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Wartime Manpower Programing System

FINAL REPORT

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September 1980

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MANAGEMENT SYSTEMS DIVISION

GENERAL
RESEARCH ® CORPORATION

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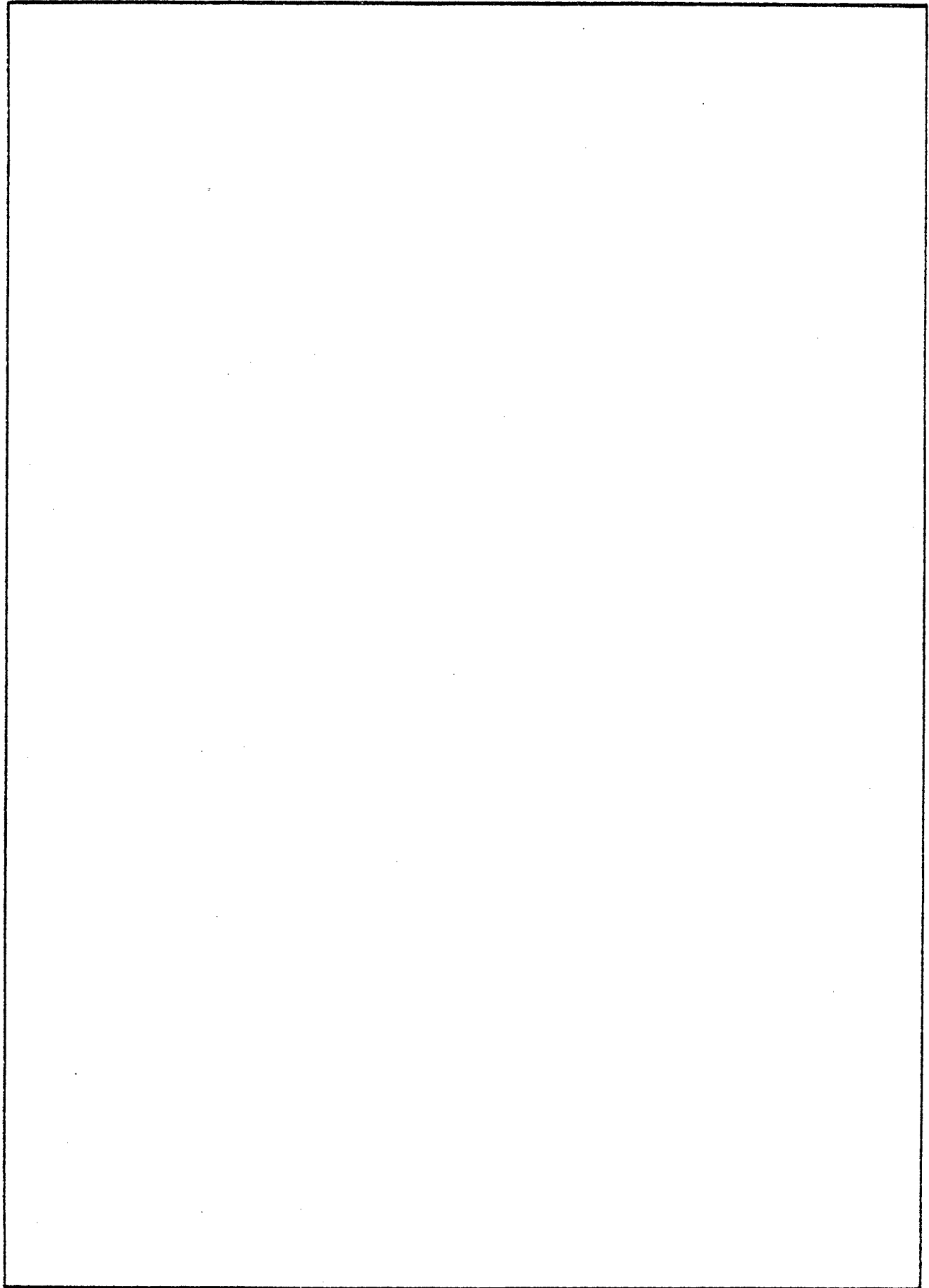7655 Old Springhouse Road, McLean, Virginia 22102

Submitted To

Deputy Assistant Secretary of Defense
(Reserve Affairs)
Room 3C-960, The Pentagon
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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*
During the period July 1978 – September 1980, the Wartime Manpower Program
System (WARMAPS) was developed by the General Research Corporation. This
one volume final report summarizes the work performed in terms of the system
concept, system development and system enhancements.

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CONTENTS

SECTION 1

INTRODUCTION

In the early 1970s, a requirement arose for an approved and con-
sistent methodology for computing wartime manpower requirements. There
were no standard procedures for computing, presenting, or justifying war-
time manpower requirements, either formulated or institutionalized. Each
Military Service developed its own assumptions and calculated its own
manpower requirements. Without a common set of assumptions, policies,
or definitions, and without a common form of presentation, it was difficult
for the Office of the Secretary of Defense (OSD) to identify the salient
issues for consideration or resolution. Specifically, the time-phased
requirements for military manpower by quantity and type could be neither
identified nor compared to existing or projected assets. Data purporting
to represent the real wartime manpower requirement lacked both accuracy
and credibility.

In late 1976, as a first step towards resolving this problem, the
Office of the Assistant Secretary of Defense for Manpower, Reserve Affairs,
and Logistics [OASD(MRA&L)], devised an experimental method for computing
and displaying aggregated wartime manpower requirements. In 1977, the
method was tested in the development of Service estimates. The results
were used in a variety of study efforts, particularly the Department of
Defense (DoD) Sustainability Study. However, the system required addi-
tional development and formal approval for use as the sole official method
for computing, presenting, and justifying wartime manpower requirements.

In 1978, the method was fully developed and formalized by General
Research Corporation (GRC) under contract with OASD(MRA&L). The objective
of the effort was (and still is) to institutionalize the computation,

presentation, and justification of wartime manpower requirements within the PPBS cycle. To be successful, the system must provide common definitions, common parameters, common computations, and common presentations.

Over the past 27 months, GRC developed a methodology which has established:

- A service-wide standardized set of assumptions and computational methods

- A vehicle for the formal approval of service requirements

- A reporting system that details DoD manpower requirements for full mobilization

- A tool for the formulation of plans to meet pretrained manpower objectives and accession requirements during wartime

The method developed by GRC is called the Wartime Manpower Program System (WARMAPS). It has gone through a series of evolutionary developments with each stage a refinement of the previous stage. Each stage was used to increase the informational utility, to improve the reporting procedures and to develop sensitivity to analysis. WARMAPS is used in support of the Program Objective Memoranda (POM) and Program Decision Memoranda (PDM) as well as for budget review. It is also used to support the preparation of congressional reports and responses to congressional and other official inquiries.

SECTION 2

SYSTEM CONCEPT

The system concept, engendered in 1978, embodies the objective of
WARMAPS: to compute and portray wartime military manpower requirements.
The Services submit incremental values for manpower demand and manpower
supply over the duration of a specified wartime scenario. WARMAPS com-
piles these supply and demand data increments and then compares time-
phased demand with time-phased supply to determine whether a shortage or
overage will occur and when. The system concept is depicted in Figure 2.1.
WARMAPS provides for the presentation of manpower data by personnel cate-
gory (officer, enlisted, active, reserve, etc) and by location (theater).

2.1   Components of Demand

Mobilization Manpower Increment (MMI) is the change in the force
structure allowance as a result of mobilization. It represents the shift
from a peacetime to a wartime force structure authorization and is a
direct result of: higher manning levels, inactivation of units, reduction
or expansion of units, losses of equipment or units that are not replaced,
civilianization, and manpower associated with unmanned units.

Replacement Demand is the demand for replacements caused by attri-
tion from battle casualties, non-battle casualties, and all other losses.
Specifically, it is the difference between the losses [Killed in Action
(KIA), Missing in Action (MIA), Prisoners of War (POW), Wounded in Action
(WIA), Disease and Non-Battle Injury (DNBI), Deserters, and Holdees] and
the Returns to Duty from patients (WIAs and DNBIs), MIAs, Deserters,
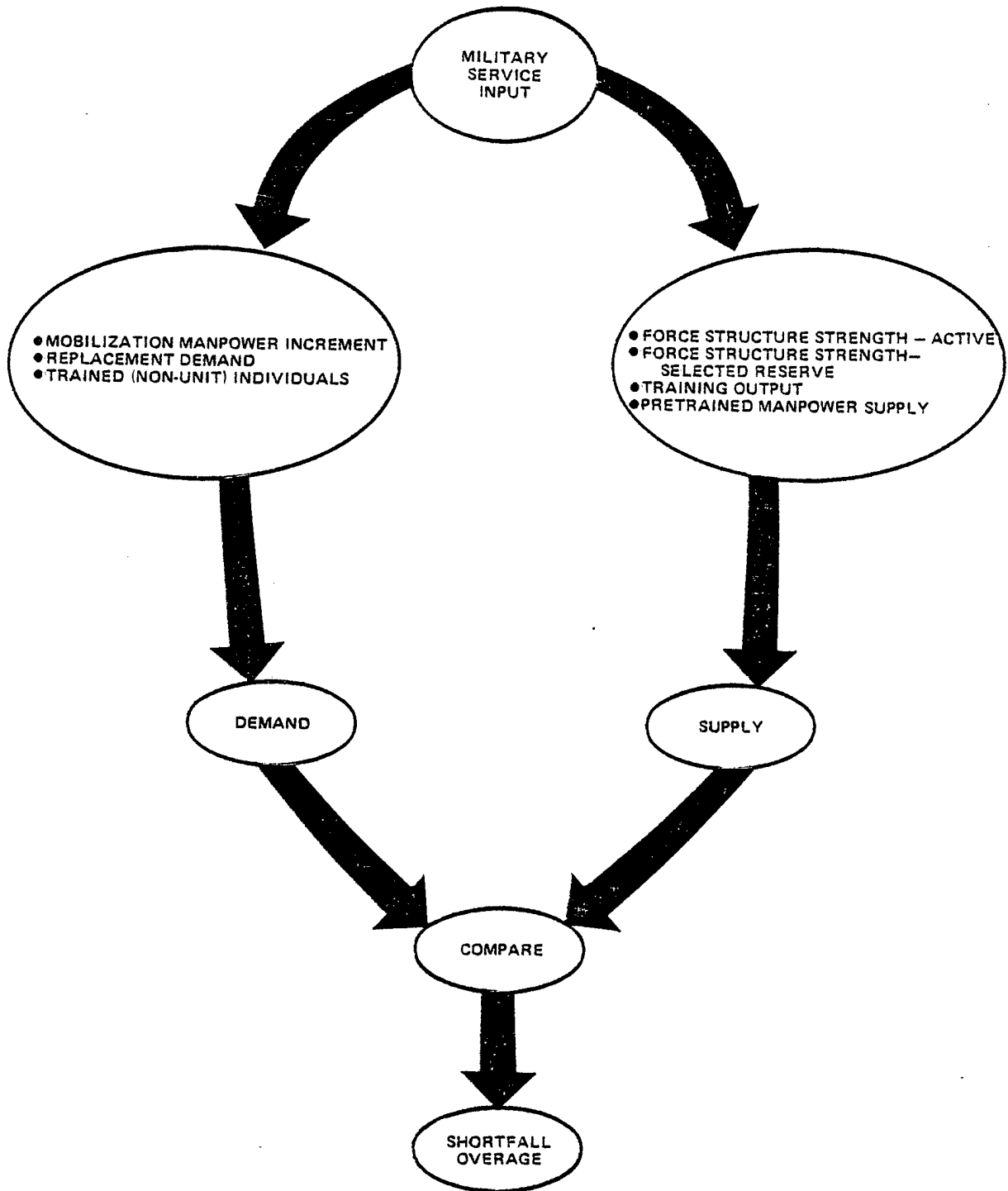and Holdees.

