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SUPPLY WORKLOAD IMPLICATIONS OF INCREASED DEPLOYMENT TO THE INDIAN OCEAN

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ABSTRACT

A Pacific Fleet Logistics Model has been developed to forecast the changes in workload on the Navy's Pacific supply centers and depots caused by changes in fleet size, fleet configuration, and deployment pattern. This report describes the verification and validation of the model by using actual homeporting and employment schedules. Projected supply workload results are presented to determine the effects of increased deployment to the Indian Ocean.

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FOREWORD

The research and development was conducted in support of Navy Decision Coordinating Paper Z1186-PN (Impact of Fleet Configuration on Requirements for Support Manpower), subproject Z1186-PN.02 (Forecasting Shore Activity Workload from Fleet Configuration), under the sponsorship of the Deputy Chief of Naval Operations (Manpower, Personnel, and Training). The objective of this subproject is to predict shore activity level manpower resources as a function of workload and operational force levels.

The report is the twelfth in a series relating to the allocation of manpower resources. The first eight (NPRDC Tech. Reps. 76TQ-39, 77-21, 77-23, 77-26, 77-44, 78-1, 78-2, and 78-7) documented the empirical analyses of fleet and shore demands placed on major shore activities in the 11th Naval District. The ninth and tenth (NPRDC Tech. Rep. 78-32 and Tech. Note 79-7) documented the development of an interactive input-output (I/O) model of the fleet-support demand network for these activities. The 11th Naval District model has been used for workload projection and budget justification purposes at the Naval Supply Center, San Diego. The eleventh (NPRDC Tech. Note 80-16) documented the development of an I/O model of the fleet-logistics support demand network for 30 major supply and maintenance sectors within the Pacific Fleet. The Pacific Fleet Logistics Model can be used by logistics managers to test the effects of major changes in policies concerning fleet homeporting and employment schedules on supply workload in the Pacific Fleet.

This report describes the verification and validation of the Pacific Fleet Logistics Model by using actual homeporting and employment schedules. Projected supply workload results are presented to determine the effects of increased deployment to the Indian Ocean. These projected results have been used in allocating resources by supply resource sponsors for POM-83.

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SUMMARY

Problem

Since the beginning of FY 1980, the Navy's extended deployments to the Indian Ocean area have caused dramatic shifts in workload for supply centers and depots. If the Navy is to sustain its presence in the Indian Ocean area over the next several years, questions concerning the efficient allocation of supply resources must be addressed. The following factors affect the supply workload in the Pacific region and must be considered: (1) the level of indirect fleet demand for supply support, (2) the homeporting "scenarios," (3) the operating tempo of the fleet, and (4) the level of maintenance support.

Objective

The objectives of this effort were to (1) verify the Pacific Fleet (PACFLT) Logistics Model using actual FY 1978 workload data, (2) test the model's ability to forecast accurately the impact that changes in deployment patterns have on the number of supply requisitions using actual FY 1980 ship employment data, and (3) project workload for the seven PACFLT supply centers and depots for FY 1981 and FY 1985.

Approach

The PACFLT Logistics Model was used to test the effect of changes in deployment patterns on supply activity workload. The model forecasts supply workload, in terms of number of requisition demands, at the seven supply centers and depots, given a specific fleet configuration and operating schedule.

Results

The results verify the ability of the PACFLT Logistics Model to model workload given fleet configuration and operating schedule. The validation of the model was also successful. The model projected workload changes at the supply centers and depots from FY 1978 to FY 1980 in a reasonably accurate manner.

The projected FY 1981 and FY 1985 results showed the need for a shift of supply resources from supply centers (especially San Diego) to supply depots (especially Subic Bay) if the Navy continues to maintain a significant presence in the Indian Ocean area.

Conclusions and Future Direction

The validity of the PACFLT Logistics Model for forecasting supply activity workload was demonstrated using historical data. Projected results have been used in allocating resources by supply resource sponsors for POM-83.

The model currently forecasts supply workload, given fleet configuration, operating schedules, and maintenance man-days at shipyards, ship repair facilities, and intermediate maintenance activities. A planned extension of this work will enable the model to forecast intermediate maintenance workload.

