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COMPUTER SUPPORT TO ANVY PUBLIC WORKS
DEPARTMENTS FOR THEIR UTILITIES
FUNCTION

Brad Fowler

NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

COMPUTER SUPPORT TO NAVY PUBLIC WORKS DEPARTMENTS
FOR THEIR UTILITIES FUNCTION

by

Brad Fowler

December 1980

Thesis Advisor: Robert B. Cunningham

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Computer Support to Navy Public Works Departments for Their Utilities Function

by

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Submitted in partial fulfillment of the
requirements for the degree of

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December 1980

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This thesis explores the requirements for Automated Data Processing (ADP) support to Navy Public Works Departments in their role as Utilities managers for Navy and Marine Corps Shore Stations. Utilities function tasks which can benefit from ADP support are described. Results of a survey questionnaire sent to all sizable Public Works Departments are analyzed and Public Works Department utilities function existing ADP support and additional support requirements are profiled. Alternative sources for Public Works Department utilities ADP support are reviewed in light of the survey results. These alternatives are; Base Engineering Support, Technical (BEST) Program for software development to be used by large computer installations for Public Works Department utilities support, BEST Program for acquisition of minicomputer hardware and development of software support, Navy Regional Data ADP Center (NARDAC) batch processed and timeshare support, Shipboard Non-tactical ADP Program (SNAP) support and commercial timeshare service support. Recommendations are made for target Public Works Department criteria, utilities function support system ADP requirements and further study of ADP support sources.

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I. INTRODUCTION

Navy Civil Engineer Corps Officers have often been intrigued with the idea of computer supported operations at our Navy and Marine Corps installations. For roughly fifteen years now, many Public Works Departments (PWDs) have had some limited support, primarily restricted to the generation of historical reports required by external organizations.

Expanded use into internal management has been slow or non-existent. Current systems are generally batch processed by outside organizations, which may not even be on the same military station. Frequently, the PWD priority for processing falls below operational users. Priority for programming assistance and error correction lies close behind. Input is sent in only weekly or monthly, which slows turn around time tremendously. These conditions lead to computer support disease. The symptoms are untimely, unreliable and unreadable reports. With no available or attentive programming specialist on call, the disease turns to decay and decay lies buried in the circular file.

Since the end of the Vietnam War, and with return to peacetime operations, the public has demanded a more productive military at lower cost. Intense public scrutiny, personnel ceiling reductions and lower real budgets now affect us all. At the same time; however, computer technology has advanced tremendously and has become available at dramatically reduced costs. This environment, combined with the Civil Engineer Corps (CEC) traditional bent towards more efficient operations, has sparked increasing interest in computer support for some relief. No longer is historical

record keeping enough. Computer support to enhance management control at the field organizational level is perceived to be technically feasible and cost effective.

In that light, PWDs have independently found ways of obtaining at least minimal computer support. Some have purchased minicomputers of their own, while some borrow or pay for computer time from local sources. Software support has been developed by several organizations including Navy Engineering Field Divisions (EFDs), the Naval Facilities Engineering Command (NAVFAC) through their Facilities Support Office (FACSO), and even by major claimants as exemplified by the Shipyard Management Information System (MIS). Many PWDs have found some support, for various functional areas, but most users have substantial complaints. Current batch processed systems operated by outside organizations with outside expertise have not met expectations.

Several new programs offer possible relief. One is SNAP, Shipboard Non-tactical ADP Program, which will provide minicomputers to ships and is expected to be expanded to fleet support shore establishments, including PWDs, sometime in the mid 1980s. Still in its infancy, questions of who, when and what have vague answers at present.

Navy Regional Data Automation Centers (NARDACs) are beginning to come on line, providing terminal access, time-sharing support to ten regional areas in the United States. This time-share support is charged on a reimbursable basis.

Third, NAVFAC has submitted a Productivity Enhancing Capital Investment (PECI) project to DOD to provide computer support for its PWDs. Five million nine hundred thousand dollars ($5.9 million) has been set

aside in Fiscal Year 1982 for Navy PWDs that can justify high payoffs through labor substitution and monetary benefit in four functional areas. This is the BEST project, Base Engineering Support, Technical management information modules. Its proponents envision functional minicomputers at PWD sites with the Civil Engineer Support Office (CESO) providing technical assistance and developing software support.

These three programs will be reviewed further in a later chapter. Appendix A contains excerpts from the Civil Engineer Corps Officers School Public Works Manual describing Public Works' utilities, goals and policies. Overall organization and functional job descriptions for the utilities function are also detailed and a formal definition of the utilities function is contained therein. Generally, all systems from steam to garbage are included. It seems practical to include all forms of energy conservation associated with utilities as well.

Research for this thesis has been conducted by extensive interviews with local PWD personnel at PWDs in the middle California region. These include PWDs at Port Hueneme, Point Mugu, Mare Island and Monterey. Consultation with NAVFAC Headquarters, FACSO and CESO have provided considerable information. In addition, a questionnaire was sent to all sizable PWDs to clarify existing conditions and future support requirements.

Chapter two will identify the tasks within the utilities function which are well suited to computer support. Chapter three will report results of the PWD questionnaire on ADP requirements. Chapter four reviews implications for computer support alternatives in light of the findings of Chapter three. Conclusions and recommendations are contained in Chapter five.

II. UTILITIES FUNCTION ADP SUPPORT

It is the intent of this chapter to separate the utilities function into subfunctional areas and generally describe what current computer support technology can do to assist the PWO and his staff. In other words, given the technology and generally accepted utilities management principles and practices, what subfunctions are computer compatible? The author has tried to describe all possible benefits available without regard for cost/benefit considerations. Cost/benefit analysis is reserved for a later chapter.

Computer support here is defined to mean some central processing unit with a sufficiently large memory capacity and a family of peripheral devices to include in-house terminals, controllers and sensors. Data processing and automation are synonomous with computer support. Differing degrees of computer systems support are available, from a text editing processor, where everything is collected and entered by hand and then printed in proper format, to a distributed processing system of numerous microprocessors and peripheral devices coordinated by a single mini or mainframe computer. The larger system may require only limited hand entry, relying on sensor information, programmed assumptions and algorithms to produce formated reports and completed forms or messages needing only a signature.

System components are capable of many other things too. For example, computer graphics is useful. Graphs and charts can be produced, adjusted and printed, based on the user's assumptions. "Smart sensors", actually

microprocessors, can operate activities at extended locations and continue to control operations per latest instructions or in a "safe" mode, even when the main computer is down. Any number of warning devices, buzzers, lights and the like can remind users of excessive energy consumption, problem areas, etc. Chemical control systems can both analyze and perform treatment on waste water and sewage.

User to machine communication, human interface, is improving rapidly. Prompting instructions on the Cathode Ray Tube (CRT) display screen can guide the operator through each operation. He's helped along by a series of "menus". It can be self-instructing, in the English language and without abbreviations. Even some of the programming can now be done in user technology, without the need for computer courses in FORTRAN, BASIC or other higher level languages.

The utilities function is divided into five subfunctional areas of discussion.

A. Operations

B. Maintenance and Inspection

C. Consumption

D. Controller Responsibilities

E. Engineering Problem Solving

No distinction has been made between types of Public Works Departments (e.g., air station versus shipyard) or between funding sources and accounting methods. Differing utility production, accounting methods and report formats really have little bearing on computer compatibility.

A. OPERATIONS

The operations subfunction includes production, operation and distribution of utilities.

An automated steam generation control system can both monitor and control fuel utilization and operation efficiency. Equipment scheduling and sensor initiated startups and shutdowns can also be automated. Management reports and charts for load factor performance, British Thermal Units (BTUs), produced and electricity or fuel oil purchases can be printed as required. Distribution can be improved through sensor detection of efficiency and loss as well as from review of steam pressure versus temperature chart printouts.

Electrical power generation can be better managed through automated load balancing, peak demand monitors and operation efficiency controls. Management reports for volume and peak demand plots, loading factor and schedule performance charts can be automated. For distribution management, load balancing and losses can be monitored.

An automated system can control the water supply by monitoring supply and selecting and operating pumping equipment. Water distribution and pressure can be monitored. Water treatment can also be monitored and controlled. Management charts can be produced for demand and usage, water supply and water quality. Water treatment control forms can be formated and produced for signature.

Other less significant or less common utilities can also benefit from computer support. Sewage collection and treatment can be automated. Daily reports comparing sewage flow and water supply can help detect distribution and collection losses. Central air conditioning, compressed air, hydraulic power and refrigeration systems can all be sensor monitored and controlled according to programmed standards. Petroleum, natural gas and liquified gas plants can benefit in the same manner as

steam or electric generation. Refuse collection, refuse disposal and communications operations will benefit least from data processing support.

In addition, several quantitive measures can be monitored directly to provide a report on plant operator performance.

B. MAINTENANCE AND INSPECTION

Control system sensors can handle part of the department's inspection burden. The system can be programmed to warn operators and shut down utilities in emergencies. In addition, the computer is a good inspection record keeper allowing better sort and summary capabilities than manual logs.

Scheduling of both inspection and maintenance work can be done, although extensive programming is required. Management control of maintenance work progress through variance analysis is a good job for the computer, (labor control reports). This requires input of Engineered Performance Standards (EPS). Review of work accomplished can also be monitored from such computer generated reports as the Tab B (labor control report showing cost data on completed job orders).

C. CONSUMPTION

The subfunction consumption, or usage, includes overall consumption management, allocation of utility services and efficiency of service utilization by the computer.

Consumption figures for utility type, currently summed in reports such as the Defense Energy Information System monthly POL and non-POL reports, DEIS I and DEIS II, respectively, and the quarterly Energy Savings Comparison report can be collected and printed. Comparison by period of

consumption with production is easily accomplished. One must also have the operations data file.

Allocation, principally load shedding implementation, can be accomplished through a control network and is a standard feature in most of the Energy Monitor Control Systems (EMCS) now being installed. Some Public Works Departments are receiving reduced rates and guarantees against blackouts from public utilities for installing immediate response load shedding equipment.

Data collected from metering of customers and/or buildings, when compared with engineered estimates of resources requirements, can produce variances for energy conservation efforts. With an automated on-line sensor detection system, immediate hands off action can be taken to correct problems. For example, peak demand can be monitored and heavy users contacted instantaneously by alarms. With accurate and timely consumption figures, sorted by customer and building, an energy reduction incentive rate scale can be instituted for billing. This is part of the demand controller concept where users are automatically notified when they begin to over consume and the PWD is also flagged with an exception report.

An additional benefit should also be realized in fiscal programming for the department. An accurate summary of consumption figures sorted by building should help pinpoint poor maintenance practices and support submission of energy conservation related projects.

D. CONTROLLER RESPONSIBILITIES

Controller responsibilities incluse financial record keeping, planning, budgeting, billing and budget execution. Some PWDs are not tasked with all these responsibilities. The point is; however, that good utilities

management requires they be done and information gleaned from them be reliable, timely and in a useable format. Civilian businesses don't manage by manhours when they can manage dollars, because dollars are a better overall performance indicator. The financial file must be accessible to today's cost conscious PWOs either in his own record system or through a compatible records system kept by the comptroller. Financial costs include civilian labor, materials, contracts, fuel and military labor.

Basic financial production and consumption cost reports such as the Utility Feeder Data Report (NAVCOMP 2126) and the Utility Cost Analysis Report, UCAR, (NAVCOMP 2127) are standard reports taht can be automated. With each utility it is possible to develop unit costs of production and/or distribution reports.

Utility billing is an easy computer task. In put of meter readings or estimates for the sonsumption file, customer Job Order Numbers (JONs) and billing rates can be processed into printed bills ready for distribution. As mentioned earlier, a good consumption file would allow flexible and incentive rate charges. Telephone bills can be sorted and summed by customer, too.