Figure 2.1 Wartime Manpower Program System — System Concept

Trained (Non-Unit) Individuals are members of the Military Services who are included in the Defense Planning and Programing Category "Individuals." They consist of students, transients, and holdees. Trained (Non-Unit) Individuals are part of the total Service strength but are not part of the Service force structure.

2.2   Components of Supply

Force Structure Strength - Active is the military personnel strength of active units during peacetime which will be available on M-Day.

Force Structure Strength - Selected Reserve during peacetime is the Selected Reserve Force Structure Allowance less trainees. The force structure strength on M-Day is the peacetime strength less "No-Shows." No-Shows are members of the Selected Reserve who fail to report to their units on M-Day.

Training Output is the total of all nonprior and current service personnel who complete training and are posted to units.

Pretrained Individual Supply consists of Individual Mobilization Augmentees (IMAs), retired personnel, and members of the Inactive National Guard (ING), Individual Ready Reserve (IRR), Ready Reserve Augmentation Units (RAU), and Standby Reserve.

2.3   The Reporting System

All data are displayed on separate tables for each component of manpower demand and supply. An example of the training table format is provided in Figure 2.2. Additional tables are produced by WARMAPS to provide summarized demand and supply information. These formats are provided in Figures 2.3 and 2.4. The key summary outputs are:

- Total Trained Manpower Demand
- Trained Manpower Supply
- Pretrained Individual Demand
- Trained Manpower Shortfall/Overage

TABLE J — TRAINING DYNAMICS

ARMY   FY 82
FULL MOBILIZATION

	PRE-M-DAY ACT. GRD. RES.	D-DAY	D+10	D+20	D+30	D+40	D+50	D+60	D+70	D+80	D+90	D+120	D+150	D+180

TRAINEES AT START
Total Off
Total Enl

NON-PRIOR SERVICE ACCESSIONS
Total Enl

PRIOR SERVICE ACCESSIONS — IRR
Total Enl

TRAINEE ATTRITION
Total Enl

TRAINING OUTPUT — NON-PRIOR
Total Off
  Off Area 2
Total Enl
  Enl Area 0

TRAINING OUTPUT — IRR
Total Enl
  Enl Area 0

TRAINEES AT END
Total Off
Total Enl

TRAINEES — INCREMENTAL CHANGE
Total Off
Total Enl

Data have been removed for security purposes. The manpower categories listed are those for which data were supplied.

Figure 2.2 Training Dynamics Input Table

TABLE 81 - MANPOWER DEMAND

ARMY   FY 82
TOTAL ENLISTED
(INCREMENTAL)
FULL MOBILIZATION

	PRE-M DAY	M-DAY	D-DAY	D+10	D+20	D+30	D+40	D+50	D+60	D+70	D+80	D+90	D+120	D+150	D+180
MOBILIZATION MPWR INCR															
Active															
Guard															
Reserve															
THEATER															
NON-THEATER															
CONUS-Deploying															
Active															
Guard															
Reserve															
CONUS Non-Deploying															
Active															
Guard															
Reserve															
ROW															
Active															
Guard															
Reserve															
REPLACEMENT DEMAND															
THEATER															
NON-THEATER CONUS															
TRAINED (NON-UNIT) INDIV															
TOTAL TRAINED MPWR DEMAND															
TRAINEES															
Active															
Guard															
Reserve															
TOTAL MPWR DEMAND															

Figure 2.3   Manpower Demand Summary Output Table

TABLE 82 - MANPOWER SUPPLY

ARMY   FY 82
TOTAL ENLISTED
(INCREMENTAL)
FULL MOBILIZATION

	PRE-M DAY	M-DAY	D+10	D+20	D+30	D+40	D+50	D+60	D+70	D+80	D+90	D+120	D+150	D+180
TOTAL TRAINED MPWR DEMAND														
TRAINED MANPOWER SUPPLY														
Active														
Guard														
Reserve														
Trained (Non-Unit) Indiv														
Training Output														
PRETRAINED INDIV DEMAND														
PRETRAINED INDIV DEM (adj)														
PRETRAINED INDIV SUPPLY														
Pretrained Ind Reservists														
Indiv Ready Reserve														
Retired Personnel														
Standby Reserve														
MANPOWER SUPPLY														
TRAINED MPWR SHORT/OVER														
TRAINEES														
TOTAL MANPOWER SUPPLY														

Figure 2.4 Manpower Supply Summary Output Table

Total Trained Manpower Demand. The total trained manpower demand
is the demand for trained manpower to fill a wartime position. It is
derived from the sum of the demand components.

Trained Manpower Supply. Trained manpower supply consists of Active
and Selected Reserve force structure strength, trained (non-unit) indivi-
duals (peacetime only), and training output.

Pretrained Individual Demand. Pretrained individual demand is the
difference between total trained manpower demand and trained manpower
supply.

Trained Manpower Shortfall/Overage. The pretrained individual
demand is compared to the pretrained individual supply. The pretrained
individual demand must be filled using the pretrained individual supply
which consists of the IRR, Standby Reserve, Inactive National Guard, etc.
The difference is a shortfall or an overage of trained manpower.

2.4   System Operation

Figure 2.5 is a flowchart representative of the WARMAPS system in
operation from the point of receipt of Service input data to the production
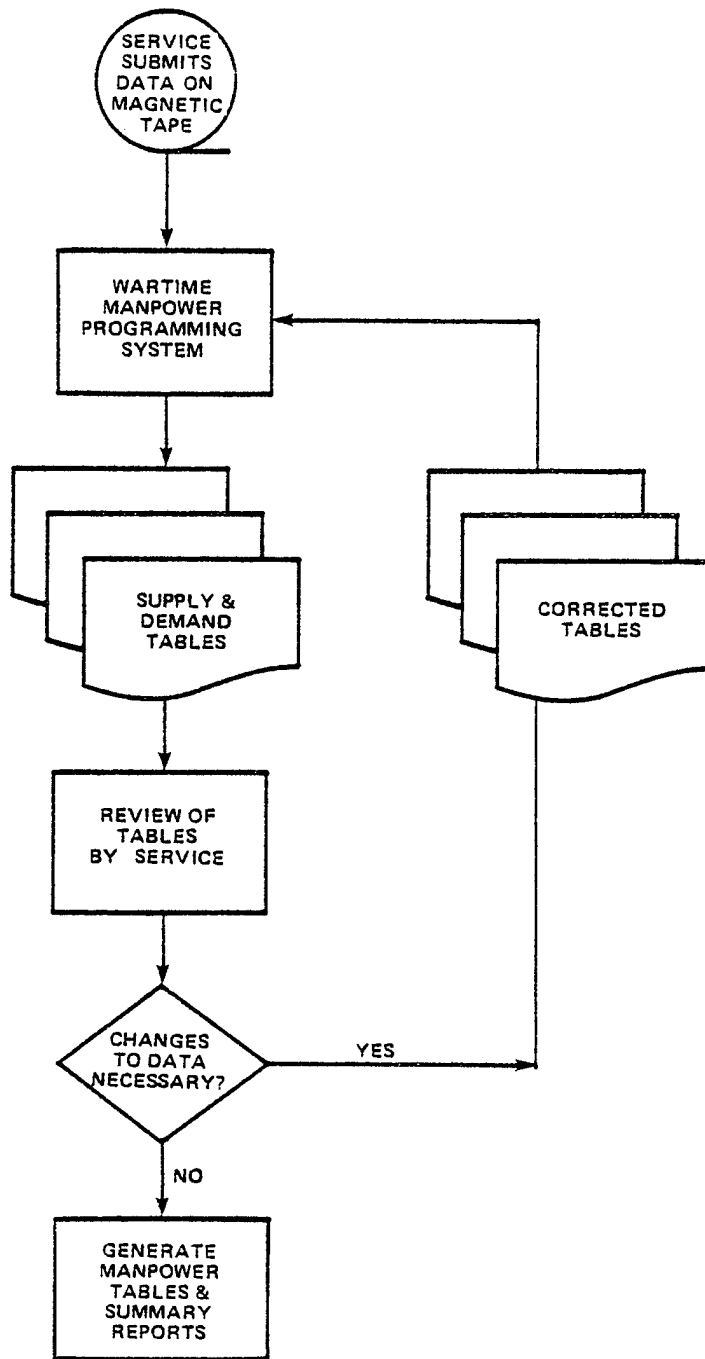of summary output reports.

Figure 2.5 Wartime Manpower Program System — System Operation

SECTION 3

SYSTEM DEVELOPMENT

The basic structure and format of WARMAPS have remained essentially constant since inception, although significant developments have been incorporated into the system over the 27-month period. These include: additional designations and disaggregations of theater; disaggregation of manpower occupational areas; distinctions between demand and requirement; the incorporation of a double scenario as an integral part of the POM/PDM submissions.

3.1   Theaters

Initially, theater data was extremely limited:

- The Army, Marine Corps, and Air Force reported only two distinctive geographical regions: theater and nontheater. Theater was defined as the sphere of conflict, i.e., Europe. Nontheater included the rest of the world.

- The Navy reported multiple theaters to accommodate its uniqueness as a seagoing service. Theater was subdivided into Atlantic/Mediterranean Afloat, Atlantic/Mediterranean Ashore, Pacific Afloat, Pacific Ashore, and Navy with the Marine Corps in Europe.

Nontheater has now been disaggregated to include the continental United States (CONUS) and Rest of World (ROW). CONUS is composed of two parts: CONUS Deploying and CONUS Non-deploying. Similarly, ROW is composed of ROW Deploying and ROW Non-deploying. A contingency theater has been added.

Navy theaters have been consolidated. Altantic/Mediterranean Ashore and Navy with the Marine Corps in Europe are now included in Theater (Europe).

3.2 Occupational Areas

Initially, WARMAPS accepted data only for the occupational areas defined as combat (tactical) in DoD 1312.1-M. Using data for Total Officers and Total Enlisted, WARMAPS computed the number of officer and enlisted personnel engaged in noncombat occupations (Total - Combat = Other). Later, the Services submitted data for the occupational areas defined as medical personnel in DoD 1312.1-M. WARMAPS has been structured to accept up to eight different occupational areas for both officer and enlisted personnel. This permits responsiveness to any OSD analytical requirement and provides the means for the Services to test the sensitivity of critical occupational specialties.

3.3 Demand and Requirement Distinctions

Until now, Service data have been based on constraints imposed by the projected lift capacity and the projected inventory of equipment, munitions, and spares. Such data are referred to as Demand data. At the request of the Services, particularly the Army and the Air Force, Requirements data will also be submitted during the 1983-87 POM cycle. Such data will be based on the unconstrained availability of equipment, munitions, spares, and lift.