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INTRODUCTION

Background

The Navy's supply system in the Pacific Ocean region is a complex network whose purpose is to support the operating fleet anywhere from the east coast of Africa to the west coast of the continental United States (CONUS). This network consists of the naval supply centers (NSCs) at San Diego, Oakland, Pearl Harbor, and Puget Sound; the naval supply depots (NSDs) at Subic Bay, Guam, and Yokosuka; and all Pacific Fleet (PACFLT) combat store ships (AFSs).

In general, when a ship is operating between Pearl Harbor and CONUS, it is supplied by the nearest NSC. However, when a ship is deployed to the Western Pacific (WESTPAC), its first line of supply is from an AFS and its second line, from the nearest NSD; the ship can also be supplied directly from NSC Oakland. Similarly, AFS ships are replenished from either NSD Subic Bay or NSD Yokosuka, while NSDs are replenished from NSC Oakland. NSC Oakland plays a dual role in the supply network; it directly supports Oakland homeported ships operating in the vicinity, as well as ships operating in WESTPAC, either directly or indirectly. The PACFLT supply requisition network is illustrated in Figure 1.

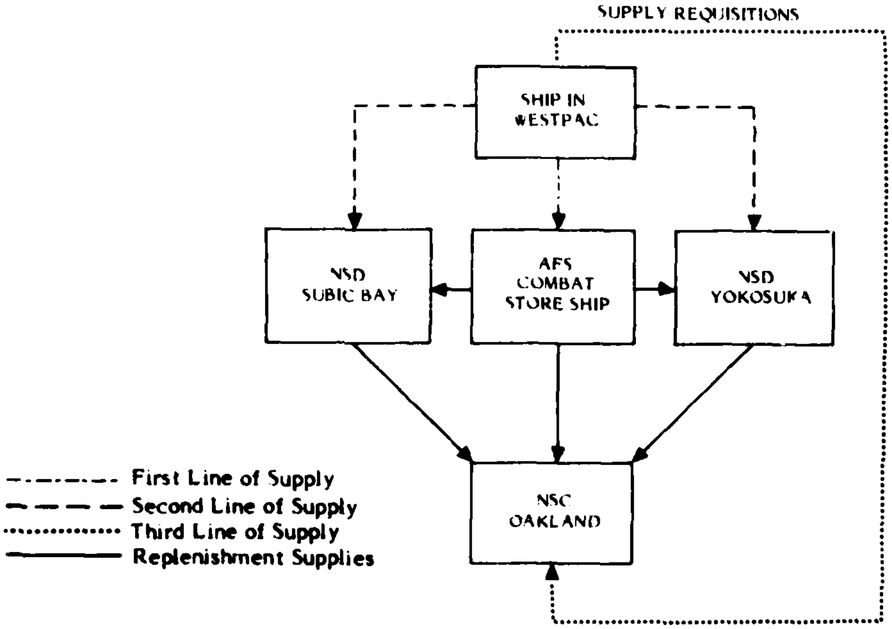

Figure 1. Pacific Fleet supply requisition network for ships operating in WESTPAC

[illegible]

Since the beginning of FY 1980, and owing to events in the Middle East, the U.S. Navy has had to adjust the operating schedule of its fleet to cover extended deployments to the Indian Ocean area. The changes in deployment patterns have caused dramatic shifts in workload for supply centers and depots, among other activities. If the Navy is to sustain its presence in the Indian Ocean area over the next several years, consideration must be given to several factors that affect the efficient allocation of supply resources. These include (1) the level of indirect fleet demand for supply support, (2) the homeporting "scenarios," (3) the operating tempo of the fleet, and (4) the level of maintenance support. All of these factors affect the supply workload in the Pacific region. Consequently, before the Navy can determine the budget and manpower needed for each of the seven PACFLT supply centers and depots, their respective workloads, given a specific fleet configuration, operating schedule, and indirect fleet demands channeled through other shore activities, must be determined.

In case of indirect fleet demands, it is worth noting that a significant amount of the demands come from shipyards and ship repair facilities (SRFs). Increased shipyard supply requisitions in support of additional ship overhauls constitute but a single example of an indirect fleet demand on the supply system.

