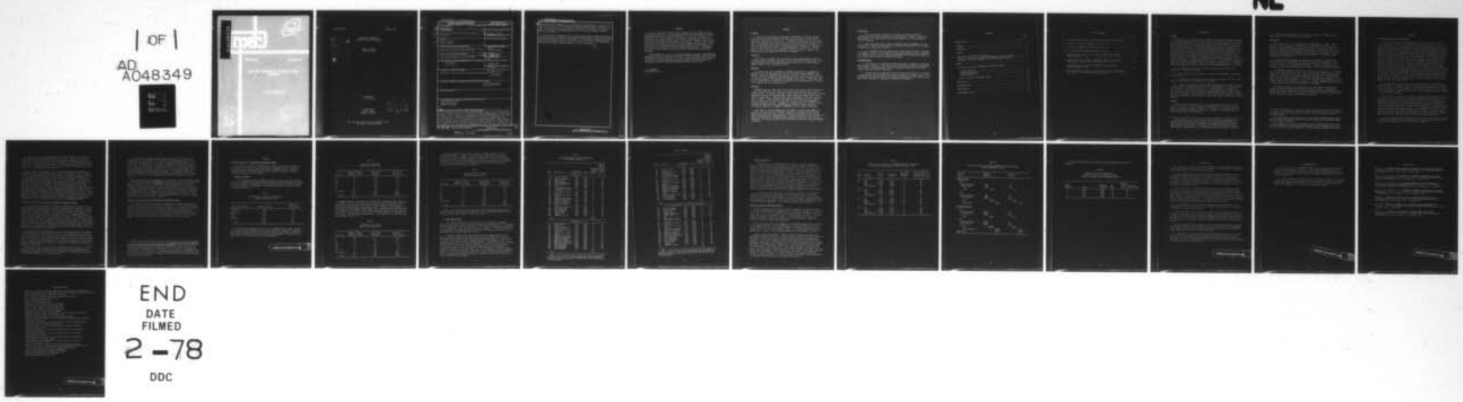
AD-A048 349 NAVY PERSONNEL RESEARCH AND DEVELOPMENT CENTER SAN D--ETC F/G 5/1
ANALYSIS OF DEMANDS ON THE NAVAL STATION, SAN DIEGO.(U)
DEC 77 T A BLANCO, M W ROWE
UNCLASSIFIED NPRDC-TR-78-7 NL

| OF |
AD A048349



END
DATE FILMED
2-78
DDC

NPRDC TR 78-7 December 1977

ANALYSIS OF DEMANDS ON THE NAVAL STATION, SAN DIEGO

Thomas A. Blanco
Murray W. Rowe

Reviewed by
Joe Silverman

Approved by
James J. Regan
Technical Director

Navy Personnel Research and Development Center
San Diego, California 92152

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER (14) NPRDC-TR-78-7	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) (6) ANALYSIS OF DEMANDS ON THE NAVAL STATION, SAN DIEGO.		5. TYPE OF REPORT & PERIOD COVERED (9) Interim rept.,
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) (10) Thomas A./Blanco Murray W./Rowe		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Navy Personnel Research and Development Center San Diego, California 92152 (Code 303)		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 63707N Z0109-PN (ZPN01)
11. CONTROLLING OFFICE NAME AND ADDRESS Navy Personnel Research and Development Center San Diego, California 92152 (Code 303)		12. REPORT DATE (11) Dec[redacted]977
		13. NUMBER OF PAGES 26
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) (12) 26p.		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

(16) Z0109, ZPN01

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

(17) Z0109PN

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Input-Output Analysis
Demand Forecasting
Manpower Planning

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

In developing a system for allocating manpower resources in the Navy, major emphasis has been placed on the design of an input-output model to forecast the workload of shore activities, based upon the size and distribution of the fleet. To determine the feasibility of input-output analysis for operational use, a full-scale model of the 11th Naval District is being developed. The structure of input-output analysis requires data on the work output of each shore activity and its destination in the fleet and at other shore activities. In addition, the demands by the fleet must be disaggregated by ship type, movement, and status.

→ next page

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

390 772

LB

cont. A major effort underway is the collection and organization of data and the empirical analysis of the fleet-shore workload demand network, focusing on 10 major shore activities in the 11th Naval District. This report is concerned with the analysis of workload demand on one of these activities--the Naval Station, San Diego.

The structure of demands on the two major departments at NAVSTA, San Diego (Waterfront Operations and Military Personnel) was analyzed, and the differences in demand among ship types were determined. The Waterfront Operations Department primarily provides port services to ships in the harbor; and the Military Personnel Department, personnel services to fleet personnel.

FOREWORD

The effort described in this report supports the Fleet Impact on Shore Requirements subproject, an advanced development under the Manpower Requirements Development System Project (Z0109-PN). The overall objective of this subproject is to apply econometric and manpower modelling technologies in the prediction and allocation of shore activity level manpower resources as a function of workload and operational force levels. The main effort of FY77 was an empirical study of the fleet and shore demands placed on major shore activities in the 11th Naval District, with the objective of developing an input-output (I/O) model of the fleet-support demand network. This report focuses on one of the major shore activities--the Naval Station (NAVSTA), San Diego.