3.4 Double Scenario

Originally, WARMAPS was set up to assess the manpower shortfalls and overages associated with a single scenario (a conventional war in Europe involving full mobilization). To accommodate recent trends in DoD strategy, WARMAPS was modified to handle a double scenario, (the conventional war in Europe involving full mobilization preceded by a contingency operation in another theater). Manpower data are compiled for both scenarios.

3.5 General Development Efforts

WARMAPS has recently been formalized with the publication of DoD Directive 1100.18 (Appendix A). DoD Instruction 1100.19 (Appendix B), which provides the Military Services with a common set of definitions, policies and procedures for the computation of wartime manpower requirements, has also been prepared and published. In addition, DoD 1100.19-H has been finalized and published. It provides the Services with detailed instructions for computing, compiling, and submitting the wartime manpower data for WARMAPS.

To accelerate the institutionalization process, the GRC Study Team has provided close coordination with and continuous assistance to the Service action officers in preparing the WARMAPS data for the POM and PDM cycles. Service data have been analyzed to assist OASD(MRA&L) in the preparation of issue and policy papers.

3.6 Chronology of Development

1978

July-Aug	Develop and refine system concept. Prepare interim data call instructions. Begin MULTICS programing.
Sep	Issue interim data call instructions.
Oct	Program edit routines. Program summary tables.
Nov-Dec	Receive and process Service data (FY 80). Expand summary tables to include occupational areas and components of pretrained individual demand.

<u>1979</u>

Jan–Mar   Assist in drafting manpower sections of POM Preparation
Instruction (PPI) and Consolidated Guidance (CG).

Draft DoDI and DoD Handbook.

Draft supplements to PPI and CG and furnish to OASD(MRA&L).

Produce additional summary tables to display components
of pretrained individual demand and supply.

Modify system to accommodate two scenarios and additional
manpower data disaggregations.

Apr–Jun   Complete system modifications for POM submissions.

Draft DoDI and DoD Handbook.

Initiate WARMAPS system documentation.

Develop cumulative summary tables.

Draft concept of the Stochastic Wartime Manpower Subsystem
(SWARMS) and sensitivity models (Replacement Demand and Training).

Initiate the system design for SWARMS.

Receive and process Service POM submissions (FY 81 and 85).

Jul–Sep   Complete System Documentation, DoDI and DoD Handbook.

Expand draft Handbook to include additional occupational
areas.

Oct–Dec   Develop two summary tables to replace all others.

Complete system design for SWARMS and begin programing on
MULTICS.

Transmit draft DoDI and Handbook for formal coordination.

Revise Handbook to accommodate three scenarios: full
mobilization, contingency, and full mobilization preceded
by contingency.

Receive and process Service PDM update data (FY 81).

<u>1980</u>

Jan-Mar   Modify supply tables to accommodate recent initiatives in the management of the Ready Reserve.

Develop demand and supply tables for civilians.

Draft DoDD.

Complete programing for SWARMS and the Replacement Demand model.

Apr-Jun   Revise DoDD 1100.XX, DoDI 1100.XX, and DoD 1100.XX-H.
Document SWARMS.
Document Replacement Demand model.
Develop Training Dynamics model.
Develop Pretrained Individual Accession model (K-model).
Receive and process Service POM submissions (FY 82 and 86).

Jul-Aug   Finalize DoDD, DoDI, and DoD Handbook.
Initiate development of a civilian wartime manpower program.

Sep   Publish DoDD 1100.18, DoDI 1100.19, and DoD 1100.19-H.
Prepare interim data call for civilian manpower subsystem.

SECTION 4

SYSTEM ENHANCEMENTS

To provide OSD with a better basis for planning and analysis, the GRC Study Team developed the Stochastic Wartime Manpower Subsystem (SWARMS), (Appendix C), which is tied directly to the WARMAPS data base. Two submodels, the Replacement Demand Model and the Training Dynamics Model are associated with SWARMS. A third model, the K-Model, has been developed independently of SWARMS. Like SWARMS, it is tied directly to the WARMAPS data base.

4.1 The Stochastic Wartime Manpower Subsystem

SWARMS was created to provide OSD and the Military Services with a more informed basis on which to develop the necessary manpower programs. SWARMS' methodology is predicated on the assumption that to calculate manpower requirements as point estimates without assigning measures of variability to the input, is unrealistic. For example, to say that on D+50 the demand for pretrained individuals is 24,600 implies that exactly 24,600 pretrained individuals are required, no more, no less. Precision to this level of detail is both impractical and unnecessary. Instead, SWARMS establishes a confidence interval for Pretrained Individual Demand based on judgment decisions regarding the variability of the components that comprise the Pretrained Individual Demand [such as MMI, Replacement Demand, Trained (Non-Unit) Individuals]. Thus, a typical SWARMS output could show that, on D+50, the demand for pretrained individuals is in a range of 24,200 to 25,300 with an associated mean and standard deviation. The SWARMS' methodology can be adapted to produce similar confidence intervals for other WARMAPS outputs such as Total Trained Manpower Demand and Trained Manpower Supply. Currently, only Replacement Demand is treated stochastically; other components may be treated similarly at a future date.

4.2   Replacement Demand Model

The Replacement Demand Model is both an independent model and a submodel to SWARMS. Its operation is essentially the same in either mode. The model designates WARMAPS data for losses (KIA, MIA, POW, WIA admissions, DNBI, deserters, and holdees) as the most likely values and assigns minimum and maximum values to each most likely value. Returns to Duty over time are computed using fixed rates of disposition derived from historical and simulated data. For each time period, a single value for Replacement Demand can be produced or a series of Replacement Demands can be generated to produce a mean, standard deviation, and confidence interval. The model's utility lies in the built-in option to vary the rates of disposition. For example, DoD planners can experiment with different times required for hospital stay or for theater evacuation to test the impact on either the Replacement Demand or the overall Pretrained Individual Demand.

4.3   Training Dynamics Model

The Training Dynamics Model uses WARMAPS data on accessions to compute trainee attrition and training output. Results are determined by applying fixed rates of disposition and delay (e.g., the time it takes to complete training, the percentage of trainees who attrit and who complete training, the fraction who become combat skilled, health skilled, etc.) to nonprior, current, and prior Service accessions. Disposition rates and delays are held constant for each run of the model but can be varied from run to run. This provides DoD planners the capability of assessing the impact of different rates of disposition and time delays on the demand for manpower. Ultimately, the Training Dynamics Model will be provided stochastic characteristics so that it can be integrated into SWARMS.

4.4   The K-Model

The K-Model was developed as a means to assist OASD(MRA&L) in determining the optimal program for meeting the time-phased demand for pretrained individauls. The model works by depleting the pool of

pretrained individuals according to availability and priority to meet the pretrained demand. Each pretrained individual category is exhausted in priority. The availability of pretrained individuals can be varied from run to run. Priority is expected to become variable at a future date.

4.5   Subsystem Operation

Figure 4.1 is a flowchart representative of the SWARMS/WARMAPS interface from the operation of WARMAPS through the stochastic treatment of WARMAPS input data and the generation of summary output reports.
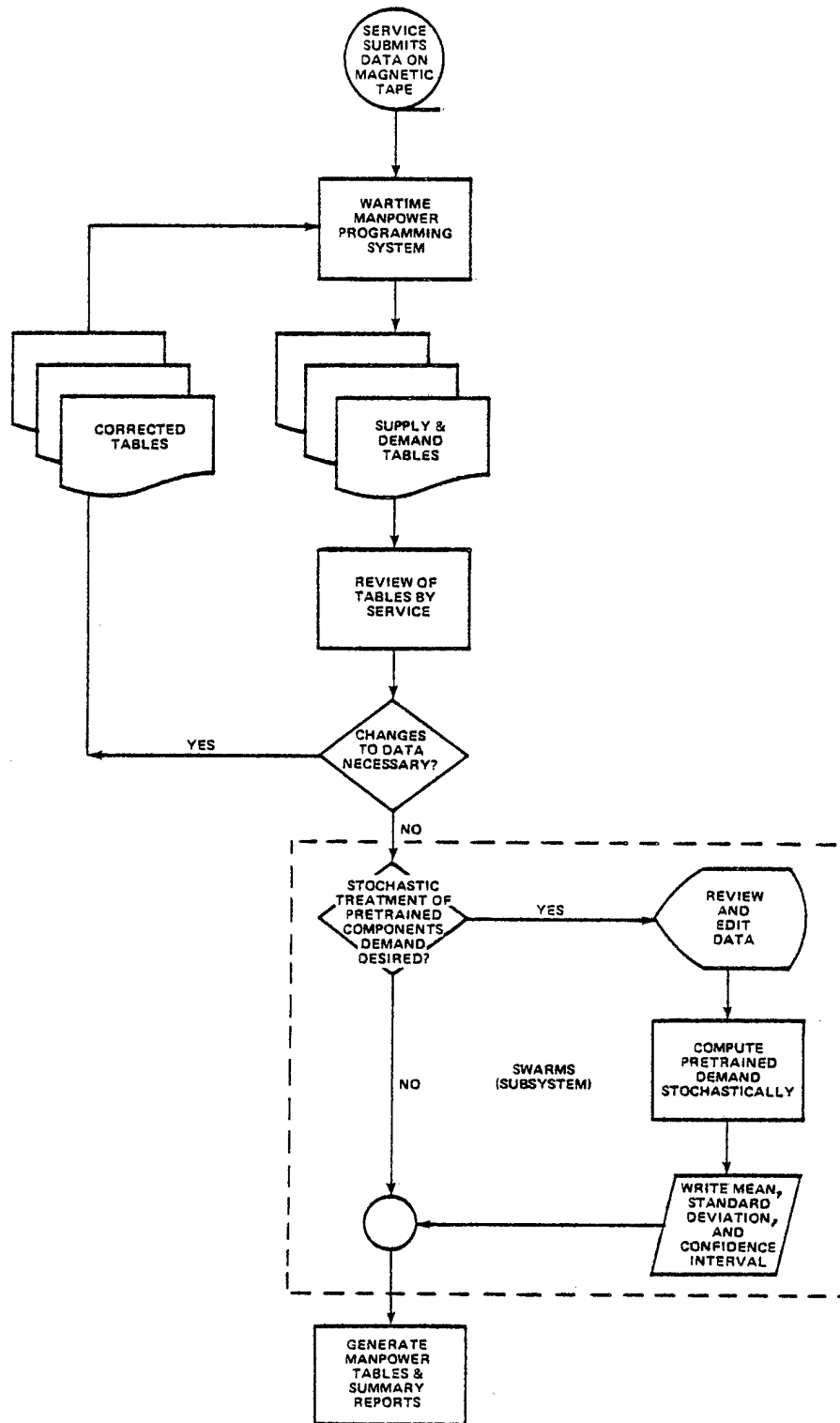
Figure 4.1 Wartime Manpower Program System -
SWARMS/WARMAPS Interface

SECTION 5

SUMMARY

WARMAPS has been adopted as the sole, authoritative method for computing and portraying wartime manpower requirements and has been formalized in a series of official DoD issuances. The Services have come to accept WARMAPS as the authoritative way to postulate their wartime military manpower requirements and to have those requirements authenticated by the Secretary of Defense for program and budget formulation and review. WARMAPS data are used extensively in OSD issue papers as well as in congressional testimony. WARMAPS has been instrumental in shaping manpower management policy, particularly with regard to pretrained individual manpower programs.

