Out Procedures
SECNAVINST 1510.2 1 October 1968	Project Transition Certificate of Training
OPNAVINST 1552.1B 1 January 1971	General Aviation Training Literature Program
OPNAVINST 1541.2D 27 April 1968	Fleet Use of Navy Electronic Warfare Simulator (NEWS)
OPNAVINST 1500.38 28 March 1972	Professional Correspondence Course Study Plan for Officers and Warrant Officers on Active Duty
NAVPERS 92566A April 1965	Specifications for the Preparation of Instructor's Guides and Trainee's Guides on Naval Equipment
NAVPERS 93904 NAVSHIPS 0900-032-6010 1968	General Specification for Training Operations and Materials
CNTECHTRAINST 1540.17 4 October 1972	Standardized Training Time Units; Establishment of
CNATRAINST 3740.5 8 November 1972	FIST - Flight Instruction Standardization and Training Program
CNATRAINST 3510.2 2 February 1972	NATOPS (Naval Air Training and Operating Procedures Standardization) Program
CNATRAINST 1500.1 9 August 1972	PILOT (Performance-Centered, Individualized, Learner-Oriented, Training) System
CNATRAINST 1542.6 29 February 1972	NATRACOM Monthly NFO Training Statistical Reporting
CNATRAINST 1542.5 29 February 1972	NATRACOM Monthly Pilot Training Statistical Reporting
MIL-STD-1379 (Navy) 15 March 1972	Military Standard - Training Operations and Training Data

Personnel

Reference No. and Date	Title
NAVPERS 15658 30 September 1972	Navy and Marine Corps Military Personnel Statistics
BUPERINST 1510.108C 8 August 1972	Management of Formal Training Data System (FTDS)
CNATRAINST 1300.3 26 October 1972	Assignment of Newly Designated Naval Aviators

Research

OPNAVINST 3960.1D 4 December 1967	Prosecution by the Operating Forces of CNO Assigned RDT&E Projects
CNATRAINST 3910.1 31 March 1972	Training Research Program
SECNAVINST 5430.67 29 June 1964	Assignment of Responsibilities for Research, Development, Test, and Evaluation
CNTINST 3910.1 10 December 1971	Training Research Program

Analysis and Planning

OPNAVINST 1500.33 18 June 1970	Navy Training Priority System
OPNAVINST 1500.8G 28 June 1972	Preparation and Implementation of Navy Training Plans for New Developments
SECNAVINST 4000.29A 13 January 1971	Development of Integrated Logistic Support for Systems/Equipments
OPNAVINST 1500.2E 3 April 1973	Establishment and Coordination of Factory Training Programs for Military and Civilian Personnel
OPNAVINST 4100.3A 6 November 1972	Department of the Navy Integrated Logistic (ILS) System
OPNAVINST 4490.2B 11 November 1971	Availability of Equipment for Training Purposes

Reference No. and Date	Title
OPNAVINST 3500.34A 20 August 1971	Personnel Qualification Standards Program (PQS)
OPNAVINST 1500.25 13 May 1968	Computer Aided Instruction Program. Operational Planning and Introduction Responsibilities and Procedures
OPNAVINST 1500.22A 19 December 1969	General Military Training
OPNAVINST 1500.12C 7 May 1968	Naval Air Reserve Aviation Technical Training Program; Policy and Responsibilities
OP 092/CAC 3 December 1970	Mission of Fleet Operational Intelligence Training Center, Pacific: Revision of
BUPERINST 1510.110 CH 1 24 March 1972	Establishment of Navy Skill Centers
OPNAVINST 1551.10 25 July 1969	Instructional Television (ITV) Program
OPNAVINST 1543.3B 24 October 1972	Navy Training Plan for Ships 3-M (Maintenance and Material Management) System
OPNAVINST 1542.3 2 February 1972	Command Aircraft Crew Simulator Training Program
OPNAVINST 1540.2B 3 November 1967	Naval Air Maintenance Training Program; Policies and Procedures
OPNAVINST 1500.34 24 September 1970	Fleet Readiness Aviation Maintenance Personnel (FRAMP) Training Program
NAVPERS 18068C 5 May 1971	Manual of Qualification for Advancement
NAVMATINST 5450.17 10 January 1969	NAVTRADEVCEN; Status, Command Responsibility, Mission and Functions, Relationship with Other Commands
NAVTRADEVCENINST 5720.6 21 September 1971	Public Release of Unclassified NAVTRADEVCEN Technical Information