Acknowledgments are due to the following NAVSTA personnel: CDR Alexander, Waterfront Operations Department; CDR Goll, Military Personnel Department; and CDR Edwards, Executive Officer. The staffs of both the Waterfront Operations and Military Personnel Departments were extremely helpful and cooperative throughout the data collection and analyses stages of this study.

J. J. CLARKIN
Commanding Officer

SUMMARY

Problem

A system for determining Navy manpower requirements and allocating manpower resources must be based on the workload and economic relation among individual shore-support activities. The demand network that links one shore activity to another, and to the fleet, constitutes the economic system of the Navy. To represent this network structure, an input-output (I/O) model of the 11th Naval District (11ND) is being developed to forecast the workload of shore activities based on the size and distribution of the fleet. An I/O model of this size requires a significant effort to collect, organize, and analyze data on the source and intensity of demands.

Objective

This study is concerned with the analysis of workload demands placed on the Naval Station (NAVSTA), San Diego by the fleet and shore activities. The results will be used in developing a full-scale model of the fleet-support demand network of the 11th Naval District.

Approach

To capture the scope of demands on NAVSTA, San Diego, the structure of demands on its two major departments--Waterfront Operations (WATEROPS) and Military Personnel (MILPERS)--was analyzed in detail. Hours of port service per day in port and number of personnel actions per fleet people day were used as workload measures for WATEROPS and MILPERS, respectively. These data were used to determine the distribution of workload in each department as a function of the number and type of ships in port.

Findings

WATEROPS provides three types port service--tug; landing craft, mechanized (LCM); and oiler--with tug service accounting for 69 percent of total port service hours. The largest customers of tug service were frigates (FFs), nuclear submarines (SSNs), dock landing ships (LSDs), destroyers (DDs), and cruisers (CGs), in that order. These five ship types accounted for 43 percent of tug service demand. Average demand rates and standard deviations were computed for each ship type for tug, LCM, and oiler service, and for an aggregate measure called port service. Comparison of computations for the four service categories showed that the consolidated port service category improved the relative variance of demands on WATEROPS of ships within a ship type.

The number of fleet personnel in port appears to reflect the number of personnel actions handled by MILPERS. Analysis of these personnel actions showed that 73 percent were activity-related; and 27 percent, Navy-related. Nearly 90 percent were nondisciplinary. A mean coefficient (for use in the I/O model) was obtained by averaging the coefficients for each of the 13 months observed. The variance about the mean coefficient reduced by removing seasonal influences.

Conclusions

1. Data are available to measure a variety of demands on NAVSTA, San Diego and will easily conform to an I/O framework. However, collection, organization, and computerization of the data proved to be time-consuming and very expensive.

2. Since ship type clearly affected demands placed on WATEROPS, the I/O model must not ignore the differences in workload attributable to, for example, a submarine vs. an aircraft carrier.

3. Since WATEROPS services primarily San Diego-homeported ships, changing the homeport of ships is very likely to affect the workload of that department. Such changes could, in turn, affect MILPERS workload by altering the number of fleet people days per month at NAVSTA, San Diego.

Recommendations

1. The variance in the MILPERS demand coefficient was reduced by removing some seasonal influence. Thus, data collection should continue to provide sufficient data for obtaining more reliable estimates through the use of more sophisticated statistical techniques.

2. A naval station's workload varies in terms of the functions it provides to the fleet and the particular port complex in which it resides. Thus, it is recommended that similar kinds of analyses be performed at other naval stations before this community is included in a Navy-wide I/O model.

CONTENTS

LIST OF TABLES

INTRODUCTION

Problem

The Navy's efforts in developing a system for allocating manpower resources have emphasized the design of an input-output (I/O) model to forecast the workload of shore/support activities, based on the size, configuration, and operating tempo of the fleet. Manpower requirements can then be derived from the model's workload forecasts. The I/O structure will link the activities of the fleet (ships, aircraft) to individual shore/support activities (shipyards, supply centers, etc.), as well as indicate linkages among shore activities. By organizing Navy activities in the I/O matrix, the extent to which each activity depends on every other activity to produce support can be quantified using historical data. For example, I/O analysis can not only determine the impact on the workload of a shipyard of introducing an additional destroyer into the overhaul schedule, but also, and more importantly, it can estimate the increased workload that will be required at a supply center to support the new overhaul. Thus, both direct and indirect effects of the fleet are captured. It is hoped that the I/O model will answer a variety of Navy management questions, such as:

1. For changes in fleet size or mix, what changes in workload can be expected at each shore activity?

2. What is the impact of changes in the shore establishment on the level of fleet support?

3. If ships are transferred from one homeport to another, what will be the effect on the workload of activities at each port?

An I/O model representing the fleet-support demand network of the 11th Naval District (11ND) is being developed for use by Navy managers. It requires data on the output of each shore activity and the destination of this output in the fleet and at other shore activities. Fleet demands must be broken out by ship type and aircraft model and by their movement and status. Since a large data base is essential to an I/O model, current efforts are devoted to collecting, organizing, and analyzing data for use in describing a fleet-support demand network.

Purpose

This data analysis effort focuses on workload demands placed on 10 11ND shore activities.[1] These activities were selected for their wide range of functions, outputs, and data problems; their manpower intensities; and their direct and indirect linkages to the fleet. Further, they comprise about 42 percent of the total 11ND workforce.