Although WARMAPS has been formalized by directive, it remains capable of continued growth, development, and utility. Actions are already underway to develop and implement a Civilian Manpower Subsystem.

APPENDIX A

DEPARTMENT OF DEFENSE DIRECTIVE 1100.18

Department of Defense Directive

SUBJECT: Wartime Manpower Planning

REFERENCES: (a) DoD Directive 1100.4, "Guidance for Manpower Programs," August 20, 1954
(b) DoD Instruction 1100.19, "Wartime Manpower Program Policies and Procedures," September 8, 1980

A. PURPOSE

This Directive establishes policies on manpower planning during peacetime, on manpower utilization during wartime, and on a standard DoD-wide method for computing and portraying projected wartime manpower requirements, demand, and supply.

B. APPLICABILITY

The provisions of this Directive apply to the Office of the Secretary of Defense, the Military Departments, the Organization of the Joint Chiefs of Staff, and the Defense Agencies (hereafter referred to as "DoD Components").

C. POLICY

1. The DoD manpower planning policy during peacetime is to:

    a. Provide an adequate military and civilian inventory for each occupation and experience level to satisfy projected wartime manpower demands that cannot be met with personnel acquired after mobilization.

    b. Use a mix of military and civilian manpower capable of satisfying wartime demands, consistent with the provisions of reference (a).

    c. Obtain the authorities and establish the management procedures necessary to provide reasonable assurance that both military and civilian wartime manpower demands can be satisfied.

    d. Ensure that DoD civilian employees occupying jobs critical to national security objectives are not members of the Ready Reserve.

2. The DoD manpower utilization policy during wartime is to:

    a. Terminate or defer activities not essential to the war effort, in order to permit the reallocation of personnel to higher priority tasks.

    b. Not assign military personnel to jobs that do not contribute directly to the prosecution of the war.

    c. Cease all screening of the Ready Reserve upon mobilization. Ready Reservists are immediately available for recall when mobilization is implemented.

    d. Recall immediately, under a full mobilization, all Ready Reservists who are preassigned to a wartime position.

    e. Not defer or exempt Ready Reservists from mobilization because of civilian occupations.

    f. Recall military retirees, not occupying civilian jobs critical to national security objectives, to fill jobs for which their age and experience qualifies them. Recalled military retirees shall not normally be deployed to a theater of operations.

    g. Integrate civilians with needed skills into the military via expeditious lateral entry procedures when no source of military manpower with the skills needed in the theater is available. Civilian personnel shall not normally be deployed to a theater of operations.

    h. Ensure that civilian employees and contractor personnel performing critical support activities overseas remain in the theater. The Department of Defense shall transport these personnel to areas of minimum risk, when feasible.

    i. Hire additional civilian employees or exercise contingency contracts to accomplish essential Continental United States work not requiring military-unique experience.

D. RESPONSIBILITIES

1. The <u>Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics) (ASD(MRA&L))</u> shall:

    a. Establish a standard DoD-wide procedure and data base for computing, compiling, projecting, and portraying the time-phased wartime manpower requirements, demand, and supply of the DoD Components.

    b. Publish guidance necessary for the operation of the Wartime Manpower Program System.

2. <u>Heads of DoD Components</u> shall:

    a. Ensure that the policies in this issuance are reflected in all relevant issuances and procedures.

b. Develop, maintain, and submit wartime manpower requirements and demand and supply data as prescribed by the ASD(MRA&L) in DoD Instruction 1100.19 (reference (b)).

E. <u>EFFECTIVE DATE</u>

This Directive is effective immediately.

W. Graham Claytor, Jr.
Deputy Secretary of Defense

APPENDIX B

DEPARTMENT OF DEFENSE INSTRUCTION 1100.19

Department of Defense Instruction ASD(MRA&L)

SUBJECT: Wartime Manpower Program Policies and Procedures

References: (a) DoD Directive 1100.18, "Wartime Manpower Planning," August 26, 1980
(b) DoD Directive 5025.1, "Department of Defense Directives System," November 18, 1977
(c) DoD Directive 1235.10, "Mobilization of the Ready Reserve," October 27, 1970
(d) DoD Directive 3005.6, "Civilian Personnel Procurement and Manpower Control During a Mobilization," March 20, 1962
(e) DoD Directive 5000.11, "Data Elements and Data Codes Standardization Program," December 7, 1964

A. PURPOSE

Under reference (a), this Instruction:

1. Establishes policies, procedures, terminology, and criteria for computing and portraying projected wartime manpower requirements, demand, and supply.

2. Establishes the Wartime Manpower Program System (WARMAPS) as the governing source for DoD wartime manpower program data.

3. Authorizes the publication and maintenance of DoD 1100.19-H, which provides detailed instructions for WARMAPS operation, pursuant to reference (b).

B. APPLICABILITY AND SCOPE

1. The provisions of this Instruction apply to the Office of the Secretary of Defense, the Military Departments, the Organization of the Joint Chiefs of Staff, and the Defense Agencies (hereafter referred to as "DoD Components"). The term "Military Services" refers to the Army, Navy, Air Force, and Marine Corps.

2. Its provisions encompass DoD military functions manpower, and the wartime requirements, demand, and supply of all military and appropriated fund civilian (direct and indirect hire) manpower.

3. Exemptions from full implementation of this Instruction shall be considered on an individual basis.

4. Manpower data provided through WARMAPS shall support:

a. Preparation and review of program objective memoranda (POM).

b. Preparation and review of budget estimates and justification.

c. Preparation of Congressional reports.

d. Preparation of responses to Congressional and other inquiries.

C. DEFINITIONS

The terms used in this Instruction are defined in enclosure 1.

D. POLICIES AND PROCEDURES

1. General. The following guidance applies to all wartime manpower program computations performed by DoD Components. DoD Component guidance for program preparation shall reflect the policies and procedures contained in this Instruction. In addition, Component policies, management systems, and procedures shall be such that these provisions can be implemented in a contingency or wartime situation.

2. Manpower Requirements Determination

a. Force Structure Manpower Requirements

(1) Force structure requirement calculations shall include all of the following:

(a) Active Component units raised from peacetime strength to war-required manning levels in a time-phased, incremental manner, consistent with required deployment and employment or projected workload.

(b) Reserve component units mobilized on M-Day. Force structure requirements for each time period after pre-M-Day shall reflect incremental increases for each unit to attain war-required manning levels, consistent with required deployment and employment or projected workload.

(c) Unmanned units mobilized at cadre strength. Cadred units shall be raised to wartime strength in sufficient time to organize, equip, and train the unit prior to required deployment and employment. Cadred units include the Navy precommissioning crew of new ships up to the time of commissioning.

(d) Force structure manning reduced appropriately to reflect nonreplaceable losses of equipment for which war reserve stocks are not authorized (such as, ships and aircraft). Force structure manning requirements shall also be reduced to reflect units whose projected workload diminishes at any point after mobilization.

(e) Units whose sole wartime mission is to facilitate the mobilization and deployment of units inactivated when that mission is completed.

(f) Units that have no wartime mission inactivated immediately after M-Day.

(2) Projected workload for units and resultant manpower requirements shall be based on wartime activity level assumptions that are consistent with manpower, equipment, spares, and munitions requirements.

(3) Projected workload shall reflect nonreplaceable losses of equipment for which war reserve stocks are not authorized.

b. Nonstructure Manpower Requirements

(1) Filler requirements, replacement requirements, postmobilization training rates, and student and trainee strengths shall be based upon the required force structure and shall be consistent with the provisions of D.2.a.

(2) In the replacement requirement calculation for a specific time period, all patients returned to duty shall be subtracted from gross casualties for that period.

(3) Patient strengths, aeromedical evacuation workload, and casualty replacement requirements shall be based upon projected casualty rates consistent with the specified scenario, the force structure requirement (as determined using the provisions of D.2.a.), and the prescribed theater evacuation policy.

(4) Training that provides only a marginal contribution to combat capability or force sustainment shall be terminated. The length of time to complete required refresher training and retraining shall be shortened by conducting training 7 days per week. Student and trainee strengths shall reflect this policy.

(5) After considering processing time and other administrative factors, and when computing inventory objectives for pretrained individuals in a time period, training output during that time period shall be counted as wartime supply and subtracted from aggregate demand for that period.

3. Manpower Demand Determination

a. Force Structure Manpower Demand

(1) Force structure demand calculations shall include all of the following actions:

(a) Active Component units raised from peacetime strength to war-required manning levels in a time-phased, incremental manner, consistent with scheduled deployment and employment or projected workload.

(b) Reserve component units mobilized on M-Day. Force structure demands for each time period after pre-M-Day shall reflect incremental increases for each unit to attain war-required manning levels, consistent with scheduled deployment and employment or projected workload.

(c) Unmanned units mobilized at cadre strength. Cadred units shall be raised to wartime strength in sufficient time to organize,

equip, and train the unit prior to scheduled deployment and employment. Cadred units include the Navy precommissioning crew of new ships up to the time of commissioning.

(d) Force structure manning reduced appropriately to reflect nonreplaceable losses of major combat equipment (such as, ships, aircraft, or tanks). Force structure manning shall also be reduced appropriately to reflect periods of extended equipment nonavailability, such as, ship battle damage repair. Similarly, force structure manning shall be reduced to reflect units whose workload diminishes at any point after mobilization.

(e) Units whose sole wartime mission is to facilitate the mobilization and deployment of units inactivated when that mission is completed.

(f) Units that have no wartime mission inactivated immediately after M-Day.

(2) Projected workload for units and resultant manpower demands shall be based on wartime activity level assumptions that are consistent with manpower, equipment, spares, and munitions demands.

(3) Projected workload shall reflect nonreplaceable losses of equipment, and the level of programed spares inventories.

(4) Scheduled deployment and employment of units shall be consistent with programed lift capability and equipment prepositioning.

(5) Unmanned units shall be included in the force structure only if procurement of equipment for these units has been programed or if these units can be equipped by commercially available, off-the-shelf items prior to scheduled deployment and employment.

(6) Filler personnel shall be scheduled into units consistent with the ability of the unit to receive, assign, and absorb those personnel in accordance with the unit's mobilization, training, and deployment and employment schedule.

b. Nonstructure Manpower Demand

(1) Filler demands, replacement demands, postmobilization training rates, and student and trainee strengths shall be based upon the programed force structure and shall be consistent with the provisions of D.3.a.

(2) In the replacement demand calculation for a specific time period, all patients returned to duty shall be subtracted from gross casualties for that period.

(3) Patient strengths, aeromedical evacuation workload, and casualty replacement demands shall be based upon projected casualty rates consistent with the specified scenario, the force structure demand (as determined using the provisions of D.3.a.), and the programed theater medical support capability.

(4) Training that provides only a marginal contribution to combat capability or force sustainment shall be terminated. The length of time to complete required refresher training and retraining shall be shortened by conducting training 7 days per week. Student and trainee strengths shall reflect this policy.

(5) After considering processing time and other administrative factors, and when computing inventory objectives for pretrained individuals in a time period, training output during that time period shall be counted as wartime supply and subtracted from aggregate demand for that period.