With the PWO knowing more about his production, consumption and their associated costs, planning and budget preparation will benefit. Better projection can be based not only upon better historical information, but also upon the projection capability available in computer systems. Past trends are more easily reviewed and future forecasts based, on different variable mixes, are better explored. Make or buy, plant size and labor adjustment decisions can also be made more intelligently. Customer reimbursable requirements can be better estimated for their budget preparation.

Finally, budget execution can be more closely monitored, not only expenditure/authorization resolution, but timely obligation observations can be realized. In fact, automation allows a responsive accrual accounting system at Navy Industrial Fund (NIF) and Operation and maintenance, Navy (O & M,N) funded departments alike. Of course, the Tab A (labor expenditure feeder to Tab B, labor control report) is computer compatible, too.

E. ENGINEERING PROBLEM SOLVING

Software packages are available, which provide calculator functions in addition to the monitor, control and report generation system. And data is already in computer memory that is likely to be worked upon (database). With free access to the database and flexible graphics capabilities, an entire new area of projection and assumption testing can unfold within the Engineering Division. Not only standards and targets can be calculated, but systems development explored.

F. CONCLUSION

Although the preceding paragraphs may appear a panacea from fantasyland, big changes in the computer industry have made the dreams closer to reality. Hardware costs have come down dramatically from a cost of roughly $.10 per million additions (simple sum calculations) in 1970 to less than $.01 per million additions in 1980[1]. But this is not as significant to the user as the tremendous increase in available software support within the last five years. Software support includes program development, updating and debugging. Now that computer hardware is cheap enough that everyone can afford some,(microcomputers at $250.00) computer makers are seeking an edge in sales with better programs,

systems which allow the non-programmer to follow step-by-step queries in order to manipulate and retrieve information. For example, NCR Corporation estimates that 60 % of its research and development budget goes to software (in 1980), compared with 35 % five years ago. A Texas Instruments assistant vice president, John Hanne, says that 20 years ago, software represented only 10 % of the cost of a normal military computer project, while today it's 90 %[2]. It means large scale management tools (tools previously cost effective for only large volumes and requiring dedicated staff specialists) are becoming feasible for smaller organizations.

A realtime or on-line system, whether it be timeshared with a large multi-user computer facility, or an in-house dedicated minicomputer system, is required for many of the benefits noted in this chapter. In addition, more sensors and meters than now exist in our shore establishments will be required.

Navy Public Works Departments and other NAVFAC organizations already have virtually every computer capability described in this chapter. EMCS projects are installed or under contract in over one-quarter of all PWDs right now[3]. PWD Annapolis claims its saving over $350,000 per year on a system which only cost about $500,000. NAS Corpus Christi has as administratively dedicated minicomputer which automatically prints bills, DEIS II Reports, UCAR Feeder Reports and production summaries. The only regular monthly input is meter readings and estimates.

Systems are available today to meet our needs.

III. SURVEY ANALYSIS

A. BACKGROUND

It is the intent of this chapter to report and analyze the results of a survey questionnaire sent to all sizable Public Works Departments. Sizeable is herein defined as meeting the classification of super, large, medium or small command size criteria established by NAVFAC. This classification is based upon the rank and number of Civil Engineer Corps officers' billets assigned to a department. The following applies:

Super- PWO-CAPT, APWO-CDR, S.E.-LT, FAC PLNG-ENS, UTIL ENGR-ENS
Large- PWO-CDR, APWO-LCDR, FAC PLNG-ENS
Medium- PWO-LCDR, APWO-LTJG, FAC PLNG-ENS
Small- PWO-LT, APWO-LTJG
BASIC- PWO-LT

Tentatively, NAVFAC has targeted super, large, and medium PWDs for computer support in several functional areas. Questionnaires were sent to small PWDs by the author in an attempt to verify this criterion. Navy PWDs classified by command size are listed in Appendix B.

Eight (8) PWDs supporting Marine Corps installations were added to NAVFAC's tentative Base Engineering Support, Technical (BEST) system target PWD list. These were not a part of the BEST system due to that program's funding source. Three additional PWDs, DTNSRDC Bethesda, DEFELEC SUP CEN Dayton and NAVCOMSTA Puerto Rico, were added based on the PWD inventory from the NAVFAC P-1, CEC Directory[4]. Three PWDs on the NAVFAC list were not included because no reference of them could be found in the NAVFAC P-1. These were FCDSTLANT Dam Neck, NAVCAMSLANT Norfolk, and NAVCOMMU Cheltenham.

The questionnaire was sent to one hundred and nine (109) PWDs in August 1980. This excluded the twenty (20) "Basic" sized PWD commands. A self-addressed franked envelope was also enclosed. The questionnaire is included as Appendix C for reference. Of the one hundred and nine (109) mailed, seventy-two (72) were returned. One respondent, the PWO of Naval Station Midway, claimed his facility was going into caretaker status. Two responses were unintelligible and one response was received too late for inclusion. Therefore, the analysis has been directed to a population of one hundred and eight (108) with sixty-eight (68) valid responses or sixty-three (63) percent. Table I is a list of all target PWDs, noting valid respondents. Also shown is PWD command size, Energy Monitor Control System (EMCS) recipients and those PWDs stating a need for ADP support for the utilities function.

Each questionnaire response was coded into fifty-six (56) different columns of information and punched on standard computer cards. Frequency and cross-tabulation of responses were computed on the Naval Postgraduate School W. R. Church Computer Center's IBM 360/68 using the statistical package for the Social Sciences (SPSS) program[5]. Most computer printouts have been summarized and displayed in tables within the text. However, computer cross-tabulations of PWD parameters with respondents needing ADP will be found immediately following the appendices. All printouts which have been summarized herein, have been forwarded to the Special Assistant for Systems, Code 10A2, NAVFAC Headquarters.

Discussion of questionnaire responses is divided into three areas. First, descriptive parameters characterizing PWDs will be reviewed. Next, existing computer support to PWDs is profiled and finally, those

TABLE I

PWD LIST OF RESPONDENTS

	COMMAND	RE-SPONSE	SIZE COM-MAND	EMCS	NEED ADP
01.	HDQTRS NDW WASH DC	X	Super		Yes
02.	NAF WASH DC	X	Small		Yes
03.	NRL WASH DC	X	Large		Unsure
04.	NAVSECSTA WASH DC	X	Small		No
05.	USNA ANNAPOLIS MD	X	Super	X	No
06.	NAVSHIPRESCHDEVCEN ANNA		Small		
07.	NATNAVMEDCEN BETH MD		Large	X	
08.	NAVORDSTA INDIAN HEAD		Large		
09.	NATC PATUXENT RIVER	X	Super	X	Yes
10.	NAVSURFWPNCEN WHITE OAK		Large	X	
11.	NAVSURFWPNCEN DAHLGREN	X	Large	X	No
12.	MCDEC QUANTICO	X	Large	X	Yes
13.	NAS SOUTH WEYMOUTH		Small		
14.	NAS BRUNSWICK		Large		
15.	NAVCOMMU CUTLER	X	Small		No
16.	NSY PORTSMOUTH NH	X	Super		Yes
17.	NETC NEWPORT	X	Super	X	Yes
18.	NUSC NEWPORT	X	Medium		Yes
19.	NAVSUPPACT BROOKLYN		Medium		
20.	NAVSUBASE NEW LONDON	X	Large		Yes
21.	WPNSTA EARLE		Medium		
22.	NSY PHILA PA		Super		
23.	NAVREGMEDCEN PHILY		Small		
24.	ASO PHILY	X	Medium		Yes
25.	NAVAIRDEVCEN WARMINSTER	X	Medium	X	Yes
26.	NAS WILLOW GROVE	X	Small		Yes
27.	NAVAIRENGCEN LAKEHURST	X	Large		No.
28.	NAVAIRPROPCEN TRENTON	X	Small		No
29.	DEFELECSUPCEN DAYTON		Medium		
30.	NAVWPNSUPPCEN CRANE		Large		

	COMMAND	RE-SPONSE	SIZE COM-MAND	EMCS	NEED ADP
31.	NAVAVIONICCEN INDIANAPOLIS	X	Medium		Yes
32.	NAVPHIBASE LITTLE CREEK	X	Large	X	Yes
33.	NAVREGMEDCEN PORTSMOUTH VA	X	Medium		No
34.	NSY NORFOLK/PORTSMOUTH	X	Super	X	Yes
35.	NAS OCEANA		Large	X	
36.	FLECOMBATRACENLANT V. BEACH	X	Medium	X	Yes
37.	NAVWPNSTA YORKTWON		Large	X	
38.	NAVORDSTA LOUISVILLE		Small	X	
39.	MCB CAMP LEJEUNE		Large	X	Yes
40.	MCAS CHERRY POINT		Medium	X	
41.	NSY CHARLESTON		Super	X	
42.	NAVWPNSTA CHARLESTON		Large	X	Yes
43.	MCAS BEAUFORT		Large		
44.	MCRD PARRIS ISLAND		Medium	X	No
45.	NAS JACKSONVILLE	X	Super	X	No
46.	NAVSTA MAYPORT	X	Medium		Yes
47.	NAS CECIL FIELD	X	Large	X	Yes
48.	NAVADMINCOM ORLANDO		Large	X	
49.	NAS KEY WEST		Large		
50.	NAS WHITING FLD	X	Medium		Yes
51.	NAS ATLANTA	X	Small	X	No
52.	CBC GULFPORT		Medium	X	
53.	NAS MERIDIAN	X	Medium		Yes
54.	NAS MEMPHIS	X	Large	X	Yes
55.	NAVSUPPACT NEW ORLEANS	X	Medium		Yes
56.	NAS NEW ORLEANS		Small		
57.	NAS CHASE FIELD	X	Medium		Yes
58.	SUBASE KINGS BAY		Large		
59.	NAS CCRPUS CHRISTI	X	Large		Yes
60.	NAS DALLAS	X	Small		Yes
61.	NAS KINGSVILLE		Medium		
62.	NAS GLENVIEW		Small		

	COMMAND	RE-SPONSE	SIZE COM-MAND	EMCS	NEED ADP
63.	NAS MIRAMAR	X	Large	X	Yes
64.	MCB CAMP PENDLETON	X	Large	X	Yes
65.	NSY LONG BEACH		Large		
66.	NAVWPNSTA SEAL BEACH	X	Large		No
67.	MCAS EL TORO	X	Super	X	Yes
68.	NAS POINT MUGU		Super	X	
69.	CBC PORT HUENEME	X	Large		Yes
70.	COMNAVSUPPFORANTARCTICA	X	Small		No
71.	NAF EL CENTRO		Small		
72.	MARCORB TWENTYNINE PALMS		Medium		
73.	NAVWPNCEN CHINA LAKE	X	Super	X	Yes
74.	NAVPGSCOL MONTEREY	X	Large	X	Yes
75.	NAS MOFFET FIELD	X	Large		Yes
76.	NSY MARE ISLAND	X	Super	X	Yes
77.	NAVCOMSTA STOCKTON	X	Medium		Yes
78.	NAS LEMOORE	X	Large		Yes
79.	MCAS YUMA	X	Large	X	Yes
80.	PUGETSOUND NSY	X	Super	X	No
81.	NAS FALLON		Small		
82.	NAVSUBASEBNGR BANGOR		Super	X	
83.	NAS WHIDBEY ISLAND		Large	X	
84.	NAVSTA ADAK	X	Large		No
85.	NAVCOMSTA PUERTO RICO	X	Medium		No
86.	NAVSECGRUACT SABANA SECA	X	Small		No
87.	NAVSTA ROOS ROADS		Large		
88.	NAVSTA PANAMA CANAL		Medium		
89.	NAVSTA GUANTANAMO BAY		Super		
90.	NAS BERMUDA	X	Large		Yes
91.	NAVFAC ARGENTIA		Medium		
92.	NAVSTA KEFLAVIK	X	Large		No
93.	NAVACTS LONDON		Medium		

	COMMAND	RE-SPONSE	SIZE COM-MAND	EMCS	NEED ADP
94.	NAVSECGRUACT EDZELL		Small		
95.	NAVSUPPACT NAPLES	X	Large		Yes
96.	NAF SIGONELLA		Medium		
97.	NAVSTA ROTA	X	Super		Yes
98.	NAVCOMSTA NEA MAKRI		Small		
99.	MCAS KANEOHE BAY		Large		
100.	NAF MIDWAY ISLAND	C A R E T A K E R		S T A T U S	
101.	NAVORDFAC SASEBO	X	Large		No
102.	MCB CAMP BUTLER OKI	X	Medium	X	Yes
103.	NAVCOMMSTA H E HOLT	X	Medium		No
104.	NAVSUPPFAC DIEGO GARCIA	X	Medium		Yes
105.	SPCC MECHANICSBURG	X	Large		No
106.	NAVWPNSTA CONCORD	X	Large		No
107.	DTNSRDC BETHESDA		Large		
108.	NAF ATSUGI	X	Large		No
109.	MCAS IWAKUNI	X	Large		Yes
	UNKNOWN	X	?	?	No
	UNKNOWN	X	?	?	No
	UNKNOWN	X	?	?	Yes
		68		38	44 Yes 24 No

PWDs stating a need for additional computer support are profiled. Frequency response tabulations for each survey question follow each paragraph of discussion.