---

[1]These activities are the Long Beach Naval Shipyard, Long Beach; Naval Supply Center, San Diego; Naval Air Rework Facility, North Island; Naval Air Stations, North Island and Miramar; Naval Regional Medical Center, San Diego; Naval Training Center, San Diego; Naval Station, San Diego; Public Works Center, San Diego; and the Development and Training Center, San Diego.

The purpose of this report is to provide an analysis of demands on the Naval Station, San Diego (NAVSTA, San Diego).[2]

Background

There are 13 U.S. naval stations located throughout the world. All are under the supervision of the Commanders in Chief, Atlantic, Pacific, and European fleets depending on their location. Naval stations provide a large variety of support functions ranging from docking and berthing of ships to processing personnel and maintaining a shore patrol. The size of each of these functions varies from one station to another because of the number of ships frequenting the station and the physical configuration of the port complex where the station resides.

At NAVSTA, San Diego, there are nine major departments. However, two--Waterfront Operations (WATEROPS) and Military Personnel (MILPERS)--not only capture the scope of fleet support provided there but also comprise a significant portion of its workload and manpower.[3] These two departments, plus the Security Department, employ over 70 percent of the entire NAVSTA workforce.[4]

The WATEROPS Department provides three types of port services: tug; landing craft, mechanized (LCM); and oiler. The first involves providing tug and pilot services to ships as they arrive or depart the San Diego Naval Complex (SDNC), change berths ("move"), or leave their berthing temporarily to allow another ship to dock or depart ("holdoff"). The LCM tasks performed by WATEROPS include "donut" control (oil separation), paint float movement, ship assistance, and "camel" delivery (ship separator placement). Finally, WATEROPS maintains several nonself-propelled oilers for fueling ships in the SDNC.

The MILPERS Department processes orders for separations, reenlistments, transfers (PCS and TAD), and transients awaiting assignment. Thousands of actions are handled annually for enlisted personnel and officers passing through NAVSTA, San Diego to and from the fleet and for similar personnel stationed at the 22 tenant activities on board NAVSTA, San Diego.

---

[2]This is the eighth in a series of reports from the empirical study of workload demands placed on 11ND shore activities. The first seven are listed in the bibliography.

[3]The remaining seven departments are: Legal Office, Administration, Chaplain's Office, Shore Patrol Department, Security Department, Degaussing Department, and Supply Department.

[4]The demands on the Security Department were not analyzed in detail, since most of its workload is generated by the physical plant at NAVSTA, rather than by the fleet (e.g., security guards for ingress and egress physical security).

APPROACH

Data Sources and Initial Processing

A statistical description and analysis of the workload demands placed on the Waterfront Operations (WATEROPS) Department by the fleet requires a large data base that identifies the type of ship receiving service, the kind of service rendered, and some measure of the workload generated by the service. Similarly, an analysis of the Military Personnel (MILPERS) Department workload demands needs data that emphasizes the types and amounts of personnel actions processed. Such data for WATEROPS were obtained from the NAVSTA, San Diego via Bradford Computer and Systems, Inc., who constructed a computerized data base from the "flat paper" records maintained at WATEROPS. The data, obtained for calendar year 1975, were in the form of daily logs for each service craft in each of the three port service categories of WATEROPS--tugs; landing craft, mechanized (LCMs); and oilers. These logs contained a record of each service action performed for the year. From the first two service category logs, "start" and "stop" times on each record allowed a computation of the hours expended in the service action. However, since no "stop" time was available in the oiler records, the workload measure for oiler service used in this analysis was derived by sampling individual, handwritten oiler logs maintained monthly by each oiler crew. All ship types receiving oiler services were sampled and an "average hours expended in oiler service" demand rate was derived for each. These rates were multiplied by the number of oiler actions a ship of the appropriate type received to produce an estimate of the hours of oiler service demand for each ship during 1975.

"Hours expended" in the various service categories was selected as the workload measure for WATEROPS rather than such alternatives as "the number of ships serviced," for several reasons. The latter, for example, does not distinguish the difference in workload between providing tug service to a cruiser or a patrol gunboat. NAVSTA, San Diego also uses this "hours expended" measure in daily workload planning.

Because these data permit an analysis of demands on WATEROPS in terms of individual ship customers, it was possible to determine the feasibility of (1) grouping ships by type, and (2) combining the three service categories into an aggregate measure called "hours of port service." It was also possible to derive the proportion of total WATEROPS workload accruing to each ship type and kind of service provided and to determine the difference in WATEROPS workload for different ship types. If ships of the same type have similar demand patterns, the fleet can be represented in an I/O model by ship types, with each type having a final demand consisting of the number of ships in each type. When these data are included in an I/O model with data from other activities, the importance of second and higher order effects can be determined.

Initial processing involved calculating the total annual workload for each ship in each WATEROPS service category. The results were used to derive distributions of workload by ship type and service category.

A study of the workload generated by the MILPERS Department was made by collecting data on the personnel actions processed. That data, obtained directly from the MILPERS ADP section, indicated the number of each type of personnel action for each month of a 15-month period from January 1975 through March 1976. (MILPERS also uses "number of actions processed" as a measure of workload.) Preliminary processing of the data produced a distribution of workload by type of personnel action handled.