4. Manpower Supply Determination

a. All military manpower available for duty on M-Day shall be programed in the active force, Selected Reserve units, or Individual Mobilization Augmentee Program.

b. All military manpower reassigned from peacetime duty in units reduced or deactivated in wartime to meet wartime requirements in other units shall be retrained in peacetime.

c. The Military Services shall program to meet the time-phased pretrained individual manpower inventory objectives using pretrained individual reservists (PIR), retired military personnel, and the Standby Reserve. The PIR includes individual mobilization augmentees (IMAs), the inactive National Guard (ING), and the Individual Ready Reserve (IRR). The Military Services shall:

(1) Identify units with wartime augmentation and filler positions, other than (2) below, and evaluate the efficacy of preassigning PIR to stations from which those units are to deploy or be employed. If not beneficial, fill requirements by other means that are more efficient. Exhaust the PIR, using the IMAs, ING, and IRR, in that order, to fill all other time-phased objectives except those predesignated to be filled by retired personnel.

(2) Identify stations that contain or will contain units with wartime positions that can be filled by retirees, and evaluate the efficacy of preassigning retirees to those stations. If not beneficial, fill requirements by other means that are more efficient.

d. Military Services shall preassign, if appropriate, and program for the refresher training or retraining of pretrained individual manpower to balance supply with demand by occupational areas:

(1) In addition to the existing PIR peacetime training programs, PIR personnel required to meet time-phased objectives between M+1 and M+30 shall receive peacetime refresher training, and be preassigned to units or stations. Retired personnel required to meet time-phased objectives between M+1 and M+30 shall receive peacetime refresher training, and be preassigned to units or stations.

(2) Personnel (PIR, retired, or Standby Reserve) required to meet time-phased objectives beyond M+30 may receive post-M-Day refresher training, and be postassigned to units or stations.

(3) Personnel (PIR or Standby Reserve) required to meet time-phased objectives beyond M-Day may be retrained from their primary skill into a critical skill after M-Day, and be postassigned to units or stations.

e. Identify all civilian employees of DoD Components who are members of the Ready Reserve, or who are nondisability military retirees under age 60. Manpower programs for full mobilization shall assume that none of these personnel are available as civilian employees after M-Day.

f. All screening of the Ready Reserve ceases upon mobilization and Ready Reservists are immediately available for recall.

g. Ready Reservists may not be deferred or exempted from mobilization because of civilian occupations.

5. <u>Manpower Management Assumptions</u>. The following are assumptions to be used for planning and programing purposes and should not prejudge actual U.S. response to a crisis.

a. Imminent NATO/Warsaw Pact conflict:

(1) Congress shall declare a national emergency and implement full mobilization, as defined in DoD Directive 1235.10 (reference (c)).

(2) The decision to reinstitute classification, examination, and induction shall be made on M-Day.

(3) On M-Day, all terms of service (definite and indefinite) shall be extended for the duration of the conflict plus 6 months, except for personnel who have completed 30 years of active service.

(4) On M-Day, Military Department Secretaries shall waive the practice of providing a 30-day notice for recalling Ready Reservists.

(5) Personnel in the Delayed Entry Program (DEP) and Reserve Component personnel awaiting initial active duty for training shall be called up on M-Day for training. High school students may be delayed until such time as they cease to pursue such course satisfactorily, graduate, or attain age 20, whichever occurs first.

(6) Beginning on M-Day, all permanent change of station (PCS) moves shall be solely for the convenience of the government with the objective of providing priority manning for the theater and deploying units.

(7) Post-M-Day military manpower demands and requirements shall assume:

(a) No leave or pass through M+60.

(b)   No leave, but 3 day passes at the discretion of unit commanders, from M+61 through M+180.

(c)   Up to 15 days' leave and unlimited passes at the discretion of unit commanders beyond M+180.

(d)   The granting of 15 days of posthospitalization leave for casualties returned to duty from a Continental United States (CONUS) medical facility.

(e)   In addition to expected transit time, 1 day of delay enroute for patients returning to duty from in-theater medical facilities located in the communications zone.

(f)   In addition to expected transit time, 1 day of delay enroute for all replacements at air embarkation and debarkation points.

(g)   That proceed time shall not be granted beginning on M-Day.

(8)   Post-M-Day civilian employee demands and requirements shall assume:

(a)   No annual leave or compensatory time through M+60.

(b)   No annual leave, but compensatory time at the discretion of unit commanders from M+61 through M+180.

(c)   Up to 2 weeks' annual leave beyond M+180.

(9)   To the maximum extent feasible, manpower demand for CONUS support activities that will not impinge upon prosecution of the war effort shall be deferred at least 180 days. The manpower made available by such actions shall be reallocated to higher priority tasks.

(10) Upon mobilization, military personnel occupying CONUS support establishment jobs (such as, personnel administration and inventory control) that must be performed in wartime shall be replaced by civilian personnel or recalled military retirees. Military Personnel shall be transferred to deploying units or made available as replacements.

(11) Emergency authorities with respect to civilian employee hiring and management, as outlined in DoD Directive 3005.6 (reference (d)), shall be implemented on M-Day.

(12) The workweek per shift for all activities not in hostile fire areas shall be no less than 60 hours through M+60; thereafter, the workweek per shift shall be no less than 48 hours.

b.   A non-NATO contingency involving partial mobilization in excess of the Presidential Selected Reserve callup authority.

(1)   Congress shall declare a national emergency and implement a partial mobilization, as defined in DoD Directive 1235.10 (reference (c)). This mobilization may be incremental, rather than instantaneous, in nature.

(2) Selected Reserve units shall be mobilized and PIRs or retired military personnel shall be recalled to augment: surveillance and reconnaissance forces; operational planning and C3I activities; mobility forces; the Selective Service System (SSS) and the Armed Forces Examining and Entrance Stations (AFEES); the training establishment; CONUS supply depots, inventory control points, and ordnance storage facilities; and other required purposes.

(3) Selected Reserve units may be mobilized to replace active component units deployed in support of the contingency.

(4) PIRs may be recalled to: provide fillers for active component and mobilized reserve component units to achieve wartime manning levels; and ensure a source of casualty replacements for forces deployed to the contingency. Retired military personnel may be recalled to occupy CONUS support establishment jobs.

(5) Requests for nondisability retirement by active duty and Ready Reserve personnel shall be deferred for 6 months commencing on M-Day, except for personnel who have completed 30 years of active service.

(6) Scheduled separations for active duty and Ready Reserve personnel shall be deferred for 6 months commencing on M-Day.

(7) The decision to reinstitute classification, examination, and induction may be made on or after M-Day.

(8) Personnel in the DEP and reserve component personnel awaiting initial active duty for training may be called up on M-Day for training. Delay provision in 5.a.(5), above, applies.

(9) Beginning on M-Day, all PCS moves shall be for the convenience of the government with the objective of providing priority manning for the theater and deploying units.

(10) Post-M-Day military manpower demands and requirements shall assume:

(a) No leave or pass in theater through M+60.

(b) No leave, but 3-day passes at the discretion of unit commanders in theater from M+61 through the duration of the contingency.

(c) No leave, but 3-day passes at the discretion of unit commanders for nontheater personnel for the duration of the contingency.

(d) Casualties returned to duty from a nontheater medical facility may be granted 15 days of posthospitalization leave prior to return.

(e) In addition to expected transit time, 1 day of delay enroute for patients returning to duty from in-theater medical facilities.

(f) In addition to expected transit time, 1 day of delay enroute for all replacements at air embarkation and debarkation points.

(g) Proceed time may not be granted beginning on M-Day.

(11) Post-M-Day civilian employee demands and requirements may not assume annual leave. However, compensatory time may be granted, at the discretion of unit commanders, through the duration of the contingency.

(12) Military personnel occupying CONUS-support establishment jobs (as defined in 5.a.(9)) may be replaced by civilian personnel or recalled military retirees upon mobilization and transferred to deploying units.

(13) The workweek policy in 5.a.(12) may be implemented.

   c. A non-NATO contingency not involving mobilization (except for the Presidential Selected Reserve call-up authority).

(1) The President may declare a national emergency but mobilization may not be implemented.

(2) Selected readiness enhancement actions may be taken.

(3) The Presidential Selected Reserve call-up authority may be used to augment active component forces.

(4) Voluntary recall of PIRs or retired military personnel may be implemented.

(5) Voluntary call-up of personnel in the DEP or reserve component personnel awaiting initial active duty for training may be implemented. Delay provision in 5.a.(5) applies.

(6) Requests for nondisability retirement by active duty and Ready Reserve personnel shall be deferred at least 2 months, except for personnel who have completed 30 years of active service.

(7) Scheduled separations for active duty and Ready Reserve personnel shall be deferred 2 months from the date of recall, if the President declares a national emergency.

(8) Ready Reserve augmentation of SSS and Ready Reserve and retiree augmentation of AFEES shall occur immediately after initial U.S. response to the contingency.

(9) Classification and examination of potential inductees may be reinstituted, if the contingency lasts more than 1 month.

(10) All PCS moves during the duration of the contingency shall be solely for the convenience of the government to provide priority manning for the theater and deploying units.

(11) Post-C-Day military manpower demands and requirements shall assume:

(a) No leave or pass in theater for the duration of the contingency.

(b) No leave, but 3 day passes at the discretion of unit commanders for nontheater personnel for the duration of the contingency.

(c) Casualties returned to duty from a nontheater medical facility may be granted 15 days of posthospitalization leave prior to return.

(d) In addition to expected transit time, 1 day of delay enroute for patients returning to duty from in-theater medical facilities.

(e) In addition to expected transit time, 1 day of delay enroute for all replacements at air embarkation and debarkation points.

(12) Post-C-day civilian employee demands and requirements shall assume no annual leave but compensatory time at the discretion of unit commanders for the duration of the contingency.

5. WARMAPS Reporting

In addition to the preceding provisions, the following conventions apply specifically to the computation of wartime manpower demand, requirements, and supply data for WARMAPS reporting.

a. The force structure must conform to the provisions of the current Consolidated Guidance (CG) or supporting program guidance.

b. Peacetime unit manning levels must conform to the provisions of the current CG or supporting program guidance, and be consistent with data submitted for the Five Year Defense Program.

c. Selective Service deliveries to the Military Services shall be in accordance with provisions of the current CG or supporting program guidance.

d. The provisions of the current CG or supporting program guidance on Selected Reserve and pretrained individual manpower shall be the basis for calculating wartime manpower supply.

e. To provide a consistent, verifiable base point for supply projections, assume that M-Day or C-Day occurs on September 30.

E. RESPONSIBILITIES

1. The Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics) (ASD(MRA&L)) shall:

a. Direct and administer the WARMAPS.

b. Publish and update DoD 1100.19-H.

c. Issue specific WARMAPS reporting instructions prior to each scheduled update.

d. Produce wartime manpower requirements, demand, and supply reports, as specified in DoD 1100.19-H.

e. Make final determination for exemption to the provisions of this issuance, upon request from Heads of DoD Components.

2. The <u>Secretaries of the Military Departments</u> shall:

a. Ensure that provisions of this issuance are implemented.

b. Designate a flag or general officer or Senior Executive Service member as the official responsible for ensuring that WARMAPS data submissions:

(1) Conform to the provisions of this issuance.

(2) Accurately reflects the official service POM.

(3) Are certified true and complete.

c. Produce and submit to ASD(MRA&L) manpower data as specified in DoD 1100.19-H.