The question of homeporting becomes particularly important when there are increases in fleet size and changes in operating schedules to cover extended deployments to the Indian Ocean area. For instance, we must know the impact of increased ship deployments to the Indian Ocean on time spent in homeport. If deployed ships spend less time in homeport, we can expect differential changes in the workloads of NSCs. In this regard, the most interesting case is NSC Oakland, because of its role in supporting WESTPAC visitor ships, depots, and repair facilities, in addition to Oakland-homeported ships.

The operating tempo of the fleet clearly affects the workload at the various shipyards. If ships are spending less time in their homeport area, scheduled overhauls may have to be postponed. As overhaul schedules are delayed, the Supply Operations Assistance Program (SOAP) will also have to be delayed. In any event, it is necessary to determine the impact of the shipyards' workload on the supply centers in terms of shipyard supply requisitions.

If the fleet is to maintain an adequate level of operating readiness, more maintenance work at the intermediate and restricted availability levels will have to be performed by deployed tenders, repair ships, and ship repair facilities (SRFs). It is not certain that existing Navy facilities, especially SRF Subic Bay, will be able to handle the extra workload. Nor is it clear that NSD Subic Bay will be able to support the additional demands from SRF Subic Bay, tenders, and repair ships.

To determine whether the Navy's presence in the Indian Ocean area would result in the degradation of supply support, the effects of the changes in deployment schedules and shifts in the allocation of supply resources must be measured. The PACFLT Logistics Model was used to test the effects of changes in deployment patterns on supply activity workload (see Blanco, Kissler, and Woon, 1980). The model forecasts supply workload, in terms of number of requisition demands, at the seven supply centers and depots, given a specific fleet configuration and operating schedule.

Objectives

The objectives of this effort were to (1) verify the PACFLT Logistics Model using actual FY 1978 workload data, (2) determine the model's ability to forecast accurately the impact that changes in deployment patterns have on the number of supply requisitions using actual FY 1980 ship employment data, and (3) project workload for the seven NSCs and NSDs for FY 1981 and FY 1985.

MODEL VERIFICATION

The PACFLT Logistics Model forecasts workload at various supply activities, given fleet size, mix, and operating schedule. The model employs an input-output (I/O) analysis framework that captures the interdependence of support workload and, as a result, the direct and indirect demands placed on the supply centers and depots. The model contains 30 economic sectors: 11 supply and 19 maintenance. The units of workload measure are the number of requisitions for the supply sectors and the number of man-days for the maintenance sectors.

The current version of the model forecasts workload at the seven PACFLT supply centers and depots based on projected fleet homeporting, employment schedules, and maintenance workload at shipyards, SRFs, and ship intermediate maintenance activities (IMAs). The model is designed to operate interactively from a computer terminal in a conversational mode. Through a series of commands, the user is able to modify the imputs to the model and then project the resultant workload for each sector.

Historical data from FY 1978 were used to verify the internal operations of the PACFLT Logistics Model. Actual supply workload from the Supply Distribution and Inventory Control Operations Report (NAVSUP 1144) was compared with the model's projected results for the seven supply centers and depots.[1]

The following assumptions/data and sources were used as imput to verify the I/O model for FY 1978:

1. Data on homeporting of ships by class and number were obtained from Commander in Chief, U.S. Pacific Fleet (CINCPACFLT).

2. Actual employment schedules were used to calculate days in port, days deployed, and days in overhaul.

3. All overhauled ships participate in the Supply Operations Assistance Program (SOAP).

4. Actual ship repair man-days were used for all shore intermediate maintenance sectors.

Total workload for each supply center and depot is accounted for by summing up individual workload components. There are three basic workload components: the economic (i.e., I/O) sectors, the fleet (both homeported and visitor ships), and miscellaneous "throughputs" of major shore activities. Table 1 compares actual workload, in terms of standard stock requisition demands, with the projected model results by workload component. The percent difference for each supply center and depot may be attibutable to the use of averages for computing requisition demand rates and average days in port/deployed for each ship class. However, the results do verify the ability of the I/O model to model workload, given fleet configuration and operating schedule.

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[1] Line 3 of the 1144 report summarizes requisitions for standard stock items.