B. QUESTIONNAIRE DESCRIPTIVE PARAMETERS

First, the overall PWD budget for all operations and maintenance is arrayed. Budgets varied greatly, with a range from several hundred thousand dollars to over fifty (50) million dollars. The median was roughly nine million dollars ($ 9 million), and the average total budget was somewhat greater ($ 11.1 million).

PWD Overall Budget (in millions of dollars):

0-2	2-4	4-7	7-10	10-15	15-20	> 20	NO RESPONSE
5	6	10	8	9	9	8	13
9 %	11 %	18 %	15 %	16 %	16 %	15 %	—

Total PWD personnel followed the same pattern, showing wide variance and having a median of 200 personnel. Again, the average is slightly higher for the 55 respondents. It is interesting to note the limited correlation between total budget and total personnel. (See Table II)

PWD Overall Personnel:

0-99	100-149	150-199	200-299	300-449	450-600	> 600	NO RESPONSE
8	11	8	12	8	5	3	13
14 %	20 %	14 %	22 %	14 %	9 %	6 %	—

Utility production frequencies, by type, were tabulated next. Steam, water, electricity, and sewage were individually counted. The "Other" category stood for other minor utilities; such as, compressed air or emergency power. The "Two or more" category stood for two or more types of utilities produced, major or minor. Steam was easily the most common

Table II

Cross-tabulation of Overall PWD Budget With Overall PWD Personnel

* * * * * * * * * * * * * * * * * * C R O S S T A B U L A T I O N O F * * * * * * * * * * * *
OVLBUD OVERALL PWD BUDGET BY OVLPER OVERALL PWD PERSONNEL
* *

OVLBUD	COUNT ROW PCT COL PCT TOT PCT	OVLPER 0-99 P 1	100-149 P 2	150-199 P 3	200-299 P 4	300-449 P 5	450-600 P 6	>600 P 7	ROW TOTAL
$0-2M	1	3 60.0 37.5 5.7	1 20.0 10.0 1.9	0 0.0 0.0 0.0	1 20.0 8.3 1.9	0 0.0 0.0 0.0	0 0.0 0.0 0.0	0 0.0 0.0 0.0	5 9.4
$2-4M	2	3 50.0 37.5 5.7	3 50.0 30.0 5.7	0 0.0 0.0 0.0	0 0.0 0.0 0.0	0 0.0 0.0 0.0	0 0.0 0.0 0.0	0 0.0 0.0 0.0	6 11.3
$4-7M	3	2 20.0 25.0 3.8	3 30.0 30.0 5.7	4 40.0 50.0 7.5	1 10.0 8.3 1.9	0 0.0 0.0 0.0	0 0.0 0.0 0.0	0 0.0 0.0 0.0	10 18.9
$7-10M	4	0 0.0 0.0 0.0	0 0.0 0.0 0.0	1 12.5 12.5 1.9	5 62.5 41.7 9.4	2 25.0 28.6 3.8	0 0.0 0.0 0.0	0 0.0 0.0 0.0	8 15.1
$10-15M	5	0 0.0 0.0 0.0	1 12.5 10.0 1.9	2 25.0 25.0 3.8	3 37.5 25.0 5.7	2 25.0 28.6 3.8	0 0.0 0.0 0.0	0 0.0 0.0 0.0	8 15.1
$15-20M	6	0 0.0 0.0 0.0	2 22.2 20.0 3.8	1 11.1 12.5 1.9	0 0.0 0.0 0.0	2 22.2 28.6 3.8	3 33.3 60.0 5.7	1 11.1 33.3 1.9	9 17.0
$>20M	7	0 0.0 0.0 0.0	0 0.0 0.0 0.0	0 0.0 0.0 0.0	2 28.6 16.7 3.8	1 14.3 14.3 1.9	2 28.6 40.0 3.8	2 28.6 66.7 3.8	7 13.2
	COLUMN TOTAL	8 15.1	10 18.9	8 15.1	12 22.6	7 13.2	5 9.4	3 5.7	53 100.0

NUMBER OF MISSING OBSERVATIONS = 15

utility. Other categories are given in order of declining frequency. These percentages may be as much as 15 % low since a blank response on the questionnaire was interpreted as no utilities instead of no response. Table III summarizes cross-tabulation of utility production type. It shows that steam was the only likely independent utility. Departments producing electricity or water or processing sewage were extremely likely (94 % or greater) to produce two or more utilities. In fact, every department processing sewage, also pumped its own water from Government owned wells. Also, those facilities producing two or more utilities were most likely producing water and/or steam.

Utilities Production:

Steam	Two or More	Water	Electricity	Sewage	Other
44	34	31	18	17	15
65 %	50 %	46 %	27 %	25 %	22 %

Cross-tabulation of utility production to total budget revealed that PWDs with overall budgets greater than ten million dollars ($ 10 million), were very likely (66 %) to produce two or more utilities. No other good correlation of utility production to overall budget or personnel was found.

Utilities personnel frequencies were reviewed next. Utilities maintenance personnel ranged from less than five (5) to as many as six hundred (600), with a median of thirteen (13). Cross-tabulation revealed no significant correlation between utilities maintenance personnel and overall budget, overall personnel utility production, or utilities operation personnel. (See Table IV) PWDs having ten (10) or less utilities maintenance personnel correlated well with PWDs having two or less utilities administrative personnel.

TABLE III

Cross-Tabulation of Utility Production

___% of	____________ Producers also Produce		____________
29 %	Steam	—>	Electricity
50 %	"	—>	Water
27 %	"	—>	Sewage
30 %	"	—>	Other Minor Utilities
61 %	"	—>	Two or More Utilities
72 %	Electricity	—>	Steam
67 %	"	—>	Water
33 %	"	—>	Sewage
56 %	"	—>	Other Minor Utilities
94 %	"	—>	Two or More Utilities
71 %	Water	—>	Steam
39 %	"	—>	Electricity
55 %	"	—>	Sewage
36 %	"	—>	Other Minor Utilities
94 %	"	—>	Two or More Utilities
71 %	Sewage	—>	Steam
35 %	"	—>	Electricity
100 %	"	—>	Water
29 %	"	—>	Other Minor Utilities
100 %	"	—>	Two or More Utilities
79 %	Two or More Utilities	—>	Steam
50 %	"	—>	Electricity
85 %	"	—>	Water
50 %	"	—>	Sewage
41 %	"	—>	Other Minor Utilities

Note that relationships are ordered (one way). Also note that they are overlapping, i.e., a steam producer may also be a sewage processor.

Table IV

Cross-tabulation of Utilities Maintenance Personnel With Utilities Operations Personnel

* * * * * * * * * * * * * * * * * C R O S S T A B U L A T I O N O F * * * * * * * * * * * *
MNTPERS NUMBER OF MAINTENANCE PERSONNEL BY OPSPERS NUMBER OF OPS PERSONNEL
* *

MNTPERS	COUNT / ROW PCT / COL PCT / TOT PCT	OPSPERS 0-5 PERS 1	6-10 PERS 2	11-20 PERS 3	21-30 PERS 4	>30 PERS 5	ROW TOTAL
0-5 PERS	1	5	5	2	0	2	14
		35.7	35.7	14.3	0.0	14.3	27.5
		90.0	45.5	22.2	0.0	12.5	
		9.8	9.8	3.9	0.0	3.9	
6-10 PERS	2	3	2	0	0	2	7
		42.9	28.6	0.0	0.0	28.6	13.7
		30.0	18.2	0.0	0.0	12.5	
		5.9	3.9	0.0	0.0	3.9	
11-20 PERS	3	1	2	5	3	5	16
		6.3	12.5	31.3	18.8	31.3	31.4
		10.0	18.2	55.6	60.0	31.3	
		2.0	3.9	9.8	5.9	9.8	
21-30 PERS	4	1	2	1	2	1	7
		14.3	28.6	14.3	28.6	14.3	13.7
		10.0	18.2	11.1	40.0	6.3	
		2.0	3.9	2.0	3.9	2.0	
>30 PERS	5	0	0	1	0	6	7
		0.0	0.0	14.3	0.0	85.7	13.7
		0.0	0.0	11.1	0.0	37.5	
		0.0	0.0	2.0	0.0	11.8	
	COLUMN TOTAL	10	11	9	5	16	51
		19.6	21.6	17.6	9.8	31.4	100.0

NUMBER OF MISSING OBSERVATIONS = 17

Utilities Personnel:

	0-5	6-10	11-20	21-30	> 30	NO RESPONSE
Maintenance	14	7	16	7	7	17
	27 %	14 %	31 %	14 %	14 %	---
Operations	10	14	11	5	20	8
	17 %	23 %	18 %	8 %	33 %	---

	0-1	2	3	4-5	> 5	NO RESPONSE
Administration	28	10	3	7	11	9
	47 %	17 %	5 %	12 %	19 %	---

Utilities operations personnel ranged from zero (0) to one hundred (100), with a median of fifteen (15). No correlation was found to exist with overall budget or personnel. As might be expected, good correlation was found between utilities operations personnel and steam producers or two or more utilities producers. Also, PWDs having ten (10) or less utilities operations personnel correlated well with PWDs having two (2) or less utilities administrative personnel.

Utilities administrative personnel ranged from zero (0) to twenty (20) with a median of two (2). No correlation existed with overall budgets, overall personnel, or utilities production.

The next survey question inquired whether utilities personnel staffing was adequate. Seventy (70) percent responded in the affirmative. Of the negative replies, most said deficiencies existed in utilities maintenance personnel.

Is the Utilities Staffing Level Adequate?

YES 37 (70 %) NO 16 (30 %) (53 RESPONSES)

The next parameter responses for annual utilities budget, showed wide

variance and ranged from several hundred thousand dollars to twenty-two (22) million dollars. The median was close to $ 2.5 million, while the average was $ 3.9 million. Although the utilities budget averages twenty-nine (29) percent of the total department budget, there was little correlation. In other words, very few PWDs' utilities budgets consume exactly twenty-nine (29) percent of their total budgets. Most are on either side, by anywhere from five (5) to thirty (30) percentage points. There was no significant correlation between utilities budgets and total department personnel. In fact, utilities budgets did not correlate well with utilities personnel or most utilities production. The only good relationship discovered was that ninty-five (95) percent of PWDs having a utilities budget greater than four (4) million dollars produce steam.