3. <u>Directors of Defense Agencies, Director of the Joint Staff, and Deputy Assistant Secretary of Defense (Administration)</u> shall determine mobilization military manpower demands for their respective organization and communicate these to the Secretaries of the Military Departments in a timely manner for inclusion in Military Service WARMAPS submissions.

4. <u>Directors of Defense Agencies</u> and joint activities responsive to or through the Joint Chiefs of Staff shall submit mobilization military manpower requirements in the Joint Mobilization Augmentation section of the Joint Manpower Program.

5. <u>Director of Defense Manpower Data Center</u> shall assist heads of DoD Components in ascertaining which civilian employees are members of the Ready Reserve or are nondisability military retirees under age 60.
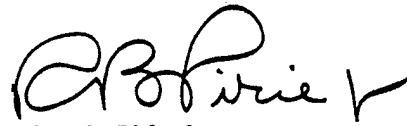
F. <u>INFORMATION REQUIREMENTS</u>

1. The semiannual reporting requirement for military personnel, Wartime Military Manpower Program, is assigned Report Control Symbol DD-M(SA&AR) 1565. Formats and instructions for this report are contained in DoD 1100.19-H. Standard data elements and codes are being developed in accordance with the policies of DoD Directive 5000.11 (reference (e)).

2. WARMAPS reports shall be prepared and edited to facilitate semiannual summission with the POM on or about May 15 and with the budget submission on or about November 15.

G. EFFECTIVE DATE

This instruction is effective immediately. Forward two copies of implementing documents to the Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics) within 120 days.

Robert B. Pirie, Jr.
Assistant Secretary of Defense (MRA&L)

Enclosure - 1
   Definitions

DEFINITIONS

1. The following terms used in this Instruction are defined in JCS Pub 1 or JCS Pub 21.

    a. Casualty
    b. Communications Zone
    c. CONUS
    d. Filler
    e. Full Mobilization
    f. M-Day
    g. Mobilization
    h. Partial Mobilization
    i. Patient
    j. Ready Reservist
    k. Reserve Component
    l. Selected Reserve
    m. Standby Reserve
    n. Theater
    o. Total Mobilization

2. Cadre. A nucleus of trained personnel capable of assuming control of a unit, training others, or performing administrative tasks. This includes Navy precommissioning crews.

3. C-Day. The unnamed day on which a deployment operation commences or is to commence.

4. Direct Hire. A civilian employee hired directly and paid directly for personal services from appropriated funds.

5. Five Year Defense Program (FYDP). The official data base or report that summarizes the resources provided for Secretary of Defense-approved programs for the Department of Defense. The FYDP identifies funding for each appropriation, manpower authorizations, and selected types of units or equipment authorizations by resource management packages called program elements.

6. Force Structure. The totality of authorized or required military or civilian manning for all units in a DoD Component.

7. Indirect Hire. A civilian employee hired in a foreign area under an agreement providing that the host government is responsible for ensuring that the local civilian labor needs of the U.S. forces are met. An indirect hire employee is appointed or paid by the host nation but is under the day-to-day operational control of the U.S. forces.

8. Manpower Demand. The number of people who can be productively used on tasks that further the war effort at any point in time during the course of a postulated conflict, considering the constraints imposed by projected lift capacity and the projected inventory of equipment, munitions, and spares.

9. <u>Manpower Requirement</u>. The number of people needed to achieve and sustain full manning for all units in the approved force structure throughout the course of a postulated conflict, assuming the availability of adequate equipment, munitions, spares, and lift.

10. <u>Military Functions</u>. Those functions of the Department of Defense and its Components that are carried out to (a) prepare forces and establish reserves of equipment and supplies for the effective prosecution of war, and plan for the expansion of peacetime components to meet the needs of war; (b) develop, maintain, and provide bases and installations with administrative and logistic support; and (c) assist in training and equipping the military forces of foreign nations.

11. <u>Peacetime Strength</u>. The end strength authorized for active forces and the Selected Reserve (to include Drilling Reservists, military technicians, and Active Guard/Reserve) in the FYDP.

12. <u>Pretrained Individual Manpower</u>. Personnel with prior military training or experience who are in one of the following three categories: PIRs (IRR, ING, and IMAs), Standby Reserve, and retired military personnel from the active or Reserve forces.

13. <u>Student</u>. A nonaccession member of a Military Service on PCS undergoing military training. This excludes cadets and armed forces health professional scholarship students.

14. <u>Trainee</u>. Servicemember with no prior service who requires initial entry training before being assigned to an operational unit; and an accessed member with prior service who requires refresher training before being assigned to an operational unit.

15. <u>Unmanned Unit</u>. A unit having a mobilization or fill schedule and for which equipment stocks exist, are programed, or could be made available under emergency conditions to meet required delivery date, but that has no manpower programed or authorized during peacetime.

16. <u>Wartime Manpower Program System (WARMAPS)</u>. A standardized DoD-wide procedure and requisite data base for computing, compiling, projecting, and protraying time-phased wartime manpower demand and supply of the DoD Components. WARMAPS depicts mobilization manpower flow dynamics by occupational grouping.

APPENDIX C

STOCHASTIC WARTIME MANPOWER SUBSYSTEM[*]

INTRODUCTION

In 1978, the Wartime Manpower Program System (WARMAPS) was developed by OASD(MRA&L) as the primary means for computing, presenting, justifying, and approving military wartime manpower requirements within the Planning, Programing and Budgeting System. WARMAPS requires each military service to submit time-phased incremental estimates of their wartime manpower requirements which, when finalized, are used as Program Objective Memoranda (POM) submissions. All WARMAPS data are calculated, compiled, and tabulated at the Pentagon Multiplexed Information and Computing Service (MULTICS) site.

There are many WARMAPS outputs: Total Manpower Demand; Total Manpower Supply; Total Trainees in Training; Total Patients in Hospitals. These are important to the development of mobilization plans for: training base requirements, airlift requirements, medical support requirements, and the like. Probably the most significant WARMAPS output is the Pretrained Individual Inventory Objective (PIIO).

THE PRETRAINED INDIVIDUAL INVENTORY OBJECTIVE (PIIO)

During the mobilization and deployment of forces in a wartime scenario, a reserve of "pretrained" individuals is essential to meeting the early demand for manpower. The PIIO is the measure of that demand. The purpose of a pool of pretrained individuals is to bring U.S. forces up to wartime levels and, then, to sustain them at that level until the expanded training base can take over the sustaining function.

The PIIO is the algebraic sum of six different WARMAPS outputs which are referred to as the PIIO components. The elements of each PIIO component are referred to as factors. These factors may be variable or nonvariable, dependent or independent. They are summed algebraically to arrive at a value for each component in a manner that is specific to that component.

THE PIIO COMPONENTS

1. <u>Mobilization Manpower Increment</u>. Mobilization Manpower Increment is the change in the force structure allowance as a result of mobilization. Although this change is due primarily to the higher manning levels during wartime, it also encompasses changes in force

structure due to: inactivated units, reduced units, civilianization, expansion of units, lost facilities, equipment or units not replaced, and the manpower required for unmanned units.

2. <u>Replacement Demand</u>. Replacement Demand is defined as the difference between the losses [killed in action (KIA), missing in action (MIA), prisoner of war (POW), wounded in action (WIA), disease and non-battle injury (DNBI), deserters, and holdees] and the returns to duty [from patients (wounded and injured), deserters, MIAs, and holdees].

3. <u>Trained (Non-Unit) Individuals</u>. Trained (Non-Unit) Individuals consist of students and transients who are part of the total strength but are not part of the force structure.

4. <u>Force Structure Deviation - Active</u>. This is the difference between the authorized peacetime force structure allowance and the projected actual force structure strength on M-day.

5. <u>Force Structure Deviation - Selected Reserve</u>. This is the difference between the authorized peacetime force structure allowance and the projected paid drill strength on M-day.

6. <u>Training Output</u>. Training Output is the total of all non-prior service accessions as they complete training and are posted to their units.

For M-day and each post M-day time increment, WARMAPS estimates theater and non-theater manpower by officer and enlisted career areas.

The PIIO is expressed by the following equation:

Mobilization Manpower Increment (MMI)

+   Replacement Demand (RD)

+   Trained (Non-Unit) Individuals (TNI)

−   Force Structure Deviation - Active (FSDA)

−   Force Structure Deviation - Selected Reserve (FSDR)

−   Training Output (TO)

=   Pretrained Individual Inventory Objective (PIIO)

$$PIIO = MMI + RD + TNI - FSDA - FSDR - TO$$

THE PROBLEM

Currently, the PIIO is calculated as a point estimate of an expected value without being assigned a measure of variability. The reason is that all input data for the PIIO components are point estimates. Thus, there is no quantifiable basis on which to draw inferences regarding the probability that the PIIO will fall within a specified range or to assess risk associated with a particular PIIO estimate.

THE SOLUTION

The Stochastic Wartime Manpower Subsystem (SWARMS) was conceived to meet DoD's need to consider risk/variability in wartime manpower demand estimates. Originally, SWARMS was seen only as a means of defining the precision of the PIIO, the principal WARMAPS output. However, it was soon realized that it would be useful to extend SWARMS to cover other WARMAPS outputs as well. Thus, although this paper deals exclusively with the PIIO, the concept has been designed purposely to be sufficiently general and flexible to apply to all the key WARMAPS outputs.

SWARMS will require each military service to submit a range of estimates rather than a single point estimate as is the current practice. In actuality, the point estimate will serve as the most likely value; two additional estimates, a minimum and maximum value, will serve as the lower and upper bounds. Throughout the rest of this paper, the lower bound will be referred to as a, the most likely value as b, and the upper bound as c. SWARMS will provide for the statistical treatment of each PIIO component factor for which an a, b, and c have been assigned. As its ultimate product, SWARMS will produce a confidence interval for the PIIO based on judgmental decisions regarding the variability of the PIIO component factors. Initially, only the independent variable factors of Replacement Demand (KIA, MIA, POW, WIA, DNBI) will be treated statistically, using predetermined probability distributions. As the SWARMS concept is developed further, the independent variable factors of other PIIO components will also be treated.

SWARMS is being integrated with WARMAPS on the Honeywell 6000 computer at the MULTICS site. Before committing SWARMS to MULTICS, we conducted a mini-experiment using a TI-59 programmable calculator, primarily to test the validity of the SWARMS methodology. An account of the experiment with results and conclusions is presented in a later section on Experimentation.

PROBABILITY DISTRIBUTIONS

When dealing with minimum, most likely, and maximum estimates, two kinds of probability distributions are most often used: the beta distribution and the triangular distribution. For SWARMS, the triangular distribution is preferred for the following reasons:

1. For the triangular distribution, no error is introduced when the expressions for the mean and standard deviation are used in computation. Both expressions provide exact values. For the beta distribution, error may be introduced when the expressions for the mean and standard deviation are used in computation. The standard deviation is an assumption and the mean is an approximation.[1] Although imprecise,

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[1] The mean and standard deviation referred to here are PERT expressions for the mean and standard deviation of a beta distribution. In using the PERT expressions, it is assumed that the duration of an activity

these expressions are widely accepted; for even when a random variable is assumed to be beta distributed, "...it is highly unlikely that any procedure could be devised to determine the exact parameters of the distribution...."[1] Since the parameters of a beta distribution determine its mean and standard deviation, it is improbable that exact values for the mean and standard deviation can be found.