Table 1

Naval Supply Centers and Depots
Sector Component Comparision, FY 1978
(Number of Requisitions)

Item	Data From Line 3, 1144 Report N	%	Model Results	Percent Difference
NSC San Diego				
I-O Sectors	506,792	28.4	481,638	-4.9
SERVMART	148,112	8.3	144,132	-2.7
Fleet	669,179	37.5	644,357	-3.7
Throughput	460,395	25.8	438,368	-4.8
	1,784,478	100.0	1,708,495	-4.2
NSC Oakland				
I-O Sectors	632,422	30.9	636,349	0.6
Fleet	489,155	23.9	473,123	-3.3
Throughput	925,097	45.2	876,506	-5.3
	2,046,674	100.0	1,985,978	-2.9
NSC Puget Sound				
I-O Sectors	206,335	42.7	208,158	0.9
Fleet	143,999	29.8	138,713	-3.7
Throughput	132,886	27.5	138,134	3.9
	483,220	100.0	485,005	0.4
NSC Pearl Harbor				
I-O Sectors	154,502	24.4	155,177	0.4
SERVMART	63,954	10.1	63,684	-0.4
Fleet	193,761	30.6	186,734	-3.6
Throughput	220,989	34.9	230,862	4.5
	633,206	100.0	636,457	0.5
NSD Guam				
I-O Sectors	36,844	16.4	35,733	-3.0
Fleet	7,189	3.2	7,676	6.8
Throughput	180,624	80.4	196,328	8.7
	224,657	100.0	239,737	6.7
NSD Subic Bay				
I-O Sectors	199,022	20.8	197,820	-0.6
Fleet	333,933	34.9	313,249	-0.6
Throughput	423,875	44.3	409,028	-3.5
	956,830	100.0	920,097	-3.8
NSD Yokosuka				
I-O Sectors	125,223	32.9	123,094	-1.7
Fleet	111,521	29.3	109,616	-1.7
Throughput	143,873	37.8	150,105	4.3
	380,617	100.0	382,815	0.6

MODEL VALIDATION

Actual employment schedules for the first three quarters of FY 1980 were used to validate the model; that is, to test the model's forecasting accuracy. Of particular concern is the impact of increased deployment to the Indian Ocean in terms of changes in requisition workload.

Table 2 displays both the projected and actual workload changes from FY 1978 to FY 1980 for the seven supply centers and depots. As shown, the model projections reflected actual workload changes during this time period in a reasonably accurate manner.

Table 2

Actual and Projected Standard Stock Requisition Demand Workload Changes (FY 1978 to FY 1980) for Pacific Region Supply Centers and Depots

Activity	Actual Change		Projected Change	
	Amount	Percent	Amount	Percent
NSD Subic Bay	139,535	14.6	142,839	14.9
NSD Yokosuka	5,117	1.3	-7,787	-2.0
NSD Guam	-18,183	-8.1	-1,120	-0.5
NSC San Diego	-79,044	-4.4	-109,757	-6.1
NSC Oakland[a]	137,026	6.7	-44,698	-2.2
NSC Pearl Harbor	17,142	2.4	18,204	2.5
NSC Puget Sound	8,709	1.8	-5,239	-1.0

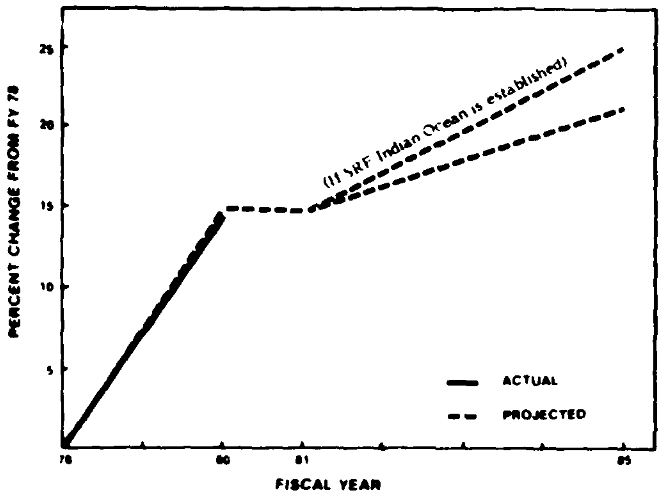
[a]Effects of NAS Alameda consolidation were not considered.