Aside from the type of action, it was hypothesized that the demands for personnel actions at MILPERS were influenced by the number of people passing through the NAVSTA during a particular period. To test this notion, a measure of the demand population, "fleet people days" (per month), was derived. It involved producing a relatively accurate count of the number of active duty Navy personnel stationed on board ships in the SDNC per day. The daily logs for March 1975-March 1976 (January and February 1975 were not available) from NAVSTA were examined to determine which Navy ships were in port each day. Finally, after compiling a list of all the Unit Identification Codes (UICs) for the appropriate ships in the SDNC, monthly manpower data were obtained from the Enlisted Personnel Management Center (EPMAC) in New Orleans for enlisted men and from the Personnel Diary Section, PERS-3614, in Washington, D.C. for officers. The daily results were aggregated by month for purposes of this analysis. This provided a measure of active duty Navy strength in the SDNC for each of the 13 months of observation and established a basis for studying the relationship between the size and configuration of the fleet and MILPERS workload.

Analysis of Waterfront Operations (WATEROPS) Department Demand

The analysis of fleet demand on WATEROPS focused on the ship type and the service category as indicators of the source and intensity of demand. Average demand rates and standard deviations were computed for each ship type receiving service in each service category. This involved looking at 116 ships, 25 ship types, and 3 service categories. The demand rate for a ship was measured in "hours of tug, LCM, and oiler service per day in port." Demand data were compiled for ships within a type for the entire year (1975). If a ship was in port for 15 days or more during 3 consecutive months, data for that ship were included in the calculations.[5] The demand rate for a ship was calculated by dividing the number of hours of service received in each service category by the total number of days in port during 1975. The demand rates for all ships within a given type and service category were then averaged to obtain the average demand rate for a ship of that type and service category.

As a general rule, I/O analysts strive for the maximum amount of disaggregation possible when constructing an I/O model. Use of aggregation results in loss of the ability to direct impacts to particular functions within an industry or activity. However, consolidation may be useful when there is a need to focus attention on one or two particular areas or a desire to economize on processing costs. It may be necessary when data on inputs into or outputs from some or all of the constituents are not available or incomplete, but data for the composite measure are obtainable.

---

[5]Exclusions of ship data were made to eliminate possible outliers or data extremes. The exclusion process limited the data base to predominately San Diego-homeported ships. "In port," in our analysis, is defined as being docked or on local operations in the San Diego area.

In structuring the Navy shore workload I/O model, it is desirable to aggregate the three WATEROPS service categories, because Navy data do not trace inputs (requisitions, etc.) beyond the major department level. It is impossible, for example, to tell how many requisitions are required to produce an hour of tug service. Because the outputs of the service categories are all measured in terms of "hours of port service," average demand rates and standard deviations were calculated for each ship type receiving service using this new, consolidated workload measure.[6] These demand rates were derived by summing the individual ship demand rates (hours per day in port) for each of the three service categories, and then averaging over each ship type.

While aggregation may be necessary if input data to some of the constituents are not known, it may also be beneficial by improving the accuracy of the forecasts of the various "final demand" specifications imposed on an I/O model. This hypothesis was tested in the case of final demands from the fleet on WATEROPS. Forecasting accuracy was measured in terms of the relative variance of demands within a ship type. Relative variance was calculated by dividing the standard deviation of demands of ships within a ship type by the aggregate mean demand rate for ships within that type. Aggregation is helpful if the relative variance of port service average demand rate for a ship type is less than those of the three service categories.

Analysis of Military Personnel (MILPERS) Department Demand

The analysis of demands on MILPERS concentrated on deriving a coefficient relating total monthly actions and its driving factor, "fleet people days per month." A mean coefficient and standard deviation were calculated by averaging the coefficient for each of the 13 months observed. An attempt was made to reduce the variation in the coefficient by removing seasonal influences. Intuitively, it was anticipated that coefficients derived during the holiday periods (November-January) would be unreasonably low because of the reduced number of personnel actions and inflated numbers of fleet people days.

---

[6] Blanco and Rowe, in their paper entitled Problems and benefits of aggregation in a Navy workload forecasting input-output model, which was presented at the joint national meeting of the Operations Research Society of America and the Institute of Management Sciences, May 1977, San Francisco, discussed the justification for aggregation in I/O models. They determined that aggregation of the three service categories of the WATEROPS Department was allowable on the basis that their outputs were consumed in the relatively same proportion during the four quarters of 1975.

RESULTS

Waterfront Operations (WATEROPS) Department Demand

The initial processing of WATEROPS data involved isolating the demand of each ship for each type of service provided. During 1975, over 227 ships in 47 different ship types received some form of WATEROPS service. WATEROPS provided 7499 and 1475 hours of tug and LCM service, respectively, and an estimated 2479 hours of oil service.

Largest Customers

As indicated previously, NAVSTA provides four types of tug services to the fleet: assistance in ship arrival, assistance in ship departure, rearrangement of a berthing configuration ("holdoff"), and moving a ship from one berth to another ("move"). A breakdown of tug workload by type of service in 1975 is presented in Table 1.

Table 1

Distribution of Tug Service Workload
NAVSTA, San Diego, 1975

Type of Tug Service	Hours of Service	Percent of Total Hours
Arrivals	1382	18
Departures	1413	19
Moves	2834	38
Holdoffs	1870	25
Total	7499	100

When ships were aggregated by type, it was found that the largest customers of tug services were frigates (FFs), nuclear submarines (SSNs), dock landing ships (LSDs), destroyers (DDs), and cruisers (CGs), in that order. These five ship types accounted for 43 percent of tug service demand. The hours of tug service for these ship types are included in Table 2.