2. It is reasonable to expect a wide variance in the estimates of casualties and other independent variable factors between the start and end of the conflict. Thus, a distribution that reflects this assumption is the desired distribution. The triangular distribution has a greater variance than the beta distribution for any a, b, c.

3. Given a minimum, most likely, and maximum value, a triangular distribution can be uniquely determined. This is not true for the beta distribution.

THE TRIANGULAR DISTRIBUTION

The triangular distribution has a probability density function of:

$$
f(x) = \begin{cases} \dfrac{2(x-a)}{(b-a)(c-a)} \,, & a \leq x \leq b \\[2ex] \dfrac{2(c-x)}{(c-b)(c-a)} & b \leq x \leq c \\[2ex] 0 & \text{elsewhere} \end{cases}
$$

The cumulative probability function is the integral of the probability density function and can be expressed by:

$$
F(x) = \begin{cases} \dfrac{(x-a)^2}{(b-a)(c-a)} & a \leq x \leq b \\[2ex] 1 - \dfrac{(c-x)^2}{(c-b)(c-a)} & b \leq x \leq c \end{cases}
$$

The inverse transformation of the cumulative probability function gives the expression for the triangular variate X with a uniform variate U:

---

is beta distributed. In non-time related situations, the same assumptions can be applied as long as there is continuity between the "optimistic" and "pessimistic" values. Thus, if we speak of casualties ranging from 20 to 30, we are applying the same principle used in PERT to describe an activity duration as ranging from 20 to 30 days.

[1] Kenneth R. MacCrimmon and Charles A. Ryavec, "An Analytical Study of the PERT Assumptions," *Operations Research* 12 (1964): p. 23.

$$X = \begin{cases} a + \sqrt{(b-a)(c-a)U} & 0 \leq U \leq \dfrac{b-a}{c-a} \\[2ex] c - \sqrt{(c-b)(c-a)(1-U)} & \dfrac{b-a}{c-a} \leq U \leq 1 \end{cases}$$

CALCULATION METHODOLOGIES

A most likely value and measure of confidence for the PIIO can be derived using either an analytical approach or a simulation approach.

The _analytical approach_ involves computing the mean and standard deviation of the triangular distributions formed on the variable factors comprising each PIIO component. The critical values (a, b, c) of the dependent variable factors are based on the minimum, most likely, and maximum values assigned to the independent variable factors. They are computed using the prescribed algorithms associated with the PIIO component being evaluated. The mean and standard deviation of any non-variable factors are, respectively, the original point estimate and zero. The means and standard deviations for each factor are then summed in a fashion to produce a mean and standard deviation for the PIIO component as a whole. When this process has been accomplished for all PIIO components, the component means and standard deviations are summed in a fashion to produce a mean value and an associated standard deviation for the PIIO.

The analytical approach has some drawbacks. It does not provide us with a distribution from which we can determine a mean and standard deviation for the PIIO. Instead, we must assume a distribution to be able to sum the means and standard deviations of the PIIO components. With this approach, we cannot be totally certain of making the correct assumption. However, if enough triangular distributions (approximately five) are summed together, the resultant distribution will be approximately normal. It is not expected, though, that all PIIO components will have five variable factors that can be treated stochastically.

Another drawback to the analytical approach is the lack of flexibility. An analytical model often must be completely reformulated at the expense of a great deal of time in order to accommodate changes for improvement and expansion. Finally, the analytical approach is severely limited in its capacity to handle dependency between variables. Since some PIIO components, Replacement Demand in particular, contain independent and dependent factors, the analytical approach would clearly be an inappropriate choice.

The _simulation approach_, on the other hand, can supply us with a distribution from which statistical inferences can be made about the PIIO. There is no need to assume a distribution; a distribution is formed regardless of the interdependencies that may exist between variables. In addition, the simulation approach has the flexibility required to accommodate changes for improvement and expansion.

The kind of simulation to be used is the Monte Carlo simulation. In a Monte Carlo simulation, probability distributions are assigned to each variable, and then, by means of random numbers, data are generated by sampling from these distributions.

For SWARMS in particular, triangular distributions are first formed for each independent variable factor. Values for the independent variable factors are generated randomly and then manipulated to produce values for the dependent variable factors. All values derived for the variable factors are then added to point estimates of the nonvariable factors to produce a value for the PIIO component. When the value of each PIIO component has been formulated in this manner, all component values are summed according to the prescribed PIIO algorithm to result in a PIIO value. Fifty such PIIO values and their mean are computed. According to our intuition and experience with simulations of this form, the distribution of the mean will be approximately normal. A χ^2 test for a .05 level of significance will be performed to determine if we can reasonably assume that the distribution of the mean is approximately normal. Statistical inferences based on the normal distribution can then be made. If the distribution of the mean is not normal, a confidence interval can be computed based on the dispersion of the 50 PIIO values. A sample size of 50 was selected because, in most applications of this type, a sample of '30 is usually sufficient to ensure an approximately normal distribution. A flow diagram depicting the entire simulation process is shown in Figure 1.

REPLACEMENT DEMAND

The PIIO component, Replacement Demand, is defined as the difference between (1) the total number of losses from all causes over a particular time period, and (2) the returns to duty from those kinds of losses over the same time period.

The Services have supplied loss estimates only for combat losses (KIA, MIA, POW, and WIA) and for non-combat losses (DNBI). Therefore, it is necessary to describe only the algorithm for returns to duty (RTD), from patients (WIAs and DNBIs). No algorithm is required for KIA, MIA, POW, as the probability of RTDs from this group is so small that such an eventuality can be ignored.

RETURNS TO DUTY COMPUTATION

RTDs are computed from the Service loss estimates based on fixed rates of disposition derived from both historical and simulated data.

A model of patient flow from the time and place of loss to the time and place of disposition is shown in Figure 2. Hypothetical rates illustrate the internal dynamics of patient flow: 80% of all combat losses are wounded in action (WIA). Of the WIAs, 50% are treated in an aid station and returned to duty within five days and 50% are admitted to theater hospitals. Of the evacuated WIAs, 80% are treated and returned to duty in 40 days, 10% die, and 10% are separated from the Service. The times to disposition reflect historical/experience

START

(A)

PIIO COMPONENT$_j$

(B)

FACTOR j j : 1 TO k, WHERE k IS DEFINED BY COMPONENT CHARACTERISTICS

IS INDEPENDENT FACTOR VARIABLE ?

IS FACTOR INDEPENDENT ?

YES → a, b, c

YES

NO → HOLD THIS DEPENDENT FACTOR UNTIL ALL FACTORS PROCESSED

NO

DRAW ONE DECIMAL RANDOM NUMBER U, FROM A UNIFORM DISTRIBUTION BETWEEN ZERO AND ONE

POINT ESTIMATE
$x = b$

IS $0 \leq U \leq \frac{b-a}{c-a}$?

NO → $x = c - \sqrt{(c-b)(c-a)(1-U)}$

YES → $x = a + \sqrt{(b-a)(c-a)U}$

ALL FACTORS DONE?

NO → NEXT FACTOR $j = j + 1$ → (B)

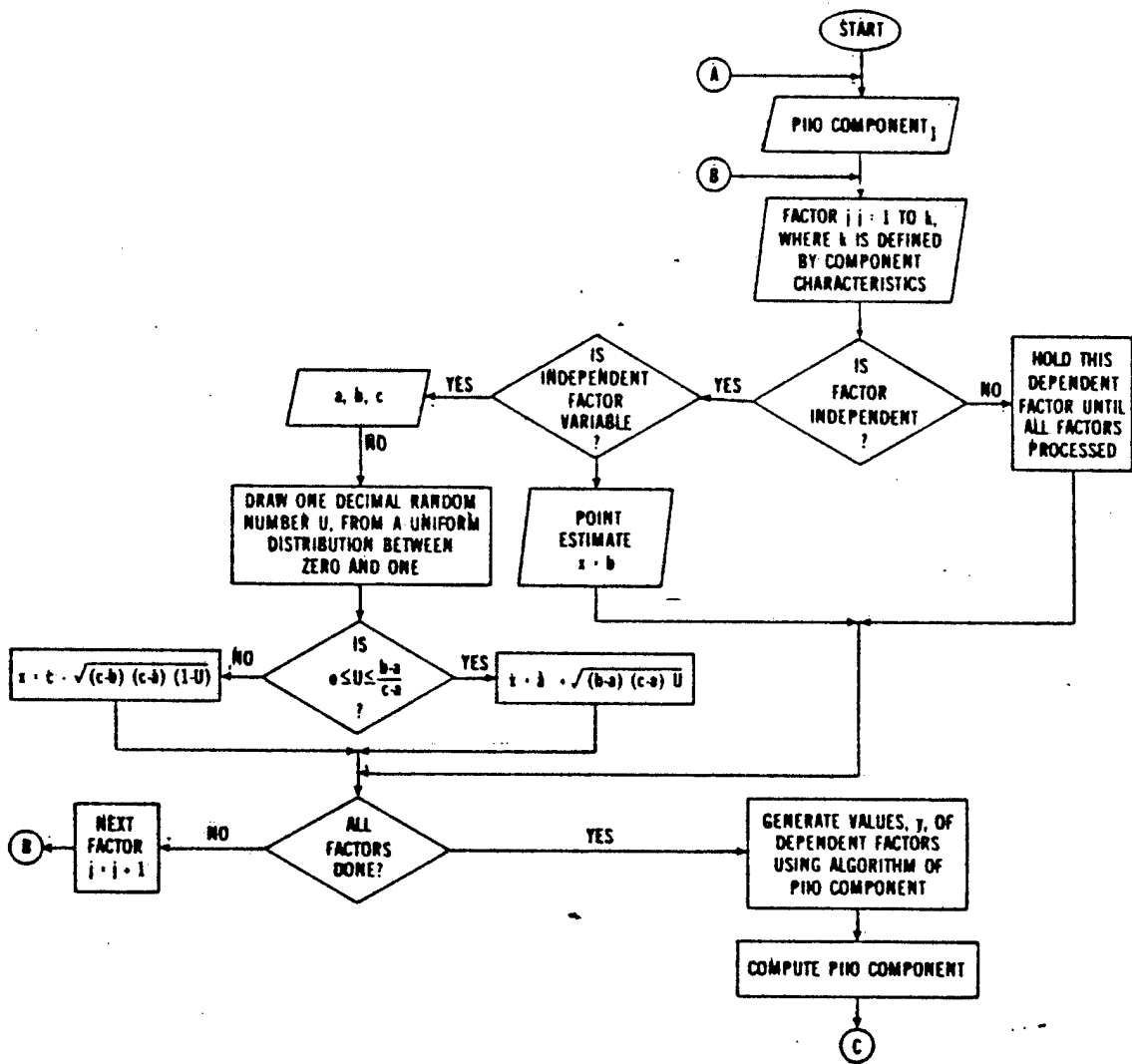YES → GENERATE VALUES, γ, OF DEPENDENT FACTORS USING ALGORITHM OF PIIO COMPONENT

COMPUTE PIIO COMPONENT

(C)

Figure 1. SWARMS Simulation Process (Continued on following page)

Figure 1. SWARMS Simulation Process (Continued)