Utilities Budget (in millions of dollars):

0-1	1-2	2-3	3-4	4-6	6-9	> 9	NO RESPONSE
12	13	5	4	9	6	7	12
21 %	23 %	9 %	7 %	10 %	11 %	13 %	---

Roughly a quarter of the PWDs responding indicated they were predominately Navy Industiral Fund (NIF) organizations. Two correlations to parameters already discussed were found. Ninty-four (94) percent of the NIF organizations produce steam and eighty-seven (87) percent have budgets greater than ten (10) million dollars.

Predominately NIF funded: 15 (24 %)

Predominately O&M funded: 48 (76 %)

The next parameter indicated that the PWO was the most frequent survey respondent. Generally, the PWO responded for the smaller activities, while management analysts responded primarily for larger activities.

Questionnaire Respondent:

PWO	APWO	MGMT ANALYST	UTILITY ENGR	UDD	SHOPS ENGR	UT SUPVR	OTHER	NO RESPONSE
23	9	7	5	5	1	4	8	6
37 %	15 %	11 %	8 %	8 %	1 %	7 %	13 %	—

The PWD parameter type is an important one. Results showed a good sampling, a broad representation of PWD types. The "Other" category consisted of widely varying utilities organizations both in size and production. The following correlations were found. All Shipyards and Weapons Centers were NIF organizations and all Naval Stations, Naval Air Stations, Naval Communication Stations and Marine Corps activities were Operations & Maintenance (O & M) funded.

PWD Type:

NAVSTA	WEAPCEN	SHIPYARD	AIRSTA	COMMSTA	MARINE	OTHER	NO RESPONSE
5 of 10	4 of 9	4 of 7	16 of 28	4 of 5	7 of 12	25 of 38	3
50 %	44 %	57 %	57 %	80 %	58 %	66 %	—

Shipyards and Communications Stations had significantly higher utilities budgets as a percentage of the overall budget; Weapons Stations a lower proportion. Shipyards and Naval Stations tended to be the largest activities by budget and personnel. They were followed by Weapons Centers and Marine Corps Activities, then Air Stations and finally, Communications Stations. One exception to this was that Marine Corps Activities were the most personnel intensive, that is, they had a much higher personnel complement than their other size parameters would have predicted. Utilities production was widely distributed among PWD types. However, no Communications Stations produced steam and no sewage was processed by Naval Stations, Shipyards, or Weapons Centers.

The next parameter, PWD location, showed little correlation to other parameters. However, the South tended to have lower utilities budgets while producing more types of utilities than other regions. A good representation from all regions was evident.

PWD Location:

NORTHEAST	EAST	SOUTH	WEST	ATLANTIC	PACIFIC
17 of 30	8 of 12	13 of 21	15 of 23	6 of 14	6 of 8
57 %	67 %	62 %	65 %	43 %	75 %

Good representation was also evident from responses to the last descriptive parameter, command size. Correlation with utilities budgets was good in the lower and higher budget ranges. Command size generally followed overall personnel and overall budgets. The greater the command size, the more likely the activity was to produce steam, electricity or two or more utilities. Utilities operations and maintenance personnel did not correlate well with command size.

PWD Command Size

SMALL	MEDIUM	LARGE	SUPER
9 of 19	17 of 28	27 of 42	12 of 18
47 %	61 %	64 %	67 %

Two parameters, not included by the author, (but which would have been valuable) were the reimbursable portion of the utilities budget and the number of utilities customers billed. Respondents who indicated a large reimbursable load, appeared to have no common parameters.

Since this diverse group had no normal distribution, a mathematical confidence interval was not calculated. Suffice to say that fifty (50) to sixty-three (63) percent of the entire sizable PWD population responded to each question. Since the parameter questions were simple and

straightforward; there was good representation from each PWD type, size and region. The figures should be quite accurate, when extended to the entire population.

C. EXISTING ADP SUPPORT PROFILE

The second major section of the survey was intended to provide a profile of existing computer support to Public Works Departments. Some of the answers to this section and the following section are more qualitative in nature and have required some interpretation by the author. Although the author strove to remain totally objective, some biases will naturally, but unintentionally, be included. The original questionnaires have been sent to Code 10A2 at NAVFAC Headquarters.

Thirty-five (35) percent of the sixty-eight (68) respondents stated they had some form of ADP support. This number is very likely low. The author has found several examples of facilities receiving ADP support from outside the organization, in the form of historical reports, i.e., Tab A & B, UCAR, etc., where respondents claimed no computer support. Apparently, some respondents interpreted the question to refer to exclusively to "in-house" support and some were simply unaware of extra-organizational support. The author was confident in saying that at least half of the PWDs are receiving some form of ADP support.

Existing Support:

YES: 35 % (24) NO: 65 % (44)

Cross-tabulation of existing utilities support with PWD descriptive parameters revealed no correlations, with the exception of PWD type. All shipyards have ADP support through the Shopyard Management Information System (MIS) while none of the Weapons Centers noted any existing utilities ADP support.

Classification of ADP supporting agencies was next requested. NARDAC is the acronym for Navy Regional Data Automation Center and AAA for Authorized Accounting Activity. The author suspects these last two categories to be the forgotten supporting agencies. No respondents mentioned station comptroller support. The NARDACs and AAAs typically provide financial based historical reports either directly to PWDs or via the station comptroller.

Supporting Agency:

STATION ADP CENTER	IN-HOUSE	NARDAC	AAA
50 % (12)	29 % (7)	8 % (2)	13 % (3)

Fifty (50) percent of those PWDs reporting existing ADP support were supported by batch processed systems while the remaining half received interactive-realtime support. The author suspects that again, the absolute figures are somewhat low, with the unreported ADP support falling into the batch processed column. The interactive-realtime support is mostly comprised of EMCSs; however, NSY Puget Sound and NAVSTA Rota reported extra-organizational realtime support. NAS Jacksonville and NAS Corpus Christi had their own administratively dedicated minicomputers and NAVSTA Keflavik reported limited use of a word processor for utilities support.

Support Type:

Batch processed	Interactive-realtime
50 % (12)	50 % (12)

The next response dealt with the area of functional support. Besides noting response frequencies, some mention will be made concerning the author's definition of each support area.

Functional Support Areas:

	Yes	No
ALLOCATION/BILLING	33 % (8)	67 % (16)
PRODUCTION/DISTRIBUTION	29 % (7)	71 % (17)
EFF. OF SERVICE UTILIZATION	13 % (3)	87 % (21)
OPERATING CONTROL SYSTEM	25 % (6)	75 % (18)
PLANNING/BUDGET EXECUTION	75 % (18)	25 % (6)
OTHER	8 % (2)	92 % (22)

Allocation deals with resource usage (consumption) by facility or customer. Billing is a logical extension of this function with the inclusion of utilities rates. In addition, the PWO's load shedding plan prioritizes the allocation of resources. Good allocation figures are highly dependent upon metering.

Production and distribution reports essentially monitor the performance of the utilities system. Production reports show production rates and volumes along with fuel utilization so that plant efficiency can be monitored. Production plant discharges may also be monitored for environmental impact. Distribution efficiencies are generally monitored through periodic line checks by utilities maintenance personnel.

Efficiency of service utilization reports display allocation figures with engineered usage standards. Variance reports result. Consumption control is highly meter dependent. A demand controller combines efficiency of service utilization with hardware and software control in a realtime environment. This extension requires an extensive sensor network. The demand controller is a type of EMCS with no utilities production necessarily involved.

An operating control system requires a realtime environment. The author defined an operating control system as an automatically controlled

system which reduces sensor and operator input, through programmed algorithms, into efficient utilities system operation. An automatic water treatment system falls within this definition and so does a production facility EMCS. Better detection of safety hazards, environmental discharges, inefficient performance and leaks is usually realized. Occasionally, the number of operating personnel can be reduced. Many EMCSs are designed to include allocation, production and distribution reports; some will also do billings. Therefore, a production and allocation EMCS can manage all support areas mentioned thus far. Of course, this expanded EMCS is highly meter and sensor dependent.

Planning and budget execution are really two separate functions, but both require financial data. Planning includes forecasting and trend analysis from historical records. Budget execution involves balancing obligations and expenditures with the budget plan. The author includes the Tab A & B, UCAR and UCAR Feeder reports within this area.

Engineering problem solving was the single "other" area response.

The frequency distribution of existing support areas showed planning and budget execution support the most common by far. Larger PWDs were found to more likely receive support in this area. Efficiency of service utilization was the least common, while the other three support areas of support were roughly as frequent at approximately thirty (30) percent. Although only six respondents stated they now have operating control system support, thirty-eight (38) PWDs have been authorized EMCSs. See Table I. Nearly all respondents claim two or more support areas.

Quality of Current Support:

	GOOD	AVERAGE	POOR	NO RESPONSE
TIMELINESS	25 % (5)	25 % (5)	50 % (10)	(4)
ACCURACY	30 % (6)	45 % (9)	25 % (5)	(4)
RELIABILITY	25 % (5)	40 % (8)	35 % (7)	(4)
PROGRAMMING ABILITY	19 % (3)	56 % (9)	25 % (4)	(8)
EASE OF CORRECTION	28 % (5)	44 % (8)	28 % (5)	(6)
OTHER	100 % (3)	—	—	(21)

The final existing support question dealt with the quality of that support. Many respondents filled in the matrix in a manner other than that specified. Instead of giving a rating for each quality measure of each support area, a single rating was given for each quality measure. The results shown above have been summarized in this format. Poor timeliness was the most serious complaint. All the poor timeliness ratings were given to batch processed support. Reliability received slightly less than an average rating while all other support qualities were average overall. However, average overall still meant that a quarter of the PWDs were receiving poor support.

Of those respondents who gave quality ratings by individual support area, PWDs receiving EMCS support were the most satisfied and those receiving planning and budget execution support least satisfied.

Three PWDs indicated good EMCS support; NAVAIRDEVCEN Warminster, MCB Camp Lejune and USNA Annapolis. Both NAS Memphis and NAS Meridian were pleased with offbase budget execution support from NAVDAC Pensecola. NAS Meridian reported having access to the Fiscal Office CRT terminal. Lastly, NAS Corpus Christi was quite happy with their Wang minicomputer for automated utilities billing and management reports (UCAR Feeder and DEIS II).

D. PROFILE OF ACTIVITY SUPPORT REQUIREMENTS

Responses to the third section of the questionnaire provided a profile of those activities needing ADP support.

Need Computer Support?

YES 65 % (44) NO 35 % (24) No Response (1)

Sixty-five (65) percent of the respondents felt a need for ADP support for utilities tasks. Respondents are listed in Table I. Four (4) respondents were interested in obtaining support, but unsure if it would be cost justified. These responses were tallied as needing support. This, plus a suspicion that those interested in getting computer support are more likely to respond to the survey, lead the author to believe a more realistic figure was closer to fifty (50) percent. However, only three activities indicated they were satisfied with existing computer support and needed no more. Overwhelmingly, those having some existing support were desirous of getting more, or at least better support. See Table V. The adequacy of the existing utilities staff had no significant impact on the responses. Appendix D details a profile by descriptive parameter of those activities which are most likely to need ADP support based on the survey results. An eighty (80) percent criterion was used. For example, at least eighty (80) percent of PWDs having a utilities budget greater than four (4) million dollars answered yes, utilities support is needed. For complete responses, cross-tabulation of each parameter with the need ADP response is included immediately following the appendices in the computer printouts.

The next survey question requested comment on specific areas of support required for those needing ADP. Refer again to Appendix C.

Table V

Cross-tabulation of Existing Computer Support With Need of ADP Support

C R O S S T A B U L A T I O N   O F
EXSTSUP   EXISTING COMPUTER SUPPORT   BY   NEEDADP   DO THEY NEED ADP SUPPORT?

EXSTSUP	NEEDADP COUNT / ROW PCT / COL PCT / TOT PCT	YES 1	NO 2	ROW TOTAL
YES	1	19 82.6 44.2 28.4	4 17.4 16.7 6.0	23 34.3
NO	2	24 54.5 55.8 35.8	20 45.5 83.3 29.9	44 65.7
	COLUMN TOTAL	43 64.2	24 35.8	67 100.0

NUMBER OF MISSING OBSERVATIONS = 1

Planning and budget execution support was most desired. Allocation, billing, production and distribution reports were next in importance. Least important were operating control systems and efficiency of service utilization. Support area requirements were not found to differ significantly due to PWD type, size or other parameters.