Table 2

Tug Service Customers
NAVSTA, San Diego, 1975

Ship Type	Number of Ships Observed in Type	Total Hours Expended	Percent of Total Hours
FF	19	1137	15.2
SSN	15	625	8.3
LSD	7	502	6.7
DD	22	494	6.6
CG	8	483	6.4
All others	156	4258	56.8
Total	227	7499	100.0

WATEROPS provides four types of landing craft, mechanized (LCM) services, with "donut" control (oil separtion) accounting for 83 percent (1219 hours) of LCM demand. The other services are paint float movement, "camel" delivery (ship separator placement), and ship assistance. Analysis of LCM demand revealed that the five largest LCM customers were frigates (FFs), destroyers (DDs), tank landing ships (LSTs), guided missile destroyers (DDGs), and dock landing ships (LSDs), in that order. These ships (N = 67) accounted for approximately 53 percent of all LCM workload during 1975. The LCM hours for these ship types are included in Table 3.

Table 3

LCM Service Customers
NAVSTA, San Diego, 1975

Ship Type	Number of Ships Observed in Type	Total Hours Expended	Percent of Total Hours
FF	19	251	17.0
DD	20	183	12.4
LST	10	135	9.1
DDG	11	110	7.5
LSD	7	107	7.3
All others	54	689	46.7
Total	121	1475	100.0

Finally, WATEROPS oiler service consists of either pumping oil off of a ship ("pump-off") or taking oil onto an oiler ("pump-on") at the Naval Fuel Facility (NFF). Roughly 78 percent (1945 hours) of total oiler hours is spent performing the former service. During 1975, 22 ship types received "pump-off" oiler service, but demands from only five accounted for an estimated 53 percent of that workload. The "pump-off" oiler workload attributable to those ship types is included in Table 4.

Table 4

Oiler "Pump-Off" Customers
NAVSTA, San Diego, 1975

Ship Type	Number of Ships Observed in Type	Total Hours Expended[a]	Percent of Total Hours
FF	19	266	13.7
CG	8	202	10.4
DD	19	193	9.9
LSD	7	189	9.7
DDG	9	185	9.5
All others	52	910	46.8
Total	114	1945	100.0

[a]These oiler service hours are estimates derived by multiplying the total number of oiler actions for each ship type by an average hour expenditure per action obtained from a sample of oiler crew logs.

Average Demand Rates

As indicated previously, the analysis of fleet demand on WATEROPS identified the ship type and the service category as determinants of that demand. Average demand rates (hours of service per day in port) and standard deviations were calculated for each ship type and service category. Calculations included data only for those ships that were in port for 15 days or more during 3 consecutive months. Results appear in Table 5.

Although ships of the same type and service category generally had similar demand patterns during 1975, there were some exceptions. First, for some ship types, there were not enough ships in the data base to conclude that all ships of a type had similar workload demands. For example, in the oiler service category, only one ship was observed in 5 of the 19 ship types. Similar deficiencies occurred in the other categories. Second, in the tug service category, 5 of the 21 ship types observed having two or more ships had a standard deviation of over 40 percent of their mean demand rate (last column). Again, this problem was equally troublesome in the other two service categories. Finally, the oiler service rates, while not erratic, might have been more reliable if it were not necessary to depend on estimates of oiler service hours, which themselves were variable.

Table 5

Average Service Hours Per Day in Port by Ship Type--NAVSTA, San Diego, 1975

Symbol	Ship Type	Demand Rate	S.D.	No. Ships[a] Observed in Type	Percent Relative Variance (S.D.÷ Demand Rate x 100)
	Tug Service				
AD	Destroyer Tender	0.17	0.12	3	71
AGSS	Auxiliary Submarine	0.03	0.00	1	0
AR	Repair Ship	0.19	0.03	2	16
AS	Submarine Tender	0.09	0.01	2	11
ASR	Submarine Rescue Ship	0.25	0.30	2	120
ATF	Fleet Ocean Tug	0.04	0.04	8	100
AO	Oiler	0.58	0.19	2	33
CG	Guided Missile Cruiser	0.31	0.20	8	65
CGN	Guided Missile Cruiser, Nuclear	0.39	0.00	1	0
CVA	Attack Aircraft Carrier	0.93	0.09	2	10
DD	Destroyer	0.22	0.07	9	32
DDG	Guided Missile Destroyer	0.21	0.05	8	24
FF	Frigate	0.35	0.10	19	29
FFG	Guided Missile Frigate	0.34	0.10	3	29
LCC	Amphibious Command Ship	0.33	0.00	1	0
LKA	Amphibious Cargo Ship	0.53	0.12	4	23
LPA	Amphibious Transport	0.49	0.00	1	0
LPD	Amphibious Transport Dock	0.38	0.05	6	13
LPH	Amphibious Assault Ship	0.38	0.14	3	37
LSD	Dock Landing Ship	0.46	0.12	7	26
LST	Tank Landing Ship	0.17	0.04	8	24
MSO	Ocean Minesweeper	0.04	0.00	2	0
PG	Patrol Gunboat	0.01	0.00	2	0
SS	Submarine	0.06	0.05	4	83
SSN	Submarine (Nuclear)	0.37	0.14	8	38
Total				116	
	LCM Service				
AD	Destroyer Tender	0.13	0.02	3	15
AR	Repair Ship	0.14	0.04	2	29
ASR	Submarine Rescue Ship	0.03	0.01	2	33
ATF	Fleet Ocean Tug	0.05	0.02	8	40
CG	Guided Missile Cruiser	0.08	0.05	7	63
DD	Destroyer	0.08	0.02	9	25
DDG	Guided Missile Destroyer	0.07	0.03	8	43
FF	Frigate	0.08	0.04	19	50
FFG	Guided Missile Frigate	0.08	0.01	3	13
LCC	Amphibious Command Ship	0.65	0.00	1	0
LKA	Amphibious Cargo Ship	0.07	0.02	4	29
LPA	Amphibious Transport	0.13	0.00	1	0
LPD	Amphibious Transport Dock	0.06	0.02	6	33
LPH	Amphibious Assault Ship	0.09	0.05	3	56
LSD	Dock Landing Ship	0.09	0.03	7	33
LST	Tank Landing Ship	0.08	0.07	8	88
MSO	Ocean Minesweeper	0.04	0.01	2	25
PG	Patrol Gunboat	0.02	0.00	2	0
Total				95	