(A) RETURNS TO DUTY — UNIT REPLACEMENT
(B) RETURNS TO DUTY — THEATER REPLACEMENT
(C) RETURNS TO DUTY — SERVICE REPLACEMENT

COMBAT LOSSES → .80 → WIA → .50 → AID STATION → (A)
AID STATION → .55 → THEATER → (B)
WIA → .50 → HOSPITAL
HOSPITAL → .35 → EVAC
HOSPITAL → .10 → DOW
COMBAT LOSSES → .20 → KIA/MIA/POW

HOSPITAL → .10 → DOW
HOSPITAL → .80 → NON-THEATER → (C)
HOSPITAL → .10 → SEPARATED

NON-COMBAT LOSSES → DNBI
DNBI → .20 → HOSPITAL
HOSPITAL → .03 → DOI
HOSPITAL → .12 → EVAC
DNBI → .80 → AID STATION → (A)
AID STATION → .85 → THEATER → (B)

HOSPITAL → .03 → DOI
HOSPITAL → .90 → NON-THEATER → (C)
HOSPITAL → .07 → SEPARATED

DNBI → .20 → HOSPITAL
HOSPITAL → .03 → DOI
HOSPITAL → .90 → NON-THEATER → (C)
DNBI → .80 → AID STATION → (A)
HOSPITAL → .07 → SEPARATED

RATES: THEATER

TIME IN AID STATION TO RDT — 5 DAYS
TIME IN HOSPITAL TO DOW — 9 DAYS
TIME IN HOSPITAL TO EVACUATION — 9 DAYS
TIME IN HOSPITAL TO RTD — 15 DAYS

NON-THEATER (EVACUEES)

TIME IN HOSPITAL TO RTD — 40 DAYS
TIME IN HOSPITAL TO SEPARATION — 45 DAYS
TIME IN HOSPITAL TO DOI — 40 DAYS

NON-THEATER (DNBI)

TIME IN AID STATION TO RTD — 5 DAYS
TIME IN HOSPITAL TO RTD — 15 DAYS
TIME IN HOSPITAL TO SEPARATION — 45 DAYS
TIME IN HOSPITAL TO DOI — 15 DAYS

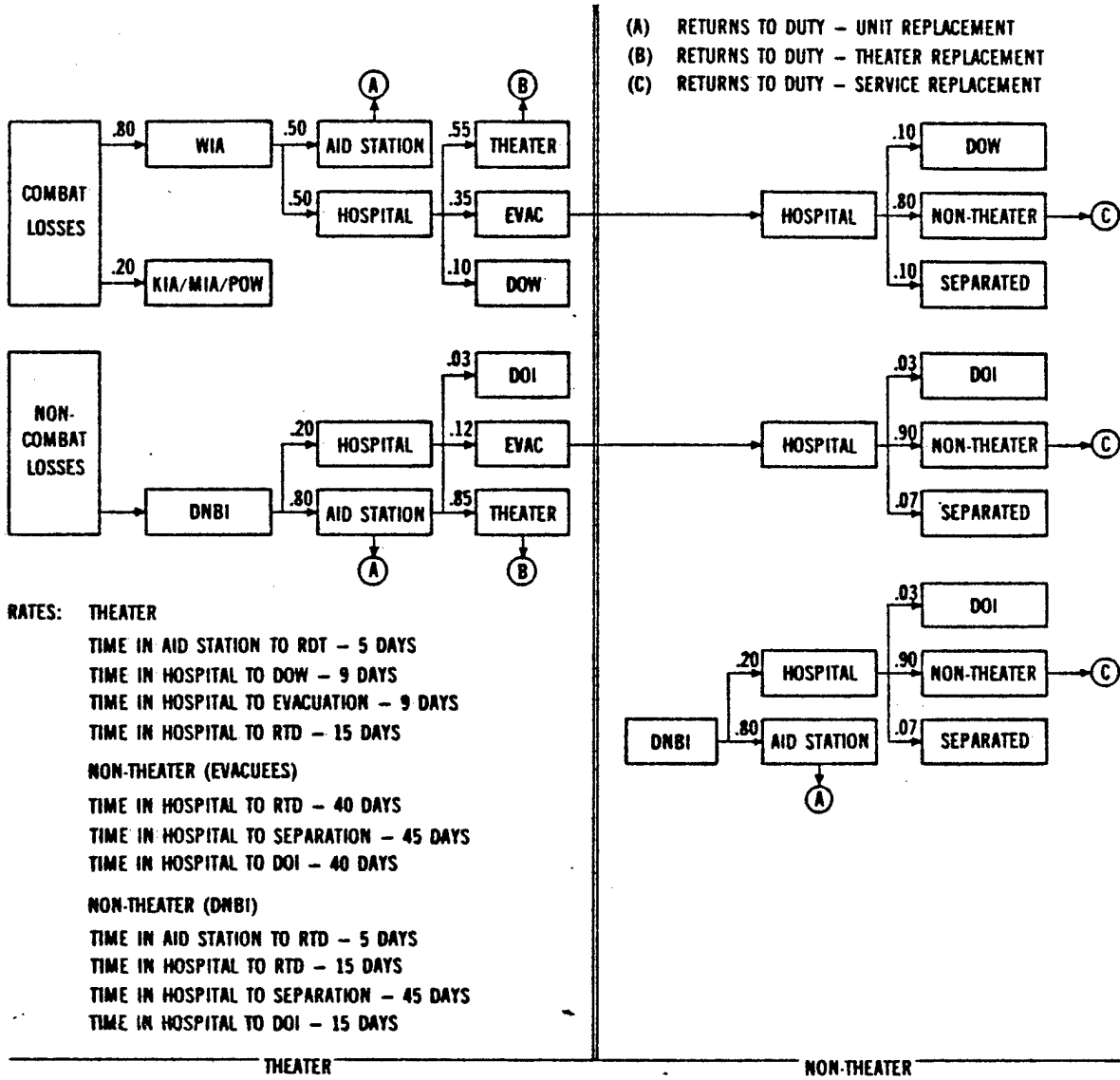THEATER   NON-THEATER

Figure 2.   WARMAPS Patient Flow Dynamics

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data on time spent in aid stations and hospitals, adjusted to include transient time.

THE STOCHASTIC PROCESS

The internal dynamics of Replacement Demand are unaltered for use in SWARMS. A triangular variate is generated for each category of loss. That number is subjected to the patient flow model to arrive at the value for RTDs, the dependent variable factor. When all RTDs from all losses have been computed and compiled, Replacement Demand is determined by subtracting RTDs from the sum of all losses (KIAs, MIAs, POWs, WIAs, and DNBIs).

Within the patient flow model, rates of distribution for losses through treatment channels to disposition and the theater evacuation policy are held constant throughout the process of generating the confidence interval for the PIIO. However, the model is capable of accepting different constant values for each Service to reflect new policy and/or experience. In a further refinement of SWARMS, the rates in the WARMAPS Patient Flow Dynamics model will be treated stochastically just as are the independent variable factors of Replacement Demand.

EXPERIMENTATION

In testing the SWARMS methodology, hypothetical data were assigned to four consecutive but arbitrary time periods consisting of ten days each (see Table 1). Only the Replacement Demand component of the PIIO was treated statistically. Mobilization Manpower Increment, Trained (Non-Unit) Individuals, and Training Output were treated as constants. Force Structure Deviation - Active and Force Structure Deviation - Selected Reserve were omitted for purposes of simplification. They are relevant only for M-day, ten days before the outbreak of war.

To simplify the problem further, it was assumed there was only one theater and no non-theater. This avoided the complication of combining theater and non-theater results, and precluded the need to compute transient time as part of the overall theater Replacement Demand.

The data in Table 1 are hypothetical point estimates as would be provided by a military service. The arbitrary rule used to assign lower and upper bounds to the estimates for KIA, MIA, POW, WIA, and DNBI (the independent variable factors of Replacement Demand) was "5% low and 10% high." Thus, for the 60,000 WIAs (b) at t_3, the minimum bound is 57,000 (a) and the upper bound 66,000 (c). Returns to duty were calculated based on the percentage rates in the WARMAPS Patient Flow Dynamics model (Figure 2).

All calculations, including the simulation, were performed using a TI-59 programmable calculator. As expected, a χ^2 test proved that the distribution of the mean of PIIO values was approximately normal for each time period. Thus, the confidence intervals (95%) were derived using the properties of the normal distribution. The results are shown in Table 2. To illustrate, in time period t_3, accepting the underlying

Table 1

THE PIIO AND ITS COMPONENTS

	t_1	t_2	t_3	t_4
KIA, MIA, POW	6,000	10,000	15,000	9,000
WIA	24,000	40,000	60,000	36,000
DNBI	18,000	30,000	45,000	27,000
Returns to Duty from:				
WIA	12,000	20,000	36,600	29,000
DNBI	14,400	24,000	39,060	26,700
Replacement Demand	21,600	36,000	44,340	16,300
Mobilization Manpower Increment	10,000	15,000	20,000	17,000
Trained (Non-Unit) Individuals[a]	-2,000	-3,000	-3,000	1,000
Training Output	5,000	10,000	25,000	20,000
PIIO	24,600	38,000	36,340	14,300

[a]A negative entry denotes individuals returning to units; a positive entry denotes individuals entering non-unit status.

Table 2

TEST RESULTS

	t_1	t_2	t_3	t_4
PIIO 95% Confidence Interval	24,806-25,033	38,400-38,801	36,915-37,592	14,210-14,529
Mean	24,919	38,601	37,254	14,370
Standard Deviation	410	725	1,220	576

judgments regarding individual loss components, the PIIO value lies between 36,915 and 37,592 with 95% confidence. The computed standard deviation can also be used to calculate the probability that the PIIO will be at most or greater than any specified value.

CONCLUSIONS

The basic assumption that initiated the SWARMS project was that it is unrealistic for Defense manpower planners and policy makers to deal with single point estimates of wartime manpower demand. For example, it is virtually impossible to say with any degree of certainty that there will be _exactly_ 60,000 WIAs at t3. It is possible, however, to establish reasonable bounds for the expected number of WIAs. As a result of providing ranges of estimates rather than point estimates, statistical inferences and related risk evaluations can be made regarding the PIIO.

The purpose of this mini-experiment was to test this methodology. By assigning optimistic and pessimistic values to the point estimates, we developed a range of PIIO values within which the PIIO value lies with 95% confidence. The utility of this approach is seen when comparing the confidence interval for the PIIO with the corresponding point estimate PIIO. In three out of the four time periods, the point estimate PIIO fell outside the 95% confidence interval. This confirms that a point estimate for the PIIO can be a misleading predictor given the underlying variability of casualty estimates. Thus, using SWARMS within the WARMAPS has two immediate advantages, increased information and flexibility: increased information because given the ability to make intelligent judgments on probable loss ranges, rational inferences can be made about the variability of PIIO requirements; and flexibility because we can experiment with various combinations of optimistic and pessimistic values to see what impact there is on the PIIO.

SWARMS can be used both by OSD and the military services for many purposes. Among these are:

- To provide a more informed basis on which to plan training base expansion for the production of replacements of combat skills.

- To provide a more informed basis on which to program medical support and, in particular, medical evacuation needs.

- To provide a more informed basis in peacetime for programming the ready reserves in adequate numbers and skills.

- To provide a more informed basis for taking management action to assure the supply of pretrained individuals in the event of mobilization.