Required Support Areas:

	YES	NO	NO RESPONSE
ALLOCATION/BILLING	73 % (29)	27 % (11)	(4)
PRODUCTION/DISTRIBUTION	75 % (30)	25 % (10)	(4)
EFF. OF SERVICE UTILIZATION	63 % (24)	37 % (14)	(6)
OPERATING CONTROL SYSTEM	61 % (25)	39 % (16)	(3)
PLANNING/BUDGET EXECUTION	85 % (34)	15 % (6)	(4)
OTHER	100 % (2)	0 % (0)	(42)

Comments showed billing support was quite important to PWDs collecting reimbursement from a large number of customers. However, two respondents indicated that for their activities, billing was a Comptroller funcrion. Respondents were split on whether batch or realtime was required for billing. It was evident that efficient batch processing support would be sufficient for allocation alone. Two respondents specifically mentioned a realtime requirement for automated load shedding.

No respondents mentioned distribution specifically for required computer support. PWDs requesting automated production performance reports most often cited plant efficiency improvement as the reason. Most of those desiring this type of support would doubtless benefit from an EMCS. Some may only need automatic controls and condition sensors at the production plant itself. Either way, it appears a realtime system is required for automated production reports.

Comments on efficiency of service utilization were limited. Most respondents indicated it was part of a good energy conservation program. Two respondents showed interest in a demand controller, but no other comments impacting on the need for realtime or batch processing were made. No respondents indicated whether meter shortages were a problem in this area.

Operating control system comments were sparse. Eighty (80) percent of the authorized EMCSs are operating control systems. Level distribution of small utility loads, lack of utility production and an aging plant were given as reasons for not needing this type of support.

Six (6) respondents claimed they had existing production facility EMCSs. Of these six (6), three (3) felt they would need no more support and three (3) felt they would phase more capability into the system later. Eighty-eight (88) percent of those PWDs designated to receive EMCSs indicated they would also need support outside of that which the EMCS provides, principally in planning and budget execution. Of that percentage, half felt realtime and half felt batch processing would be adequate for "non-EMCS" support. PWDs not presently targeted for EMCSs were also split evenly over whether support areas, other than operating control systems, require batch or realtime processing.

Respondents requiring planning support were interested in trend analysis of past operations and costs, and forecasting future resources requirements for PWDs or other tenent activities. The UCAR was specified as an important report for this function; utilities maintenance record keeping was specifically mentioned by two respondents. Other respondents wanted to track the budget execution cycle and receive cumulative costs,

utilities consumption and utilities maintenance summaries. Two respondents claimed a need for obligation reports vice expenditure reports. Several were dissatisfied with comptroller support in this area. Batch and realtime advocates were split.

In the "Other" support area, respondents were desirous of getting an engineering problem solving capability.

The next parameter response indicated which members of the organization needed utilities ADP support. Considerable overlapping exists. An average of over three (3) billets were named by each respondent. The utilities engineer was most often named. Larger activities tended to mark the utilities engineer more heavily while smaller activities tended to specify the PWO consistently. The APWO and "Other" (predominately administrative or budget personnel) were marked as frequently by big and small PWDs alike. Shops Engineer, Utility Division Director, Maintenance Control Division Director and Maintenance Division Director were marked less frequently.

Who Needs Support?
(With 41 YES Respondents)

PWO	APWO	SHOP ENGR	UTIL ENGR	UDD	MCDD	MDD	OTHER
20	21	14	27	12	13	6	19

Excluding the three (3) PWDs desiring to upgrade existing EMCSs, respondents were split almost evenly on the question of whether batch or interactive-realtime systems were required. Table VI shows responses broken down by command size. One consistent theme of those PWDs already receiving ADP support was that batch support was not timely. It may be that some respondents desiring realtime support felt efficient and timely batch processing was sufficient, but from experience, improbable to

TABLE VI

Statistics on PWDs Needing ADP Support

Support Type

SIZE COMMAND	BATCH	INTERACTIVE-REALTIME
Super	50 % (4)	50 % (4)
Large	22 % (4)	78 % (14)
Medium	64 % (7)	36 % (4)
Small	67 % (2)	33 % (1)

Support Worth $6000.00 Per Year

SIZE COMMAND	YES	NO
Super	100 % (9)	0 % (0)
Large	77 % (13)	23 % (4)
Medium	58 % (7)	42 % (5)
Small	0 % (0)	100 % (3)

Manpower Savings Available

SIZE COMMAND	YES	NO
Super	88 % (7)	12 % (1)
Large	62 % (10)	38 % (6)
Medium	46 % (6)	54 % (7)
Small	33 % (1)	67 % (2)

obtain through outside support organizations. That is, interactive realtime was desired for control rather than timeliness. Of course, support flexibility is also a good reason for interactive-realtime processing.

Type Support Desired:
(With 40 Respondents)

BATCH PROCESSED	INTERACTIVE-REALTIME
45 % (18)	55 % (22)

The next survey question inquired whether needed ADP support was worth six thousand (6000) dollars from annual PWD operating funds. Table VI shows responses sorted by PWD command size. Six thousand (6000) dollars annually would easily maintain a decent-sized minicomputer and peripherals in roughly the fifty thousand (50,000) dollar range, which would provide adequate support. A minicomputer system in this range could handle the utilities reports and billings for most PWDs. However, an EMCS would cost five (5) to fifty (50) times this amount[5]. Two thirds of those responding were willing to spend that amount annually. None of the three small command size PWDs was willing to spend that much.

Is Automation Worth $6,000.00 Per Year?
(With 41 Total Respondents)

YES 68 % (28) NO 32 % (13)

Sixty-three (63) percent of the respondents claimed manpower savings could be realized with a minicomputer. Although a sensitive question, the author was satisfied that responses were truthful, if not always complete. Nearly all respondents noted that manpower savings would be redirected to other required tasks within the department. The larger the command size parameter, the more often respondents stated manpower

savings could be realized. See Table VI. Most respondents felt manpower savings would reduce administrative tasks.

Can Manpower Be Saved?
(With 40 Respondents)

YES 63 % (25)	NO 37 % (15)

The following shows manpower savings possible for the few respondents commenting on "How much?".

NUMBER OF RESPONDENTS	AVERAGE SAVINGS IN MAN-YEARS	TASKS REDUCED
1	5.00	Collecting Field Data
1	6.00	Stm Plt Operators(EMCS)
1	2.00	Valve cont. & Load Shed.
6	0.36	Administrative
1	2.00	Billing

The last survey question responses revealed some enthusiasm for automated charting and graphing capabilities, but nothing overwhelming. No correlation with PWD descriptive parameters was found. Several of those that thought it important were interested in their use for briefing people outside the organization. Required response time for charts and graphs centered around days.

How Important is Computer Charting/Graphing?
(With 39 Responses)

IMPORTANT	NICE TO HAVE	NOT IMPORTANT
38 % (15)	38 % (15)	24 % (9)

Response Time Required For Charts and Graphs
(With 23 Responses)

HOURS	DAYS	WEEKS
30 % (7)	43 % (10)	27 % (6)

IV. ALTERNATIVE SOURCES OF ADP SUPPORT

A. GENERAL

Survey results showed a lot of diversity in PWD utilities responsibilities. Each descriptive parameter covered a wide range of values. It is evident that no single solution to ADP support requirements exists. Not all PWDs need an EMCS, not all need billing support and not all need computers.

At this point it is useful to review alternative solutions to the problem and note the advantages and disadvantages of each.

B. EMCS SUPPORT

As noted earlier, thirty-eight (38) PWDs have already been designated to receive Energy Monitor Control Systems. These PWDs were chosen in programs like the Energy Conservation Investment Program (ECIP). They were funded mostly through Military Construction (MILCON) energy dollars. The program is relatively new. Some PWDs have reported EMCSs as a success; while others have not realized the expectations of management. Since about seventy-five (75) percent of the now designated systems have not yet become operational, the next couple of years will provide a much better period in which to fully evaluate their effectiveness.

With fuel costs increasing and computer hardware costs decreasing EMCSs will become more cost effective in the future. Many of the most energy inefficient commands have been assisted. However, several

regions, notably the overseas locations, have virtually no EMCSs authorized at present. This fact makes the author suspect several regions may not have been scrutinized as closely as they should have been at this point.

It is still safe to say that a sizable percentage of the PWD population will have EMCSs in the next few years. Two questions arise: First, how many PWDs, requiring ADP support, will receive EMCSs? And second, does an EMCS negate the need for other computer support?

Although PWD response to EMCS was mixed, many Navy shore installations have been beset by problems which affect the efficiency of these systems. Poor design, poor construction, poor inspection and inadequately trained operation and maintenance personnel have all been blamed. These too much, too soon, symptoms have caused NAVFAC to put a temporary freeze on EMCS development. The program may continue more slowly after evaluation or an alternative approach may be substituted; such as, a distribution of independent single building microprecessors. It is not at all clear how many PWDs will have an EMCS in two or three years.

As stated earlier, an EMCS can provide allocation, billing, production, distribution and utilization of services support, as well as, operational control. The DEIS II and UCAR Feeder Reports can also be obtained with the addition of fuel and contracted utilities rates. Each of these functions can be phased in after the initial system is operational. In fact, questionnaire comments indicate that a phased approach is the best installation procedure for a successful EMCS. On the other hand, some EMCSs are not easily nor inexpensively expanded. With the exception of the Central Processing Unit (CPU), all other peripheral devices

(terminal, printer, storage, sensors, etc.) may require new acquisitions in order for an expansion to proceed.

Planning and budget execution require labor and materials costs i.e., the financial file. Labor time cards and material requisitions are collected and later sorted or distributed to separate functional areas. These enable calculation of the true full cost of production, distribution and maintenance of utilities. This is a separate task from those above and the responsibility of the Comptroller. It is not a logical addition to an EMCS, and neither is organization of the utilities maintenance records; which is also a part of the planning task. Therefore, the Tab A & B Reports and the UCAR would not, generally, come from an EMCS based ADP system. This support must generally come from other ADP resources.

C. SNAP SUPPORT

No authorization has been granted nor funding proposed for the Shipboard Non-tactical ADP Program (SNAP) for Navy shore support facilities. The number of PWDs to benefit from the program is unknown and the proposed hardware and software has not been designed. Program implementation for PWDs is dependent upon success of the Shipboard System and future funding legislation. Because of this no time frame for PWD implementation has been set.

This program could not be evaluated by the author, since it is still in the long range planning phase.

D. NARDAC SUPPORT

The survey results showed many respondents supportive of a good batch system, especially for management reports. The Navy Regional Data

Automation Centers (NARDACs) can provide either batch processed support or interactive, timeshared support. NARDAC Jacksonville is the lead activity for developing PWD support software for all NARDACs. However, they currently have no PWD utilities support software (programs) other than financial file reports (TAB A & B, UCAR). NARDAC Jacksonville has stated it will develop a utilities support program at the request of a PWD, through the PWD's local NARDAC, most likely at no cost to the PWD. To date no PWD request has reached NARDAC Jacksonville.

A PWD cannot get an EMCS, an automatic load shedding program, nor a demand controller through a time share system at a NARDAC. However, all other utilities tasks can be supported.

Fiscal Year 80 U-1100 rates for NARDAC ADP charge back are given in Table VII. The U-1100 resource pool on that table stands for UNIVAC 1100 Computer, which is by far the most common NARDAC support computer[6]. Although some PWDs (specifically mission funded, previously supported customers) are not charged these rates, the support costs are still a cost to overall Navy Funding. In addition to paying these rates, the PWD would have to acquire a terminal for interactive support and possibly a modem and leased telephone line for communication.