Reference No. and Date	Title
OPNAVINST 1500.26 15 July 1968	Responsibilities for Factory Training of Navy Military Personnel
CNTECHTRAINST 1540.31 30 June 1972	Task Analysis as the Basis for Training
OPNAVINST 1500.28A 15 June 1972	Fleet Ballistic Missile Weapons System Training Program
OPNAVINST 3500.23B 5 May 1972	Assembly, Organization and Training of Crews for U.S. Navy Ships Commissioned in Time of Peace
CNTECHTRAINST 1540.8 14 September 1972	Schedules; Preparation of
NAVMATINST 4000.20	Integrated Logistic Support Planning Procedures
WS-13580A 1 June 1972	Training Path System, General Specification for
WS-13581 1 January 1971	Personnel Performance Profiles, General Specification for
NAVTRA 38002	Submarine Training System Personnel Performance Profiles (Volume 1) (Revision 1)
NAVORD OD 43180	FBM/WS Personnel Performance Profiles and Training Path System (Revision 1)
Evaluation	
OPNAVINST 5040.12 28 April 1971	Naval Command Inspection Program for Forces Afloat
OPNAVINST 5040.7F 28 April 1971	Naval Command Inspection Program
NAVSECNORDIV Report 25-72 19 July 1972	Electronics Equipment Training and Manning Surveys
COMTRALANTINST 1500.6 1 March 1971	Fleet Training Evaluation Data Collection
CNTECHTRAINST 1540.12 24 January 1973	Evaluation of Instruction

Reference No. and Date	Title
NAVSECNORDIV Report No. 4-73 8 February 1973	3M Policy Committee Presentation - NAVSECNORDIV
CNATRAINST 1610.2F 28 July 1967	Standards of Performance for Students Undergoing Pilot or NAO/NFO Training
CNATRAINST B1610.7E 8 November 1968	Procedures for Students with Low Flight Marks
CNATRAINST B1610.6C 30 March 1970	Method of Computing Academic Training Grade Weight Factors
WS-13606 1 April 1971	FBM System Training Program Test Items, General Specification for
NAVTRASUPP Form No. 2	Educational Self-Audit

Resource Management

Reference No. and Date	Title
OPNAVINST 1000.16C 5 February 1973	Manpower Authorizations; Policies and Procedures Regarding Changes to
CNATRANOTE 7110 9 April 1973	Preparation and Submission of FY 74 Apportionment
NAVPERS 15163 April 1972	Navy Military Manpower Billet Cost Data for Life Cycle Planning Purposes
CNTECHTRAINST 7310.2/7310.6 21 March 1973/8 December 1972	CNTECHTRA Resources Analysis Branch - Code 53
FLETRACENSDIEGONOTE 7100 8 February 1973	O&MN, Fiscal Year 1974 Apportionment; Request for Information
OPNAVINST 5040.8B 10 April 1969	Management of Inactive Aircraft Inventory
NAVCOMPTINST 7110.8E 26 February 1968	Financial Responsibility for the Training and Instruction of Military Personnel
SECNAVINST 5000.16D 8 January 1970	Policy, Roles, and Responsibilities Within Dept. of Navy for Implementation of DOD Planning, Programming and Budgeting System