[a]Number of ships observed in type included in this table do not agree with those shown in Tables 2, 3, and 4 since average demand rate computations included data only for those ships that were in port for 15 days or more during 3 consecutive months.

Table 5 (Continued)

Symbol	Ship Type	Demand Rate	S.D.	No. Ships[a] Observed in Type	Percent Relative Variance (S.D. ÷ Demand Rate x 100)
	Oiler Service				
AD	Destroyer Tender	0.07	0.04	3	57
AR	Repair Ship	0.06	0.03	2	50
ASR	Submarine Rescue Ship	0.04	0.00	1	0
ATF	Fleet Ocean Tug	0.03	0.00	2	0
CG	Guided Missile Cruiser	0.13	0.06	8	46
CGN	Guided Missile Cruiser, Nuclear	0.01	0.00	1	0
CVA	Attack Aircraft Carrier	0.78	0.33	2	42
DD	Destroyer	0.09	0.03	9	33
DDG	Guided Missile Destroyer	0.12	0.04	7	33
FF	Frigate	0.08	0.03	18	38
FFG	Guided Missile Frigate	0.09	0.01	3	11
LCC	Amphibious Command Ship	0.10	0.00	1	0
LKA	Amphibious Cargo Ship	0.15	0.07	4	47
LPA	Amphibious Transport	0.18	0.00	1	0
LPD	Amphibious Transport, Dock	0.13	0.05	6	38
LPH	Amphibious Assault Ship	0.17	0.11	3	65
LSD	Dock Landing Ship	0.16	0.09	7	56
LST	Tank Landing Ship	0.06	0.03	8	50
MSO	Ocean Minesweeper	0.02	0.00	1	0
Total				87	
	Port Service (Aggregation of Tug, LCM, and Oiler Service)				
AD	Destroyer Tender	0.37	0.16	3	44
AGSS	Auxiliary Submarine	0.03	0.00	1	0
AR	Repair Ship	0.39	0.02	2	5
AS	Submarine Tender	0.09	0.01	2	11
ASR	Submarine Rescue Ship	0.30	0.35	2	115
ATF	Fleet Ocean Tug	0.10	0.06	8	60
AO	Oiler	0.58	0.19	2	33
CG	Guided Missile Cruiser	0.52	0.22	8	43
CGN	Guided Missile Cruiser, Nuclear	0.40	0.00	1	0
CVA	Attack Aircraft Carrier	1.71	0.43	2	25
DD	Destroyer	0.39	0.08	9	21
DDG	Guided Missile Destroyer	0.39	0.08	8	21
FF	Frigate	0.51	0.13	19	25
FFG	Guided Missile Frigate	0.50	0.10	3	20
LCC	Amphibious Command Ship	1.08	0.00	1	0
LKA	Amphibious Cargo Ship	0.75	0.18	4	24
LPA	Amphibious Transport	0.70	0.00	1	0
LPD	Amphibious Transport Dock	0.56	0.11	6	19
LPH	Amphibious Assault Ship	0.64	0.18	3	28
LSD	Dock Landing Ship	0.71	0.20	7	28
LST	Tank Landing Ship	0.31	0.07	8	23
MSO	Ocean Minesweeper	0.09	0.01	2	11
PG	Patrol Gunboat	0.03	0.00	2	0
SS	Submarine	0.06	0.05	4	83
SSN	Submarine, Nuclear	0.37	0.14	8	38
Total				116	

[a]Number of ships observed in type included in this table do not agree with those shown in Tables 2, 3, and 4 since average demand rate calculations included data *only* for those ships that were in port for 15 days or more during 3 consecutive months.