Survey results showed sixty-eight (68) percent of the respondents needing ADP support willing to spend $6,000.00 per year for computer support. Further analysis showed respondents desiring interactive-real-time support were more willing to spend that amount than respondents desiring batch processed support (76 % to 53 %). To get an idea of the NARDAC support that $6,000.00 can purchase, Appendix E has been developed.

The scenario details a basic utilities support program. It is similar to the support received by NAS Corpus Christi on their minicomputer, but is expanded to include several other reports requested by respondents. The cost for three levels of support have been estimated. First, payment for batch support is estimated at $3,017.00 per year. (Back up for estimates can be found in Appendix F.)

Second, for the PWDs within voice grade telecommunication range of the NARDAC, cost for a timesharing support alternative is given. This essentially requires the rental of an in-house CRT terminal and deletion of computer card handling by the NARDAC. This assumes the PWD can initiate time-shared computer runs by the NARDAC through the CRT terminal. Turnaround time is assumed to be two working days, essentially the mailing time from NARDAC to PWD. Annual costs were estimated at $6,606.00.

Third, the addition of an in-house printer and deletion of NARDAC printing charges would give the PWO complete interactive-realtime response for approximately $7,981.00 per year. Note that no increase in computer use has been included for realtime over batch processing.

Although a rough estimate, the results indicate that a NARDAC can support the basic needs of questionnaire respondents at a price they would be willing to pay. Of course, this statement is true only for those respondents reporting a need for ADP support.

Some respondents requested ADP support from which they could get the UCAR. Some also wanted utilities maintenance cost record keeping support. These types of support require labor, materials, and overhead costs (the financial file), as well as the maintenance projects file. These records are usually maintained separately from utilities consumption

records by the PWD or the Comptroller. They should be a part of the PWD's management information system. However, both these sets of records are much larger by themselves than the data base for the basic utilities support scenario discussed earlier. In fact, the requirement to produce the UCAR, instead of just the UCAR Feeder Report, will increase the support system records by a factor of at least ten. Respondents would not be willing to pay the added expense for utilities support alone.

NARDAC support is not readily available to all PWDs. The Civil Engineer Support Office has estimated it can only support thirty (30) percent of the PWDs with interactive-realtime support[7]. Batch support, including card punching, is available to a significantly larger group by mail; perhaps double or triple that figure. NARDAC batch support currently received by PWDs for financial file reports was rated from very good to very poor.

NARDAC support places little or no maintenance responsibility on the PWO. Another advantage is that once utilities support software has been developed and debugged, new PWDs receiving support should receive proven bug-free support.

A disadvantage of using NARDACs or any type of outside support is the dependency upon that outside organization. The PWO has less control over his sources of information. Another disadvantage is that PWD jobs are competing for support with operational users who may be given a higher priority for processing, thereby significantly increasing turnaround time.

E. COMMERCIAL TIMESHARE SERVICE SUPPORT

A PWO interested in utilities support should also consider commercial timesharing service. Commercial timesharing service can provide the same type of support as a NARDAC at prices competitive with and in some cases, significantly lower than a NARDAC. The advantages over NARDACs are quick implementation, greater flexibility to change, tailored software, and competitive priority. The disadvantages are software development costs and contract development/administration efforts.

As an example, Pacific Timesharing, a local Monterey timeshare vendor was contacted by the author for a price quotation. Rates were as follows:

Connected or "Log-on" Time = $5.00/hour

Retrievable Storage = $2\frac{1}{2}$ ¢ /288 bytes or $87/megabyte/month

Note how much simpler and less expensive these rates are than the NARDAC rates of Table VII. Timeshare response time for this company was very good and the company's computer was down less than two hours per month over the past year. The company programmer had developed a considerable amount of software for a local military activity with great success. The company indicated it would be able to develop the software for a production, distribution, and billing system for an average size PWD inside of a week for less than $500.00. This example is but a single sample of a large population. However, it does illustrate that commercial timesharing is certainly an alternative worthy of investigation.

F. BEST SUPPORT

Survey results showed a definite block of respondents who wanted an in-house minicomputer. The Base Engineering Support, Technical (BEST)

TABLE VII

FY 80 Rates for NARDAC ADP Chargeback System

RESOURCE POOL	BILLING COMPONENT	RATE	
		ARU	DOLLARS
U-1100	Jobs	0.3000	0.2661/job
	Connect Time	7.2983	6.4736/hr.
	CPU Time	198.4889	176.0596/hr.
	Memory Time	11.85420	10.5146/hr.
	I/O Time	45.6478	40.4896/hr.
	Cards Read	0.0001	0.0001/per card
	Cards Punched	0.0020	0.0018/per card
	Pages Printed	0.0060	0.0053/per page
	Tape Mounts	1.0000	0.8870/mount
	Temp. Disk	0.0210	0.0186/track/hr CPU & I/O)
	Perm. Disk	0.0050	0.0044/track/day
	Disk Mounts	3.0000	2.66100/mount

Program is capable of supplying minicomputers to PWDs. It is supported by Department of Defense Productivity Dollars. To qualify for this funding, productivity increases must be possible. At least one half the increase in productivity, realized by introduction of the Productivity Enhancing Capital Investment (PECI), must result from labor reductions.

The majority of respondents, who reported manyear savings, indicated an average of .36 manyears. Assuming this person is a GS-5 with an annual salary and fringe benefits of $16,000.00, .36 manyears can support a maximum average annual investment of $11,520.00. (This assumes that other non-labor cost reductions can support half this figure.) This will support a minicomputer system worth approximately $37,000.00 with annual maintenance costs of $4,800.00. (See Appendix G for calculations and other initial cost versus maintenance cost scenarios.) Judging from other BEST minicomputer module cost estimates done by the Civil Engineer Support Office (CESO), the labor reduction constraint by itself will not defeat the minicomputer alternative. In other words, a $37,000 figure for acquisition and conversion is probably adequate for the basic utilities support outlined in Appendix E.

Only two respondents indicated a possible manpower savings, five or six personnel, capable of supporting the cost of an EMCS under this program. EMCS acquisition costs run from about $250,000 to $5,000,000. Annual maintenance costs, at ten percent, start at about $25,000. The BEST Program would also be unable to support financial file and maintenance file record keeping to support the utilities function alone for the same reasons noted earlier. The UCAR and the Utilities Maintenance

Report must be supported by labor cost savings other than those described in questionnaire responses.

There are several advantages to the BEST Program of minicomputer support. The interactive-realtime system provides immediate response. The PWO has control over system work priorities and flexible use of the support twenty-four hours a day, seven days a week. CESO will provide proven software to all PWDs and the commonality of systems between PWDs should promote the quick deployment of system improvements. Finally, the PWO is able to get the hardware and software at no cost to his department or his major claimant.

A disadvantage is that some PWDs will be unable to find maintenance support for the single, Navy wide brand of minicomputer selected. The PWO must also develop a maintenance service contract. A second disadvantage comes from the BEST Program philosophy of independent modules. The confusion of maintaining a half dozen minicomputers from different vendors could be a real problem. Also, the incompatibility between systems could cause duplication of data entry efforts to different functional areas.

Since the BEST Program is simply a fund source for productivity improvements, a second option for PWD support is possible. NAVFAC may request funding to develop only the software for support to the utilities function. The software would then be made available for use on large Navy computers to support the PWDs.

An advantage to this alternative is that the interested expert, NAVFAC, is developing the software. High quality, effective programs should result.

Disadvantages to this alternative are that each different Navy computer would require a specially developed set of software. CESO has noted at least five different, major computer systems in the Navy inventory. In addition, there are other minor computer systems serving some PWDs; while still others have access to no Navy mainframe computers at all.

V. CONCLUSIONS AND RECOMMENDATIONS

Survey results showed PWDs having existing support for the utilities function were strongly in favor of improving that support. Most respondents were not interested in highly sophisticated, "hands off" type support, but simply a timely and reliable basic report generating capability. In fact, batch processed reports would fill most requirements well, if they were timely and reliable. (except energy inefficient commands needing an EMCS)

NAVFAC's tentative target for support, super, large and medium command size activities is probably the best single criterion for selection, but still an inadequate measure by itself. It must be remembered that although seventy-one (71) percent within this category responded yes to needing ADP support, questionnaire respondents are likely to be slightly biased in favor of ADP and six Marine Corps Activities, activities not included in NAVFAC's original target list, responded yes. The number of Navy PWDs needing ADP support is closer to fifty (50) percent. It is recommended that the criteria in Appendix D be reviewed for use in targeting of independent support for the utilities function. In addition, those activities designated to receive large EMCSs will probably not require the basic utilities support package proposed in this chapter.

Questionnaire respondents were very interested in financial based report support. PWOs realize they have to manage in terms of dollars rather than manhours. The BEST Program requires the inclusion of the finance file, somewhere in the management information system, as a database which can be drawn upon by the other functional modules. To be timely enough for use with the utilities support package it should be obligation based. This is especially true for NIF organizations which must use full cost accounting procedures.

There is also a need for the BEST Program to address the needs of small and medium command size PWDs who could use a single ADP support source for many functional areas. These are the activities that are not quite large enough to support a need for independent computer support in the nine functional modules envisioned by BEST Program proponents.

Many PWDs emphasized the need for more meters and/or sensors to adequately utilize computer support in the utilities area. Any support alternative must deal with this need.

Basic billing, production, distribution, consumption and budgeting ADP support, such as that proposed in Appendix E; is not a large computer load. It could easily be run on hardware dedicated to other functional areas. For example, the BEST Program Transportation and Utilities Modules could easily be combined to utilize substantially the same minicomputer, thereby reducing acquisition costs.

It is recommended that the basic utilities support package proposed in Appendix E be used as a guideline for support requirements. In addition, a charting and graphing capability was desired by most PWD respondents needing utilities support. However, the need was not supported strongly enough to justify excessive additional cost.

There is no single alternative solution which will adequately meet the diverse needs of the PWD community. The BEST Program of minicomputer acquisition or software development, NARDAC support and commercial timeshare service can all meet the needs of the PWO at reasonable cost. Each solution has its advantages and disadvantages. It is recommended that a letter be sent to newly targeted PWDs explaining the basic utilities support package proposed herein. The letter should also outline the ADP support alternatives, briefly noting advantages and disadvantages of each. Responses would then provide the basis for a plan of action by NAVFAC.

A final recommendation is that the needs of NAVFAC for future centralized information gathering be defined. If NAVFAC Headquarters envisions a telecommunication network for PWD information, certain standards for system software, languages and reporting format will have to be set. Then acquisition specifications can be developed for network systems compatibility.

APPENDIX A

PUBLIC WORKS UTILITIES GOALS AND POLICIES

Part One: Scope and Objectives

Objectives. The objectives of the Utilities Management Program are:

A. To furnish utilities services as required to accomplish the mission assigned and operate upon policies insuring the high quality and proper use of such services.

B. To provide management and engineering services to insure the most effective and efficient operation of utilities to conserve energy and financial resources.

C. To maintain in the most economical manner all active real property to a standard which will prevent deterioration beyond normal wear and tear, and inactive facilities to a standard commensurate with reactivation requirements.

D. To provide timely planning and programming for the expansion and/or replacement of utility systems, or parts thereof, and to accomplish alterations, additions, and other modifications to existing facilities, and minor new construction, as necessary to provide essential facilities for changes in mission or other circumstances which preclude programming under normal construction budget procedures.

Policies.

A. Positive programs for the conservation of utilities services are to be initiated and continued to insure that the usage does not exceed the actual requirements or imposed limits.

B. Utilities services are to be purchased from existing commercial

systems where economically possible in lieu of construction or expansion of Department of Defense installations. Maximum use is to be made, on a cross-serving basis, of a government-owned or operated utilities.