SUPPLY WORKLOAD FORECAST, FY 1981 - FY 1985

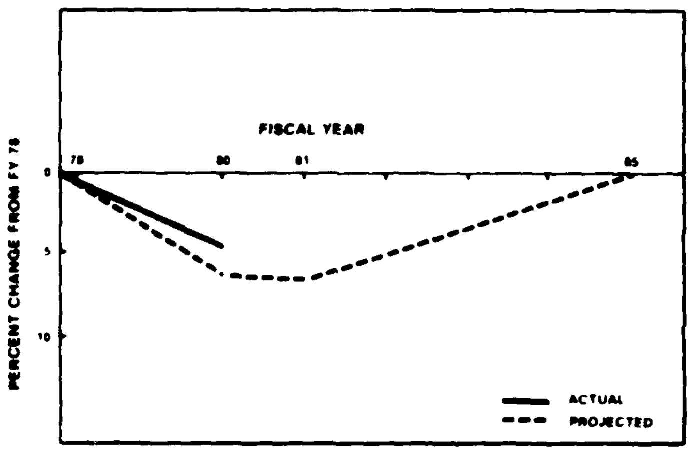
Once verified and validated, the PACFLT Logistics Model was used to make projections for FY 1981 and FY 1985 based on projected fleet configurations as of December 1980. Using FY 1978 as baseline data, actual and projected percentage workload changes for NSD Subic Bay, NSC San Diego, and NSC Pearl Harbor were computed. These are shown in Figure 2.

It is obvious that continued naval presence in the the Indian Ocean would have the greatest impact on NSD Subic Bay because of its supply mission and proximity to the area. The direct demands on NSD Subic Bay are largely caused by deployed ships. The indirect demands are a result of increased workload at SRF Subic Bay and increased employment of repair/tender/supply ships to support combat ships stationed in the Indian Ocean area.

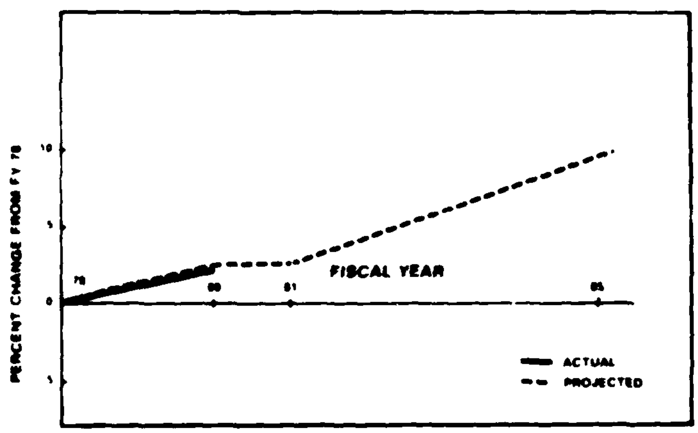
Table 3 summarizes the total number of PACFLT ships homeported and in overhaul for FYs 1978, 1980, 1981 and 1985. Although more than half (about 53%) of the PACFLT ships are homeported in San Diego, the direct demands on NSC San Diego decreased in FY 1980 because of fleet deployment in the Indian Ocean. The NSC San Diego indirect



a. NSD Subic Bay



b. NSC San Diego



c. NSC Pearl Harbor

Figure 2. Actual/projected percent workload changes--FY 1978-FY 1985.

demands also decreased because of the delay in overhaul schedules (9 ships in overhaul in FY 1980 versus 15 ships in overhaul in FY 1978) and the resultant decrease in shipyard requisitions.

Table 3

Total Number of Pacific Fleet Homeported and Overhauled Ships
FY 1978-FY 1985

Activity/Status	FY78 (Actual)	FY80 (Actual)	FY81 (Projected)	FY85 (Projected)
NSC Oakland:				
Homeported	21	21	20	17
Overhauled	11	6	4	4
Total	32	27	24	21
NSC Pearl Harbor:				
Homeported	40	43	47	49
Overhauled	7	5	6	4
Total	47	48	53	53
NSC Puget Sound:				
Homeported	11	8	7	4
Overhauled	11	9	13	6
Total	22	17	20	10
NSC San Diego:				
Homeported	107	106	98	115
Overhauled	15	9	13	14
Total	122	115	111	129
NSD Yokosuka:				
Homeported	7	6	8	8
Overhauled	1	2	1	0
Total	8	8	9	8

The operating tempo of the fleet in FY 1981 is a continuation of FY 1980 and, since the fleet configurations are similar in both years, the projected results are very close. Table 4 summarizes the projected percentage (%) workload changes for the seven supply centers and depots, from a high (increase) of 14.8 percent at NSD Subic Bay, to a low (decrease) of -6.4 percent at NSC San Diego.