Reference No. and Date	Title
SECNAVINST 4860.44A 27 October 1971	Commercial or Industrial Activities Program
SECNAVINST 5000.13 10 October 1961	Glossary of Terms Used in the Areas of Financial, Supply and Installation Management
OPNAVINST 1000.16B (Enclosure to)	Composition of the Manpower Allocation/Requirements Plan (MARP)
OPNAVINST 5311.4A 22 May 1969	Responsibility for Programming Manpower Requirements
CNTINST 7300.1A 6 November 1972	Resource Management System (RMS) Reporting Requirements Within the Naval Training Command
CNTINST 7043.2 13 March 1973	OPN (Other Procurement, Navy) Budget Procedures
CNTECHTRAINST 7310.6 8 December 1972	Mechanized Course Cost System Test
SECNAVINST 5000.16D 8 January 1970	Policy, Roles, and Responsibilities Within the Department of the Navy for Implementation of the DOD Planning, Programming, and Budget System (PPBS)
OPNAV 90P-1C 15 February 1969	Navy Programming Manual
NAVSO P-1000 2 April 1970	Navy Comptroller Manual - Budgeting, Volume 7
NAVSO P-2457 10 July 197	Department of the Navy, RDT&E Management Guide Part I: System Description
NAVSO P-3006 6 July 1972	Financial Management of Resources (Department and Field Activities)
CNTECHTRAINST 1500.9A 25 July 1973	Naval Technical Training Command Activities, Schools and Courses; Reporting System for

Reference No. and Date	Title
BUPERSINST 1510.108C 8 August 1972	Formal Training Data System (FTDS); Management of
CNATRAINST 5230.1 18 May 1972	NATIS (Naval Aviation Training Information System) Manual
Philosophy, Policy	
OPNAVINST 1500.18 19 March 1963	Navy Training Policy
OPNAVINST 1500.19C 7 July 1972	Authority and Responsibility of Fleet Commanders in Chief for Naval Training Activities Ashore
OPNAVINST 1500.11F 27 April 1972	Naval Aviation Training Program Policies, Responsibilities, and Procedures
OPNAVINST 9860.5A 20 August 1971	Incorporation of Self-Contained Training Capabilities Into Shipboard Equipment and Systems
DOD Directive 1322.10 SECNAVINST 1520.4A	Policies On Graduate Education for Military Officers
OPNAVINST 1510.8A 20 July 1971	Project Transition
OPNAVINST 1500.27	Interservice Formal School Training
Courses/Syllabi	
CNATRAINST 1542.19 20 November 1972	Syllabus, Basic Training (JET), T-2A/B/C
CNATRAINST 1550.1F 4 December 1972	Flight and Academic Training Syllabi
CNATRAINST B1542.63J 8 February 1973	Basic Academic Training Syllabus
CNATRAINST B1542.74A 29 July 1970	Indoctrination Syllabus for Student Naval Flight Surgeons, Aviation Psychologists, and Aviation Physiologists

Reference No. and Date	Title
CNATRAINST 1542.22 27 December 1972	TA-4J/TF-95 Flight Instructor and Ancillary Syllabi
NAVDESCOLNOTE 1520 & 1520A 7 Feb. 1973 and 24 Apr. 1973	Navy Destroyer School Curriculum Outlines
FITCPAC/24: JCS 1500 1 September 1972	Pacific Fleet Intelligence Training Center - Bulletin of Instruction - CY 1973

Miscellaneous References

CNTECHTRA Research Branch Report 9-73 March 1973	Preventive Counseling and Prescriptive Remediation
NAVSHIPS 0900-060-0380 15 August 1972	Ship Life Cycle Management Support Manual-Planning Guide for Training Support of Ship Introductions and Modifications
OPNAVINST 1500.39 21 March 1973	Glossary of Navy Education and Training Terminology
NPTRL Research Report SRR 72-13 January 1972	Procedures for Obtaining Training Feedback Relative to Electronics Maintenance
NPTRL Research Report SRR 72-14 January 1972	Training Feedback to the Navy Storekeeper Class "A" School

APPENDIX D

ACTIVITIES/LOCATIONS VISITED

KEY:

TN - Training, not in the CNET Command

OP - Operational Organization

I - Interface Organization

FLORIDA

	Naval Education and Training Command	Pensacola
	Naval Training Support Command	Pensacola
(I)	Naval Aerospace Medical Institute	Pensacola
	Naval Air Maintenance Training Detachment	Cecil Field
(TN)	Fleet Aviation Specialized Operational Training Group	Cecil Field
	Naval Air Technical Training Center	Jacksonville
(TN)	Fleet Aviation Specialized Operational Training Group	Jacksonville
	Naval Air Maintenance Training Detachment	Jacksonville
(OP)	Commander Patrol Wing Eleven	Jacksonville
	Naval Training Equipment Center	Orlando
	Service School Command	Orlando
	Advanced Underseas Warfare Weapons School	Orlando

TENNESSEE

Naval Technical Training Command	Millington
Naval Air Technical Training Center	Millington
Naval Air Maintenance Training Group	Millington
Navy Training Publications Center	Millington

TEXAS

Naval Air Training Command	Corpus Christi
Training Wing 4	Corpus Christi
Training Wing 3	Beeville

CALIFORNIA

Commander Training Command, U. S. Pacific Fleet	San Diego
Fleet Combat Direction Systems Training Center, Pacific	San Diego
Fleet Intelligence Training Center	San Diego
Fleet Training Center	San Diego
Fleet Anti-Submarine Warfare School	San Diego

CALIFORNIA (Continued)

	Service School Command	San Diego
	Individual Learning Development Group (ILDG)	San Diego
	Naval Development and Training Center	San Diego
(I)	Naval Personnel Research and Development Center (NPRDC)	San Diego
(TN)	Naval Hospital Corps School	San Diego
(TN)	VF-121 Replacement Air Group	Miramar

VIRGINIA

	Commander Training Command, U. S. Atlantic Fleet	Norfolk
	Fleet Combat Direction System Training Center, Atlantic	Dam Neck
	Fleet Training Center	Norfolk
	Atlantic Fleet ASW Tactical School	Norfolk
	Navy Amphibious School	Little Creek
(OP)	Commander Naval Air Force, U. S. Atlantic Fleet	Norfolk
(TN)	Fleet Aviation Specialized Operational Training Group Atlantic	Norfolk
(OP)	Commander Amphibious Force, U. S. Atlantic Fleet	Little Creek
	Naval Guided Missiles School	Dam Neck
(TN)	Missile Training Unit Atlantic	Dam Neck
(TN)	VF-101 Replacement Air Group	Oceana
	Central Test Site - Personnel and Training Evaluation Program	Dam Neck
(I)	Naval Ships Engineering Center - Norfolk Division	Norfolk

SOUTH CAROLINA

	Education and Training Support Detachment	Charleston
	Fleet Ballistic Missile Submarine Training Center	Charleston
	Fleet and Mine Warfare Training Center	Charleston

ILLINOIS

	Naval Training Center	Great Lakes
	Recruit Training Center	Great Lakes
	Service School Command	Great Lakes
	Basic Electricity and Electronics School	Great Lakes

ILLINOIS (Continued)

Propulsion Engineering School	Great Lakes
Opticalman/Instrumentman School	Great Lakes
Instructor Training School	Great Lakes
Fire Control Technicians School	Great Lakes
Electronics Technicians School	Great Lakes
Naval Examining Center	Great Lakes

RHODE ISLAND/CONNECTICUT

Naval Submarine School	Groton (Conn.)
Naval Destroyer School	Newport
Fleet Training Center	Newport
Naval War College	Newport
Naval Officer Training Center	Newport
Education and Training Support Detachment	Newport

WASHINGTON, D. C. AREA

(I)	Bureau of Naval Personnel
(I)	Navy Recruiting Command
(I)	Office of Naval Research
(I,TN)	Naval Operation-Submarine Warfare (NAVOP 29)
(I,TN)	Naval Operations - Surface Warfare Training (NAVOP 39)
(I,TN)	Naval Operations - Air Warfare (NAVOP 59)
(I)	Office of Research, Development, Test and Evaluation (NAVOP 98)
(I,TN)	Director of Naval Education and Training (NAVOP 099)
(I)	Naval Operations Manpower Manning and Control Division (NAVOP 100)
(I,TN)	Strategic Systems Project Office (NSP-15)
(I)	Naval Ships Systems Command - Training Support Division
(I)	Naval Ships Engineering Center (NAVSEC 6181)
(I)	Naval Personnel and Research Development Center (Washington, D. C. Branch)
(I)	Decision Systems Associates (DSA)