C. Utility maintenance programs, consistent with accepted engineering standards and practices, are to be established. Maintenance practices must receive continued analysis with a view toward accomplishment by the most economical means. This work is to be programmed to permit orderly and economical accomplishment. Standby, emergency or alternate facilities are to be installed and maintained only as necessary to meet departmental operational requirements. Heating plants, cold storage and refrigeration plants, and pumping plants are to be automatically controlled wherever practical.

D. Supervisory improvement programs directed toward improved management and supervision of maintenance and utilities operations activities, are to be initiated and/or continued. Particular emphasis must be placed on the effective use of budget, cost, operating, property and fiscal information at all levels.

E. The activities of the installation will be concentrated in a minimum number of facilities to economize on maintenance and conserve utilities. Periodic review of the activities of the installation are to be made to insure that only the minimum number of facilities required are being utilized.

F. Utilities Systems shall be maintained and operated in accordance with applicable environmental regulations.

Definition of Public Utilities. Public utilities refers to the fixed

facilities and systems which provide major utilities services at naval shore activities and generally include the following:

A. Telephone systems.

B. Electrical power supply and distribution systems.

C. Water supply treatment and distribution systems including systems for fire protection.

D. Heating systems, steam, hot water and others over 750,000 BTU/hr.

E. Sewage collection, treatment and disposal facilities.

F. Airconditioning equipment and plants with a capacity of five tons and over.

G. Ice manufacturing equipment and cold storage plants operated by Public Works Department.

H. Exterior separate alarm systems-both local and central reporting types.

I. Gas generating plants, storage facilities and transmission lines.

J. Compressed air plants and systems.

K. Miscellaneous utilities, including central dehumidification and hydraulic systems, acetylene and oxygen generating plants.

Utility systems are identified by the 800 class of Navy Catagory Codes.

Part Two: Responsibilities, Organization, and Staffing

Responsibilities.

A. Activity Line Responsibilities:

1. The Commanding Officer. The Commanding Officer is responsible for the proper management of funds allocated for the operation and maintenance of utilities according to the regulations prescribed by his chain of command.

2. Public Works Officer. The Public Works Officer is responsible to the Commanding Officer for the organization, administration and supervision of the Public Works Department, which includes the responsibility for the operation, distribution, maintenance and repair of public utilities.

Specifically the PWO is responsible for providing adequate utilities services at the lowest cost commensurate with the mission fulfillment in the quantities, and at the time and place required, to assure activity capability in meeting mission requirements.

3. Assistant Public Works Officer. The Assistant Public Works Officer is responsible to the Public Works Officer for day-to-day operations and overall coordination of the several organizational components of the department. He is specifically responsible for the direction of planning activities and subsequent follow-up. He also exercises control over performance and technical and management guidance to subordinate supervisors. At smaller activities, the Assistant Public Works Officer is responsible for providing direct supervision for day-to-day operation of, and coordination of all matters pertaining to, the operations of maintenance, utilities and transportation divisions. At larger activities, the latter responsibilities are delegated by the Assistant Public Works Officer to the Shops Engineer, who is held responsible for providing required day-to-day supervision over the three operating divisions.

4. Shops Engineer. The Shops Engineer, or his counterpart, is

responsible to the Assistant Public Works Officer for the direction and coordination of all matters pertaining to the operations of the maintenance, utilities and transportation divisions and for maintaining liaison with other activity departments on problems relating to maintenance, utilities and transportation. His duties include the following:

a. The determination of areas of excessive direct or overhead labor cost, and the providing of direction of corrective measures.

b. The verification of progress on specific jobs.

c. The comparison of the available labor with apparent or anticipated work loads, and the recommendation of work forces as required.

d. The review of work methods to assure the adoption of the most economical use of equipment and manpower.

5. Utilities Division Officer. The Utilities Division Officer (UDD) or his counterpart, is responsible to the Assistant Public Works Officer/Shops Engineer for the operation and maintenance of all activity utilities plants and distribution systems. His is the key position in the overall utilities operation. He is responsible for providing the required utilities services, where and when they are wanted, and at the lowest practical cost to the government. Specifically his duties include the following:

a. The operation of utility systems at target conditions, in cooperation with the Utilties Engineer, and the monitoring of plant efficiency and performance.

b. The direction and supervision of all operator and preventive maintenance inspections on utilities equipment and systems when performed by utilities personnel.

c. The provision of technical advice and recommendations to the Assistant Public Works Officer on the planning an scope of maintenance to be performed on utilities plants and systems.

d. In cooperation with the Utilities Engineer, MCDD and MDD, the scheduling of equipment shutdowns for the accomplishment of inspection and maintenance.

e. The inspection and approval of all maintenance work performed on utilities equipment and systems.

f. The organization of the division for the effective accomplishment of assigned responsibilities.

6. Maintenance Division Director. The Maintenance Division Director (MDD), or his counterpart, is responsible to the Assistant Public Works Officer/Shop Engineer for the maintenance of all public utilities, except where preventitive maintenance is accomplished by utilities personnel. When authorized, his responsibility includes the repair, alteration and new construction incident to maintenance, except work which may be done by private contract, and service work performed by utilities operators/inspectors. Maintenance division personnel are responsible for all other maintenance required on utilities equipment and systems as determined and approved by the Utilities Division Director, and authorized in accordance with the pertinent provisions contained in NAVFAC MO-321. The Maintenance Division Director will retain responsibility for the maintenance of the facilities housing

utilities, but he shall coordinate and arrange all projected work with the Utilities Division Director before proceeding with any work in the utilities area.

B. Activity Staff Responsibilities:

1. Utilities Engineer. The Utilities Engineer or his counterpart, is responsible to the Assistant Public Works Officer for providing continuous technical assistance in the operation, maintenance utilization and conservation of utilities. He serves as an advisor and expert consultant on utilities matters. His functions involve the application of engineering research techniques in the management of utilities. His major goals are to increase production efficiency, to reduce distribution losses, to eliminate usage waste and to procure utilities at a minimum cost. His position may be established as a staff assistant to the PWO or APWO or to the UDD. He may, however, be assigned to the Engineering Division under its director.

He must research all aspects of utilities system, including metering and measurement, testing, operating methods, utilities plant maintenance programs, distribution characteristics and consumer usage requirements. This applies to electricity, steam, heating, air conditioning, water supply, sewage, wire communication, compressed air, volatile liquids and gas systems. Application of this research to practical utilities management is made through his findings which provide information and guidance to operation and maintenance personnel. He accomplishes this as a consultant to the Assistant Public Works Officer, Shops Engineer, the

Utilities Division Director, the Maintenance Control Division Director and other personnel concerned in the planning, organizing, directing and controlling of the utilities system. The Utilities Engineer's major duties and responsibilities include:

a. Developing utilities systems plans, programs and procedures.

b. Planning and pursuing a progressive utilities (energy) conservation program at the activity.

c. Developing the required production and usage targets for the economical operation of utility systems in cooperation with the Utilities Division Director.

d. Furnishing information and guidance to operating and maintenance personnel on the standards and criteria.

e. Exercising continuous interest concerning the quality of the service provided.

f. Performing technical and economic evaluation of the utilities service requirements, and developing information essential to long-range planning for load growth, system flexibility and proper equipment selection.

g. Assisting the UDD, the MCDD and the MDD in developing utilities emergency plans and developing operational procedures for casualty conditions.

h. Participating in the preparation and analysis of utilities management reports.

For complete discussion of the Utilities Engineer's duties, refer to NAVFAC P-96.

2. Maintenance Control Division Director. The Maintenance Control

Division (MCDD) is responsible to the Assistant Public Works Officer for planning the maintenance workload program, and for screening and classifying all work requests prior to their submission to the maintenance shops for accomplishment. For a complete statement of his duties, see NAVFAC P-318.

With respect to public utilities, his primary duty is to plan for and schedule the inspection on all utilities systems and facilities, in conjunction with the Utilities Engineer and the UDD.

3. Engineering Division Director. The Engineering Division Director is responsible to the Assistant Pulic Works Officer for utilities matters pertaining to engineering studies normally under or coordinated with the Utilities Engineer, preliminary designs and estimates for special repair and improvement projects, and engineering designs, including the development of plans and specifications.

C. EFD Responsibilities. The EFD's acting as extensions of NAVFAC, provide middle management for all utilities programs. They are responsible for directing the implementation of programs developed at the NAVFAC level, and for providing the continuance of these programs. This assistance is provided in:

1. Planning to meet facility requirements.
2. Programming to improve utilization, operations and maintenance.
3. Procurement and sale of utilities services.
4. Technical analyses and counsel.
5. Application of utility cost accounting procedures.

6. Establishment of proper information flow, including logs and reports.

7. Preparation and use of management reports.

8. Analysis of reports for the detection and anticipation of problems and savings opportunities.

9. Selection of the corrective action most applicable to the problem at hand.

D. Commander, NAVFAC Responsibilities. The Commander, NAVFAC, is the technical advisor to the Chief of Naval Operations for utilities management, and is responsible for ensuring that public utilities at all Naval activities are properly planned, managed and maintained. This responsibility includes establishing operating and maintenance standards and procedures pertinent to utilities programs, and for developing management reports and technical guides.

Organization:

A. The Utilities Division is basically a production or operating element of the Public Works Department. The organizational structure of the Division depends upon the diversity of the utility services provided, and the extent and complexity of the systems operated.

B. Typical organizational structures for large and small Public Works Departments are included in NAVFAC P-318.

Staffing:

A. The personnel staffing of the Utilities Division are predominately Wage System, or blue collar employees. Normally, the only classified or general schedule employees assigned to the Division would be clerical and stenographic personnel.

B. Criteria for staffing the Division are contained in the following directives:

1. NAVFAC P-318

2. NAVFACINST 11300.7

APPENDIX B

PWD LIST BY COMMAND SIZE

SUPER

SUBASE BANGOR
NAVSHIPYD PORTSMOUTH, NH
NAVSHIPYD PHILA
NAVSHIPYD PORTSMOUTH, VA
NAVSHIPYD CHARLESTON
NAVSHIPYD MARE ISLAND
NAVSHIPYD PUGET SOUND
NAS POINT MUGU
NAS JACKSONVILLE
NATC PAX RIVER
NAVAL ACADEMY ANNAPOLIS
MCAS EL TORO
NAVSTA ROTA, SPAIN
NAVSTA WASHINGTON, D.C.
NAVSTA GTMO
NETC NEWPORT
NAVWPNCEN CHINA LAKE

LARGE

NAVSHIPYD LONG BEACH
NAVAIRENGCEN LAKEHURST
NAS BRUNSWICK
NAS OCEANA
NAS CECIL FIELD
NAS BERMUDA
NAS MEMPHIS
NAS MIRAMAR
NAS LEMOORE
NAS MOFFET FIELD
NAS WHIDBEY ISLAND
NAF ATSUGI, JAPAN
NAVSTA ROOSEVELT ROADS
NAVSTA ADAK
NAVSTA KEFLAVIK
NAVWPNSTA CHARLESTON
NAVWPNSTA CONCORD
NAS CORPUS CHRISTI
NAS KEY WEST
NAVWPNSTA YORKTOWN
MCB CAMP PENDLETON
MCB CAMP LEJUNE
NAVSURFWPNCEN DAHLGREN
NATNAVMEDCEN BETHESDA
NAVSURFWPNCENLAB WHITE OAK
NOS INDIAN HEAD
SUBASE NEW LONDON
NAVPHIBASE LITTLE CREEK
SPCC MECHANICSBURG
NTC ORLANDO
PG SCHOOL MONTEREY
CBC PORT HUENEME
NRL WASHINGTON, D.C.
NAVSUPPACT NAPLES
NAVORDFAC SASEBO
MCAS BEAUFORT
MCAS KANEOHE BAY
MCAS IWAKUNI, JAPAN
MCAS YUMA
NAVWPNSTA SEAL BEACH
NAVWPNSUPPCEN CRANE
SUBASE KINGS BAY
MCDEC QUANTICO

MEDIUM

NAS KINGSVILLE
NAS WHITING FIELD
NAS MERIDIAN
NAF SIGONELLA
NAVWPNSTA EARLE
NAVSTA MAYPORT
NAVSTA MIDWAY
NAVSTA PANAMA CANAL
NAVSUPPACT NEW ORLEANS
NAS CHASE FIELD
NAVSUPPACT BROOKLYN
NAVAIRDEVCEN WARMINSTER
FLT AA WARFARE TRNG CTR, VA BEACH
ASO PHILA
NAVAVIONICSCEN INDIANAPOLIS
CBC GULFPORT

MEDIUM, CONT.