Demand Aggregation

Because data on productive inputs to each of the three individual service categories were not available, the outputs of those categories were summed to form the aggregate WATEROPS workload measure "hours of port service." Average demand rates and standard deviations calculated for each ship type using this consolidated measure appear in Table 5, along with measures of the relative variance of each demand rate. When the relative variance of the aggregate or port service average demand rate for a ship type is compared to that of the three service categories individually, it is hypothesized that it would be smaller, indicating an improvement in the accuracy of "final demand" forecasting as a result of using the consolidated demand rate. To test this hypothesis, the demand rates, standard deviations, and relative variances computed for four large ship types--DDs, DDGs, FFs, and LSTs--for the WATEROPS service categories shown in Table 5 were compared. Results are shown in Table 6, which indicates that aggregation indeed was beneficial; that is, the relative variance for the port service category is smallest in all four cases.

In several other ship types, the relative variance of the aggregate demand rate was less than two of the relative variance of any of the constituents, indicating that aggregation is still quite useful. Even in cases where there was little or no reduction in relative variance, aggregation should not necessarily be discarded. Such results simply indicate that an often useful derivative of aggregation is not applicable under such conditions.

Military Personnel (MILPERS) Demand

Military personnel actions were classified as either (1) gains or losses to the Navy (reenlistments, retirements) or (2) gains or losses to the activity (e.g., PCS, TAD, etc.). In addition, data were gathered to indicate whether the action was of a disciplinary nature. Results appear in Table 7. As shown, during the 13-month observation period, 42,772 personnel actions were processed by MILPERS, 73 percent of which were activity related. Nearly 90 percent of the actions were nondisciplinary.

The coefficient (which links demand with the demand population) to be used as the demand indicator for the MILPERS sector of the I/O model was obtained by (1) computing a ratio relating the number of personnel actions per fleet people day for each of the 13 months of data, and (2) averaging these monthly coefficients to derive a mean monthly demand rate (coefficient) of .0051.

Several attempts were made to reduce variation in that mean demand rate by removing seasonal fluctuation. This consisted of little more than simplistic "smoothing," since the lack of sufficient data precluded any sophisticated analysis. In the first attempt, the mean coefficient was recalculated after removing the data for the observations for the three seasonally effected months (November and December 1975; January 1976). This smoothing process increased the mean monthly coefficient to .0055 and reduced the relative variance from 20 to 15 percent (a 25% reduction). In the second attempt, the seasonal influence was eliminated by substituting the coefficients for the three "seasonal" months with the average of the 10 remaining observations. This method also increased the mean coefficient to .0055; further, it decreased the relative variance to only 13 percent. As more data becomes available, further attempts to eliminate seasonal and other variations can be made.

Table 6

Comparison of Statistics for WATEROPS Service Categories for Selected Ship Types, NAVSTA, San Diego, 1975

Ship Type	Service Category	Demand Rate	Standard Deviation	No. Ships Observed in Type	Percent Relative Variance (S.D. ÷ Demand Rate x 100)
DD	Tug	0.22	0.07	9	32
	LCM	0.08	0.02	9	25
	Oiler	0.09	0.03	9	33
	Port Service	0.39	0.08	9	21
DDG	Tug	0.21	0.05	8	24
	LCM	0.07	0.03	8	43
	Oiler	0.12	0.04	7	33
	Port Service	0.39	0.08	8	21
FF	Tug	0.35	0.10	19	29
	LCM	0.08	0.04	19	50
	Oiler	0.08	0.03	18	38
	Port Service	0.51	0.13	19	25
LST	Tug	0.17	0.04	8	24
	LCM	0.08	0.07	8	88
	Oiler	0.06	0.03	8	50
	Port Service	0.31	0.07	8	23

Table 7

Personnel Actions Processed, MILPERS, NAVSTA, San Diego
(March 1975-March 1976)

Personnel Action	Number Observed			Percent of Total		
Navy-related						
Gain:						
Nondisciplinary	1020			2.4		
Disciplinary	648			1.5		
Total		1668			3.9	
Loss:						
Nondisciplinary	8867			20.7		
Disciplinary	1009			2.4		
Total		9876			23.1	
Total--Navy			11544			27.0
Activity-related						
Gain:						
Nondisciplinary	17708			41.4		
Disciplinary	1882			4.4		
Total		19590			45.8	
Loss:						
Nondisciplinary	10510			24.6		
Disciplinary	1128			2.6		
Total		11638			27.2	
Total--Activity			31228			73.0
GRAND TOTAL			42772			100.0

The three mean coefficients, and their related statistics, appear in Table 8.

Table 8

Mean Coefficients Computed for
MILPERS Actions per Fleet People Day
NAVSTA, San Diego (March 1975-March 1976)

Mean Monthly	Value	Standard Deviation	No. Mos.	Percent Relative Variance (S.D. ÷ Value x 100)
1	.0051	.0010	13	20
2	.0055	.0009	10	15
3	.0055	.0007	13	13

CONCLUSIONS

The analysis of demands on the Naval Station, San Diego (NAVSTA, San Diego) permits some general conclusions on the feasibility of building an input-output (I/O) model of the fleet-support demand network.

1. Data exist in several forms in several locations to measure a variety of demands on NAVSTA, San Diego. Although these data will fit into an I/O framework, collection and analysis of the data are difficult and expensive. For example, computerized Waterfront Operations (WATEROPS) workload data were obtained on a "one time" basis by contract. To update those data in the future may require extracting and organizing data from numerous flat paper reports from NAVSTA, San Diego itself.