APPENDIX E

GLOSSARY

(Contains Acronymns and Abbreviations)

AAA	-	Authorization Accounting Activity
A/C	-	Aircraft
Acquis.	-	Acquisition
Acct.	-	Accounting
Act./Act'y	-	Activity
ACV	-	Air Cushioned Vehicle
Admin.	-	Administration/Administrative
ADO	-	Advanced Development Objective
ADP	-	Automatic Data Processing
ADS	-	Automated Data System
ADSTAP	-	Advancement, Strength, and Training Plan
Adv.	-	Advanced
Amt.	-	Amount
APF	-	Amphibious Projection Forces
AOB	-	Average On Board
Appn.	-	Appropriation
ARI	-	Arithmetic
ASW	-	Anti-Submarine Warfare
ATP	-	Allied Tactical Publications
Avail.	-	Available
AVF	-	All Volunteer Force
Avg.	-	Average
AWT	-	Awaiting
BE/E	-	Basic Electricity and Electronics
BQT	-	Basic Qualification Test
BT	-	Boiler Technician
BUMED	-	Bureau of Medicine and Surgery
BUPERS	-	Bureau of Naval Personnel
CAI	-	Computer Assisted Instruction
CCI	-	Computer Controlled Instruction
CEB	-	CNO Executive Board
CENTRA	-	Centralized Training Material Management System
Chg.	-	Change
CHNAVTRASUPP	-	Chief of Naval Training Support
CINCLANTFLT	-	Commander in Chief, U.S. Atlantic Fleet
CINCPACFLT	-	Commander in Chief, U.S. Pacific Fleet
CIVSUB	-	Civilian Substitution Program

Cmd.	-	Command
CMI	-	Computer Managed Instruction
CNATRA	-	Chief of Naval Air Training
CNET	-	Chief of Naval Education and Training
CNM	-	Chief of Naval Material
CNO	-	Chief of Naval Operations
CNT	-	Chief of Naval Training (now CNET)
CNTECHTRA	-	Chief of Naval Technical Training
Comp.	-	Compare
COMTRALANT	-	Commander, Training Command, Atlantic Fleet
COMTRAPAC	-	Commander, Training Command, Pacific Fleet
CPAM	-	CNO Program Analysis Memorandum
Ctrl.	-	Control
Curr.	-	Curriculum
DCP	-	Development Concept Paper
Decrmts.	-	Decrements
Depr.	-	Depreciation
Dept.	-	Department
DNET	-	Director of Naval Education and Training
DNFYP	-	Department of the Navy Five-Year Program
DOD	-	Department of Defense
DOTS	-	Design of Training Systems
DP	-	Data Processing
DPPG	-	Defense Policy and Planning Guidance
EAM	-	Electronic Accounting Machine
Educ.	-	Education
EMT	-	Enlisted Master Tape
Enl.	-	Enlisted
Equip.	-	Equipment
Est.	-	Estimate
EW	-	Electronic Warfare
FBM	-	Fleet Ballistic Missile
Fdbk.	-	Feedback
FRAMP	-	Fleet Replacement Aviation Maintenance Program
FTC	-	Fleet Training Center
FTDS	-	Formal Training Data System
Func./Funct.	-	Function
Funct.	-	Functional
FYDP	-	Five-Year Defense Program
GCT	-	General Classification Test
GOR	-	General Operational Requirement
Hdr.	-	Header
H.S.	-	High School