The projected results at NSC Oakland for FY 1981 are a good example of the interdependence of support workload of the I/O approach. The requisition demands on NSC Oakland decreased as a result of Oakland-homeported ships spending less time in the homeport area. However, the decrease in workload is offset because of the direct and indirect support that NSC Oakland gives to WESTPAC operating ships (as shown in the

PACFLT supply network of Figure 1). The net effect on NSC Oakland is a decrease of only 2.2 percent from FY 1978 (excluding the effects of the NAS Alameda consolidation).

Table 4

Projected Changes in Standard Stock Requisition Demands on Naval Supply Centers and Depots--FY 1978 to FY 1981

	Projected Workload	
Activity	Amount Change	Percent Change
NSC San Diego	-114,955	-6.4
NSC Pearl Harbor	19,878	2.7
NSC Oakland	-44,132	-2.2
NSC Puget Sound	-1,541	-0.3
NSD Yokosuka	-18,094	-4.8
NSD Subic Bay	141,699	14.8
NSD Guam	-1,041	-0.5

FY 1981 projections for NSD Yokosuka showed a 4.8 percent decrease in workload under the *assumption* of increased Indian Ocean deployment. The impact on NSD Yokosuka is attributable to two reasons. First, direct supply requisitions from the fleet would decrease because (1) Yokosuka-homeported ships would spend more time away from the homeport area and (2) visitor ships, which usually spend some time in Yokosuka before moving toward Subic Bay, would be bypassing Yokosuka to a greater degree. Second, indirect supply requisitions would decrease as the result of the shifts of intermediate maintenance-level work performed by tenders and repair ships.

Table 5 shows the total man-days expended by tenders and repair ships by location. The FY 1978 and FY 1980 data are actual man-days expended. The FY 1981 and FY 1985 data are projected man-days based on proposed tender and repair ship long-term employment schedules and historical tender utilization at each location.

As the PACFLT presence in the Indian Ocean area increases, there is a shift in intermediate-level maintenance. From FY 1978 through FY 1985, intermediate-level maintenance at San Diego and Alameda decrease as resources in WESTPAC (including Diego Garcia) increase. Because of the activity in the Indian Ocean area in FY 1980, afloat intermediate-level maintenance resources in Subic Bay and Yokosuka were shifted to Diego Garcia, and there were no intermediate maintenance man-days expended in Yokosuka. In FY 1981, additional tenders and repair ships are projected to deploy to Yokosuka while intermediate-level maintenance activity continues at Diego Garcia.

Table 5

Total Man-Days Expended by Tenders and Repair Ships by Location
FY 1978-FY 1985

Activity	FY 1978 (Actual)	FY 1980 (Actual)	FY 1981 (Projected)	FY 1985 (Projected)
IMA San Diego	185,457	133,470	107,606	143,515
IMA Alameda	40,078	37,449	30,069	29,709
IMA Pearl Harbor	38,929	37,005	40,340	47,067
IMA Subic Bay (incl. Diego Garcia)	24,530	83,252	91,652	91,652
IMA Yokosuka	26,813	0	14,918	14,918
Total	315,807	291,176	284,585	326,861

The fleet size and mix are projected to change drastically by FY 1985 as new ships are built and older ships decommissioned. For example, San Diego would have 15 PERRY-class (FFG 7) frigates, as compared to 5 in FY 1981. Other new ships in the fleet include KIDD-class (DDG 993) guided missile destroyers and CALIFORNIA- and VIRGINIA-class nuclear-guided missile cruisers.