2. An I/O model of a national economy or of a Navy fleet-support network is divided into sectors. In the case of a national model, sectors generally represent industries (automobiles, textiles, etc.) producing a single, measureable output. Similarly, it was originally hoped that each sector in the Navy shore workload forecasting I/O model would be one of the 10 activities mentioned above. However, this analysis of the workload indicates that at least two major outputs exist at NAVSTA, San Diego. Consequently, the I/O model should have at least two sectors representing these two major workload areas.

3. Since ship type clearly affected demands placed on WATEROPS, the I/O model must not ignore the differences in workload attributable to, for example, a submarine vs. an aircraft carrier.

4. The results of this study will be used to develop I/O coefficients for the NAVSTA, San Diego sectors of the I/O model. These results will be used in combination with results from analyses of demands on other major shore activities. For example, an I/O coefficient relating WATEROPS and the Naval Supply Center, San Diego might be measured in units of requisitions of supply per hour of port service.

5. Since WATEROPS services primarily San Diego-homeported ships, changing the homeport of ships is very likely to affect the workload of that department. Such changes could, in turn, affect MILPERS workload by altering the number of fleet people days per month at NAVSTA, San Diego.

6. Because the services provided and workload generated by naval stations tend to reflect the particular port complex in which they reside, it may be difficult to use this analysis to represent other naval stations as part of a Navy-wide I/O model. Consequently, it may be necessary to perform similar kinds of analyses for other naval stations.

RECOMMENDATIONS

1. The variance in the MILPERS demand coefficient was reduced by removing some of the seasonal influence. Since it may be possible to further diminish this variability by employing more sophisticated statistical techniques, data collection should continue to provide sufficient data necessary for such techniques.

2. A naval station's workload varies in terms of the functions it provides to the fleet and the particular port complex it resides. Thus, it is recommended that similar kinds of analyses be performed at other naval stations before this community is included in a Navy-wide I/O model.

BIBLIOGRAPHY

Blanco, T. A. Analysis of fleet and shore demands on the Naval Supply Center, San Diego (NPRDC Tech. Rep. 76TQ-39). San Diego: Navy Personnel Research and Development Center, June 1976. (AD-A035 589)

Blanco, T. A., & Rowe, M. W. Analysis of demands on the Naval Air Rework Facility, North Island (NPRDC Tech. Rep. 77-21). San Diego: Navy Personnel Research and Development Center, March 1977. (AD-A037 799)

Blanco, T. A., & Rowe, M. W. Analysis on demands on the San Diego-based Intermediate Maintenance Activities (NPRDC Tech. Rep. 78-1). San Diego: Navy Personnel Research and Development Center, November 1977. (AD-046 610)

Bokesch, W. M., & Wertz, D. A. Analysis of demands on the Naval Air Station, Miramar, CA (NPRDC Tech. Rep. 77-44). San Diego: Navy Personnel Research and Development Center, September 1977. (AD-A045 560)

Chipman, M. Analysis of demands on the Naval Regional Medical Center, San Diego (NPRDC Tech. Rep. 77-23). San Diego: Navy Personnel Research and Development Center, April 1977. (AD-A038 419)

Rowe, M. W. Analysis of demands on the Long Beach Naval Shipyard (NPRDC Tech. Rep. 77-7). San Diego: Navy Personnel Research and Development Center, December 1976. (AD-A038 842)

Whisman, A. W. Analysis of demands on the Navy Public Works Center, San Diego (NPRDC Tech. Rep. 78-2). San Diego: Navy Personnel Research and Development Center, October 1977. (AD-046 593)

DISTRIBUTION LIST

Assistant Secretary of the Navy (Manpower, Reserve Affairs and Logistics)
Principal Deputy Assistant Secretary of the Navy (Manpower and Reserve Affairs)
Chief of Naval Operations (OP-987H), (OP-964D)
Chief of Naval Personnel (Pers-10c), (Pers-04), (Pers-2B)
Chief of Naval Research (Code 450) (4)
Chief of Information (OI-2252)
Director of Navy Laboratories
Commandant of the Marine Corps (Code MPI-20)
Chief of Naval Education and Training (N-5)
Chief of Naval Technical Training (Code 016)
Chief of Naval Education and Training Support
Commander, Naval Data Automation Command
Commanding Officer, Naval Development and Training Center (Code 0120)
Commanding Officer, Naval Station, San Diego
Director, Training Analysis and Evaluation Group (TAEG)
Personnel Research Division, Air Force Human Resources Laboratory (AFSC), Brooks Air Force Base
Occupational and Manpower Research Division, Air Force Human Resources Laboratory (AFSC), Brooks Air Force Base
Technical Library, Air Force Human Resources Laboratory (AFSC), Brooks Air Force Base
Technical Training Division, Air Force Human Resources Laboratory, Lowry Air Force Base
Flying Training Division, Air Force Human Resources Laboratory, Williams Air Force Base
Advanced Systems Division, Air Force Human Resources Laboratory, Wright-Patterson Air Force Base
Program Manager, Life Sciences Directorate, Air Force Office of Scientific Research (AFSC)
Army Research Institute for the Behavioral and Social Sciences
Military Assistant for Training and Personnel Technology, Office of the Under Secretary of Defense for Research and Engineering
Director for Acquisition Planning, OASD(MRA&L)
Library Operations Section, Library of Congress
Coast Guard Headquarters (G-P-1/62)
Defense Documentation Center (12)