ICBM	-	Intercontinental Ballistics Missile
ID	-	Identification
IFRS	-	Integrated Facilities Requirements System
IFTIS	-	In-Flight Training Information Subsystem
ILDG	-	Individualized Learning Development Group
ILS	-	Integrated Logistics Support, Individualized Learning System
ILSMT	-	Integrated Logistic Support Maintenance Team
IMI	-	Instructor Managed Instruction
IMRL	-	Individual Material Readiness List
Incl.	-	Include/Including
IPE/Ind. Plt. Equip.	-	Industrial Plant Equipment
Info.	-	Information
INST	-	Instruction
Inst.	-	Instructor
Install.	-	Installation
Instrs.	-	Instructions
I.Q.	-	Intelligence Quotient
IUT	-	Instructors Under Training
JCS	-	Joint Chiefs of Staff
JFM	-	Joint Forces Memorandum
JIEP	-	Joint Intelligence Estimate for Planning
JLRSS	-	Joint Long-Range Strategic Study
JPA	-	Job Performance Aids
JRDOD	-	Joint Research and Development Objectives Plan
JSOP	-	Joint Strategic Objectives Plan
Lab.	-	Laboratory
LOSC	-	Law of the Sea Conference
LST	-	Landing Ship Tank
MAA	-	Master-at-Arms
Maint.	-	Maintenance
Mat.	-	Material
MCRF	-	Master Course Reference File
MEA	-	Maintenance Engineering Analysis
MECTERP	-	Mechanized Training Equipment Requirements Plan
Mgmt.	-	Management
MILCON	-	Military Construction (Appropriation)
Milpers	-	Military Personnel
Misc.	-	Miscellaneous
3M	-	Maintenance and Material Management
MM	-	Machinist's Mate
Mods.	-	Modification
Mos.	-	Months
MOTV	-	Mobile Technical Unit

Mpwr.	-	Manpower
MRP	-	Maintenance, Real Property
MSP	-	Management Support Plan
MS	-	Management System
NARM	-	Navy Resource Model
NATIS	-	Naval Aviation Training Information System
NAVCOMPT	-	Office of the Comptroller of the Navy
NAVORD	-	Naval Ordnance System Command Headquarters
NAVMAT	-	Naval Materiel Command Headquarters
NAVPERS	-	Naval Personnel Command Headquarters
NAVSEC	-	Naval Ship Engineering Center
NAVSECNORDIV	-	Naval Ship Engineering Center, Norfolk Division
NAVSHIPS	-	Naval Ship Systems Command
NAVTIS	-	Naval Training Information System
NAVTRA	-	Naval Training Command Headquarters
NAVTRAEQUIPCEN	-	Navy Training Equipment Center
NCFA-ADS	-	Navy Campus for Achievement - Automated Data System
NCIS	-	Navy Cost Information System
NEC	-	Navy Enlisted Classification
NETS	-	Naval Education and Training System
NFO	-	Naval Flight Officer
NFOTR	-	Naval Flight Officer Training Rate
NITRAS	-	Navy Integrated Training and Resources Administration System
NLRG	-	Navy Long-Range Guidance
NMRG	-	Navy Mid-Range Guidance
No.	-	Number
NOA	-	New Obligational Authority
NOBC	-	Navy Officer Billet Classification
NPRDC	-	Naval Personnel Research and Development Center
NPTRL	-	Naval Personnel and Training Research Laboratory (now NPRDC)
NROTC	-	Naval Reserve Officer Training Corps
NSS	-	Navy Strategic Study
NTEC	-	Naval Training Equipment Center
NTF	-	Navy Technological Forecast
NTP	-	Navy Technological Projections; Navy Training Plan
NTPC	-	Navy Training Plans Conference
NWIP	-	Naval Warfare Information Publications
NWP	-	Naval Warfare Publications
O&MN	-	Operation and Maintenance, Navy (Appropriation)
OB	-	Operating Budget
OBT	-	On-Board Training
OCR	-	Optical Card Reader
Off.	-	Officer
OJT	-	On-the-Job Training
OMB	-	Office of Management and Budget