Because of the shifts in maintenance demands observed in FYs 1980 and 1981 and the increased fleet size expected in FY 1985, a significantly increased demand is placed on tenders and repair ships to perform intermediate maintenance workload in the Indian Ocean area. To relieve part of this heavy workload and increase readiness in the area, additional maintenance resources such as a ship repair facility (SRF) may be needed in the Indian Ocean area.

Based on this intermediate maintenance (IM) need, two separate scenarios were used for the FY 1985 projections: (1) no additional SRF capability, and (2) SRF Indian Ocean established. Scenario 2 assumes SRF Indian Ocean would accomplish 50 percent of the IM workload of SRF Subic Bay.

As the fleet size increases in FY 1985, and the Indian Ocean deployment pattern continues, the greatest impact is again on NSD Subic Bay. Projected results show a 21.2 percent increase in NSD Subic Bay workload (see Table 6), and, if an SRF Indian Ocean is established, NSD Subic Bay's workload would increase by another 3.8 percent to a total 25 percent increase from baseline FY 1978.

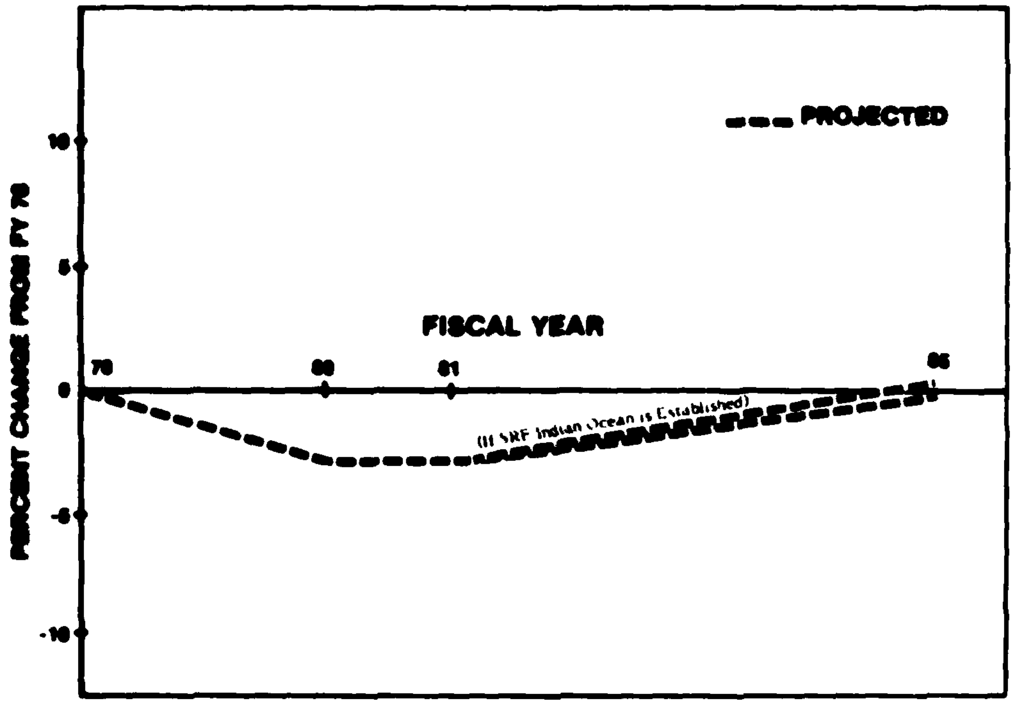
Although we assumed PACFLT ships still maintained extended Indian Ocean deployments in FY 1985, the workload at NSC San Diego is projected to grow back to the FY 1978 level owing to increased fleet size and changes in fleet mix. The number of San Diego-homeported ships increases by 6 percent while these homeported in Pearl Harbor increases by 13 percent from FY 1978 to 1985. As a result, projected NSC Pearl Harbor workload increases by 10.1 percent in FY 1985 over the FY 1978 baseline.

Figure 3 shows the projected workload changes resulting from combining the NSCs (San Diego, Pearl Harbor, Oakland and Puget Sound) and NSDs (Subic Bay, Yokosuka and Guam). The projected results show that the Navy must shift the resources devoted to supply support from the NSCs (especially San Diego) to the NSDs (especially Subic Bay) if the Navy continues to maintain a significant presence in the Indian Ocean area.