ONR	- Office of Naval Research
OPEVAL	- Operational Evaluation
Oper.	- Operation
OPN	- Other Procurement, Navy (Appropriation)
OPNAVINST	- Chief of Naval Operations Instruction
OSD	- Office of the Secretary of Defense; Operational Sequence Diagram
P&T	- Personnel and Training
PAMN	- Procurement of Aircraft and Missiles, Navy (Appropriation)
PBD	- Program/Budget Decision
PCS	- Permanent Change of Station
PDM	- Program Decision Memorandum
Pers.	- Personnel
PL	- Public Law
Plng.	- Planning
POM	- Program Objectives Memorandum
PPBS	- Planning-Programming-Budgeting System
PPGM	- Planning-Programming-Guidance Memorandum
PPP	- Personnel Performance Profile
PQS	- Personnel Qualification Standard
Prelim.	- Preliminary
Preps.	- Preparations
Prob.	- Probability
Proc.	- Procurement
Prof.	- Professional
Prog.	- Program
Prop.	- Property
PTA	- Proposed Technical Approach
PTEP	- Personnel and Training Evaluation Program
PTR	- Pilot Training Rate
RAG	- Replacement Air Group
Rcd.	- Record
R&D	- Research & Development
RDT&E	- Research, Development, Test and Evaluation
Repro.	- Reproduction
Reqs./Rqmnt./ Rqmnts.	- Requirement(s)
R.F.	- Radio Frequency
Rqd.	- Required
RFP	- Request for Proposal
RMS	- Resource Management System
Rpt.	- Report
RTM	- Rate Training Manual
SA	- Strategic Assumption
SCN	- Shipbuilding and Conversion, Navy (Appropriation)
Scol.	- School
SCRR	- System Capabilities/Requirements and Resources
SCS	- Sea Control Ship

SD	-	System Design
SECDEF	-	Secretary of Defense
SECNAV	-	Secretary of the Navy
SER	-	Shore Establishment Relocation
SHOROC	-	Shore Required Operational Capability
Sim.	-	Simulation
SLBM	-	Sub-Launched Ballistic Missile
SMD	-	Ship Manning Document
SMF	-	Student Master File
SNA	-	Student Naval Aviators
SOR	-	Specific Operational Requirement
SPD	-	Ship Project Directive
Spec.	-	Specialist
SSAN	-	Social Security Account Number
SSN	-	Nuclear Submarine
SSPO	-	Strategic Systems Project Office
Stud.	-	Student
STAPLAN	-	Status-Time-Attrition Planning
Subsys.	-	Subsystem
Sum.	-	Summary
Supp.	-	Support
SWA	-	Strategic Working Assumption
Sync.	-	Synchronization
SYSCOM	-	Systems Command
Tact.	-	Tactical
TAD	-	Temporary Additional Duty
TAEG	-	Training Analysis and Evaluation Group
TAMARS	-	Training Aids Materiel Automated Reporting System
TAO	-	Tactical Action Officer
TDP	-	Technical Development Plan
T&E	-	Test & Evaluation
Tech.	-	Technical
T-F	-	True-False
T/O	-	Trade Off
TPC	-	Training Program Coordinator
TPOM	-	Tentative Program Objectives Memorandum
TP&P	-	Transients, Patients, and Prisoners
TRAO	-	Training Administration System
TRAPS	-	Training Requirements and Planning Subsystem
Trng.	-	Training
TSOR	-	Tentative Specific Operational Requirement
TYCOMS	-	Type Commanders
Utl.	-	Utilization
VA	-	Attack Squadron (Naval Air)
VF	-	Fighter Squadron (Naval Air)
VSTOL	-	Very Short Take-off and Landing
VTOL	-	Vertical Take-off and Landing
WO	-	Watch Officer

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13. ABSTRACT

This report presents a functional descriptive model of the current Naval Education and Training System and idealized concepts oriented toward a 1980 time frame. While technological gaps and problem areas are presented, no organizational elements are specified, since the prime areas of interest are the functions performed. In addition, the rationale for selection of candidate mathematical models to be developed in Phase II is given.

Strategic working assumptions for the 1980's are presented in Volume 2 of this report.

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Training System						
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Functional Analysis						
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Strategic Assumptions (1980)						