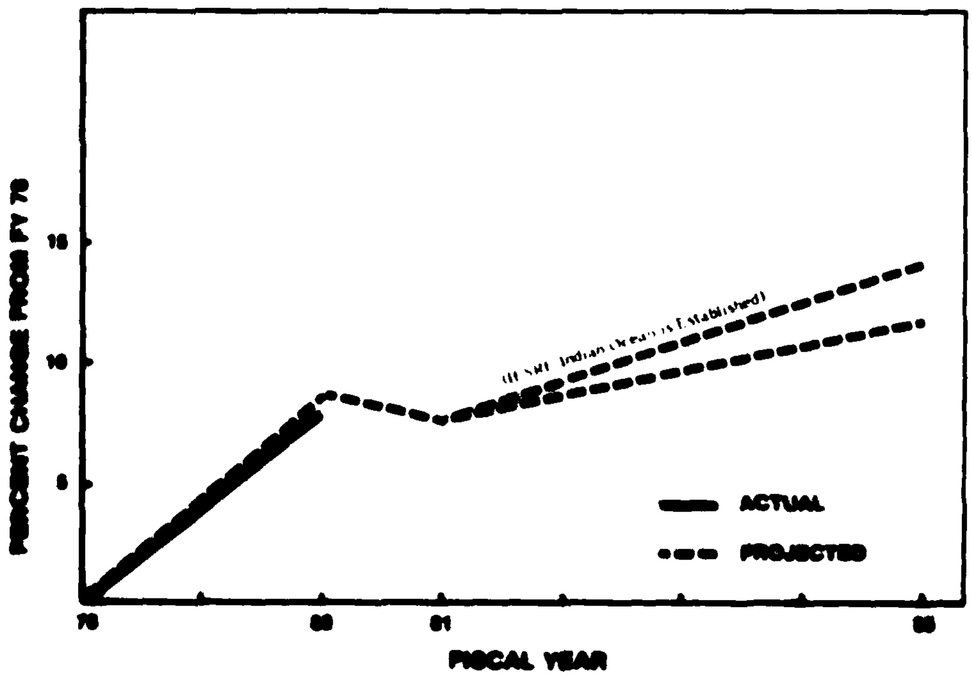
Table 6

Projected Changes in Standard Stock Requisition Demands on Naval Supply Centers and Depots--FY 1978 to FY 1985

	Projected Workload Without SRF Indian Ocean		Projected Workload With SRF Indian Ocean	
Activity	Amount Change	Percent Change	Amount Change	Percent Change
NSC San Diego	-5,184	-0.3	-4,946	-0.3
NSC Pearl Harbor	73,256	10.1	73,256	10.1
NSC Oakland	-49,083	-2.4	-33,493	-1.6
NSC Puget Sound	-22,469	-4.6	-22,469	-4.6
NSD Yokosuka	-18,498	-4.9	-18,498	-4.9
NSD Subic Bay	202,709	21.2	238,819	25.0
NSD Guam	1,384	0.6	1,384	0.6



a. NSCs



b. MSDs

Figure 3. Total actual/projected percent workload changes--FY 1978-FY 1985.

CONCLUSIONS

The validity of the PACFLT Logistics Model for forecasting supply activity workload was demonstrated using historical data. The FY 1978 projected results verify the model's basic assumptions and estimating parameters, and the FY 1980 projected results demonstrate the model's ability to measure accurately changes in supply workload due to shifts in deployment patterns. Projected results for FY 1981 and FY 1985 have been used in allocating resources by supply resource sponsors for POM-83. Among other issues, the PACFLT Logistics Model sheds light on the allocation of supply resources between the Naval Supply System Command and CINCPACFLT.

FUTURE DIRECTION

The PACFLT Logistics Model currently forecasts supply workload, given fleet configuration, operating schedules, and maintenance man-days at shipyards, SRFs, and IMAs. A planned extension will enable the model to forecast intermediate maintenance workload. Further analysis of the maintenance sectors might include:

1. Determining, for each ship class, the percent time spent in an upkeep status at each location.

2. Calculating demand rates such as maintenance man-days per day in upkeep.

3. Investigating the relationship between levels of maintenance support while ships are deployed and required maintenance after they return to homeport.

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