NAVCOMMSTA STOCKTON
NAVCOMMSTA HAROLD E. HOLT
NAVFAC ARGENTIA
NUSC NEWPORT
DEFELECSUPCEN DAYTON
CAMP BUTLER OKINAWA
MCAS CHERRY POINT

COMNAVACTS UK
NAVREGMEDCEN PORTSMOUTH, VA
NAVSUPPFAC DIEGO GARCIA
DTNSRDC BETHESDA
NAVCOMMSTA PUERTO RICO
MCRD PARRIS ISLAND
MARCORB TWENTYNINE PALMS

SMALL

NAS SOUTH WEYMOUTH
NAS WILLOW GROVE
NAS ATLANTA
NAS DALLAS
NAS NEW ORLEANS
NAS GLENVIEW
NAS FALLON
NAF ANDREWS
NAVCOMMSTA GREECE
NAVSUPPFOR ANTARCTICA

NAVSECGRUACT EDZELL
NAVSECGRUACT SABANA SECA
NAVRADSTA CUTLER
NAVSECSTA WASHINGTON, D.C.
NAVREGMEDCEN PHILA
NAVAIRPROPCEN, TRENTON
NAVORDSTA LOUISVILLE
NAVPARACHUTETESTRAN EL CENTRO
NAVSHIPRESDEVCEN ANNALAB

BASIC

NAVCOMMSTA JAPAN DET KAMISEYA
NAVARCLAB PT BARROW
NAVCOMMU THRUSO UK
NAVSECGRUACT WINTER HARBOR
NAVSECGRUACT NORTHWEST
NAVREGMEDCEN CAMP LEJEUNE
NAVCOASTSYSLAB PANAMA CITY
NAF MISAWA
NAF SOUDA BAY
FLT SUPOFF LA MADDALENA

NAVFAC ELEUTHRA
NAVFAC LEWES
SUPPLY CORPS SCH ATHENS
NAVSUPCEN NORTH CHEATHAM ANNEX
NAVOBSERV WASHINGTON, D.C.
NAVMEDRESEARCHUNIT #3 CAIRO
ASA DET "A" ANTARCTICA
NAVSUPPACT SEATTLE
NAVANTSUPPFOR DET CHRISTCHURCH
NAVACT UK DET HOLY LOCH

APPENDIX C

SURVEY COVER LETTER AND QUESTIONNAIRE

August 6. 1980
LT Brad Fowler
CEC, USN
AV: 878-2537

Dear Sir,

For my NPGS thesis, I am analysing the pros and cons of Computer Support for the PWD Utilities Function. My recommendations will be reviewed by NAVFAC as they develop the PWD Base Engineering Support, Technical (BEST) management information program. The BEST program will be funded by DOD productivity money. Support being explored includes micro/minicomputers and real time/interactive terminal to mainframe options, in addition to standard batch systems. Utilities is one of eight PWD functions the BEST program addresses. Each function will be supported independently, ie. separate computer support systems for separate PWD functions. This will allow flexible support to widely differing PWD taskings.

Please take a few minutes to fill out the enclosed questionaire and return it via the self-addressed envelope. This is not intended to be simply a statistical questionaire. Please comment on anything you feel is relevant and please elaborate as much as your busy schedule permits. Help a poor CEC Officer through college today!

I'll be glad to send you the survey results. Just let me know you're interest somewhere on the questionaire.

Very respectfully,

Brad Fowler

UTILITIES SUPPORT QUESTIONAIRE

I. A. Does your department already have automated data processing (ADP) support for the utilities function? YES NO

If so, who supports you? (ex. in-house, station ADP center, etc.)

Is the support from a batch system or an interactive, real time system?

And in what areas? (Please briefly describe the reports)

1) Allocation and/or billing reports

2) Production/Distribution system performance and condition reports

3) Efficiency of service utilization reports (usage target variances)

4) Operating control system

5) Planning and/or Budget execution reports

6) Other

B. How would you rate the quality of your current support? (In the matrix below, 1 = GOOD, 2 = AVERAGE, 3 = POOR)

	1	2	3	4	5	6
a) Timeliness						
b) Accuracy						
c) Reliability						
d) Programming ability						
e) Ease of correction						

←(keyed to areas listed above)

Please comment on problems. (If any)

II. A. Does your department need to have (not like to have!), computer support for the utilities function? (whether or not already receiving support) Note: Computer support meaning anything from mini/micro in-house to batch from a local ADP support center. YES NO

If NO, why? (insufficient volume, computer unreliability, etc.)

(II. A. cont.)

If YES, for what specifically? (Again, please briefly comment)

1) Allocation and/or Billing reports

2) Production/Distribution system performance and condition reports

3) Efficiency of service utilization reports (usage target variances)

4) Operating control system

5) Planning and/or Budget execution reports

6) Other

Who in the organization needs the support? (please circle)
PWO APWO SHOPS ENGR UTIL ENGR UDD MCDD MDD Other__________

Would batch processing be adequate or is interactive/real time needed? (please explain briefly)

Would the computer support be worth $6000.00 annually from your operating budget? (for utilities support only!) YES NO

B. Could you save utilities manpower resources with a minicomputer? YES NO
Any idea how much? (Please elaborate on where savings occur)

C. How important would a computer charting/graphing capability be to your utilities management? What response time do you need? (hours, days, wks)

III. Please fill in the following parameters for FY 1979.

A. Total Dept. Budget ________ Total Dept. Pers. ______ (Mil + Civ (perm))

B. Utilities produced ______________________________

C. Number of personnel dedicated specifically to utilities.
Maintenance ________ Operations ________ Administration ________
Is this staffing level adequate in each area? (Please comment)

D. Utilities budget NIF ________ O&M,N ________

E. Questionaire filled out by: ________________ Billet _______ Ph. ext. ____

APPENDIX D

TARGET PWD CRITERIA

PWDs with the following characteristics MOST LIKELY need utilities support:

- -Utility budget > $ 4 million
- -Utility budget > $ 3 million <u>and</u> Overall Personnel > 450
- -Utility budget > $ 3 million <u>and</u> Utilities Administrative personnel >5
- -Utility budget > $ 3 million <u>and</u> Overall budget > $ 7 million
- -Overall budget > $ 15 million
- -Overall personnel > 450
- -Utilities maintenance personnel > 20
- -Utilities operations personnel > 30
- -Marine Corps Activities
- -Air Stations
- -Shipyards
- -Activities already receiving support
- -Steam production <u>and</u> utilities budget > $ 1 million
- -Two or more utilities production <u>and</u> utilities budget > $ 4 million
- -Super command size
- -Large command size <u>and</u> utilities budget > $ 3 million
- -Medium command size <u>and</u> utilities budget > $ 1 million
- -Medium command size <u>and</u> steam production

PWDs with the following characteristics SHOULD NOT be considered for utilities support:

- -Overall budget < $ 2 million
- -Overall personnel < 100
- -Small command size

APPENDIX E

NARDAC SUPPORT SCENARIO COST ANALYSES

REPORTS:

Monthly

-Cumulative Consumption Report

-UCAR Feeder

-DEIS II

-Billing Report

-Budgeted Vs. Actual Resource Usage in Dollars (excluding maintenance labor, overhead and materials)

Weekly

-Production/Distribution Performance Report

Periodically

-Utilities Forecast Analysis for Resource Usage in Dollars (excluding maintenance labor, overhead and materials)

Total: 10 JOBS/MONTH

ENTRY REQUIREMENTS: (10 HOURS/MONTH MAXIMUM ASSUMED)

Monthly

-meter readings

Periodically

-Utility Rates

-Fuel Prices

PAYMENT TO NARDAC

(time estimates are explained in Appendix F)

Jobs	:	10 X .2661	=	$ 2.66
Connect Time	:	1 hr. X $6.4736/hr.	=	6.47
CPU Time	:	5 Min.X .0167 hr/min X $176.0596/hr	=	14.67
Memory Time	:	6 hr X $10.5146	=	63.09
I/O Time	:	3 hr X $40.4896/hr	=	121.47
Cards Read	:	500 X $.0001/card	=	.05
Cards Punched	:	500 X $.0018/card	=	.90
Pages Printed	:	60 X $.0053/page	=	.32
Tape Mounts	:	0	=	00.00
Temp. Disk	:	206TK X 3.0167hr X $.0186/track hr.	=	11.56
Perm. Disk	:	206 TK X 30 Days X $.0044/track day	=	27.19
Disk Mounts	:	1 Mount X $3.00/mount	=	3.00
		Total/month		$ 251.38

Total to NARDAC/month	$251.38	(A)
Total to NARDAC/year	$3017.00	(B)

Addition of in-house terminal

1 CRT Terminal	$265.00		
1 Modem	20.00		
1 Leased Telephone Line	15.00		
Total Equipment & Maintenance/mon	$300.00		
Less Card reading & Punching/mon	.95		
Total Equip. & Main. /mon	$299.05	(C)	or $3589.00/year (D)

NEW TOTAL OF A + C = $550.43/mon

NEW TOTAL OF B + D = $6,606.00/year

Addition of in-house printer

1 Printer	= $115.00	
less pages printed	= .32	
total per month	$114.68	(E)

NEW TOTAL OF A + E + C = $665.21/month

or TOTAL YEARLY COST OF $7981.00

APPENDIX F

MONTHLY ESTIMATES FOR BASIC NARDAC UTILITIES SUPPORT

Jobs	:	10 per month (See Appendix E)
Connect Time	:	1 hour per month. Based on CESO estimates.
CPU Time	:	5 minutes. Nas Corpus Christi uses 35 minutes of CPU time for the top four monthly jobs. Estimate of another 15 min. for the bottom two jobs, bringing total to 50 minutes. 50 minutes of computer time on a minicomputer would be reduced at least ten-fold on a main frame 50 ÷ 10 = 5 min.
Memory Time	:	6 hours. Based on CESO estimates of 1:6 relationship between connect time and memory time.
I/O Time	:	3 hours. Based on CESO estimates of 1:3 relationship between connect & I/O time.
Cards punched	:	500. Based on estimated monthly meter readings.
Cards read	:	500. Based also on estimated monthly meter readings.
Pages Printed	:	60

Cumulative Consumption Report	2
UCAR Feeder	1
DEIS II	1
Billing Report (50 Customers)	50
Budget Vs Actual Resource Usage	2
Production/Distribution Report 1 X 4/mon.	4
TOTAL	60

Tape Mounts	:	0
Temporary Disk	:	206 Tracks. Nas Corpus Christi uses less than one megabyte of on-line storage. One megabyte X 206 tracks/megabyte = 206 tracks. CPU & I/O Time = 3.0167 hrs
Permanent Disk	:	Assumed same as above.
Disk Mounts	:	1

APPENDIX G

BEST PROGRAM INVESTMENT ANALYSIS

Assumption 1: .36 manyears labor cost reduction

Assumption 2: GS-5 Salary and Fringe benefits = $16,000.00

Annual Labor Cost Savings : $5,760.00
(.36 X $16,000.00)

Assumption 3: Total annual cost savings is double Labor cost Savings. Total annual cost savings: 2 X $5,760 = $11,520.00

Scenario 1

Minicomputer investment with $500.00/month maintenance costs and eight (8) year life.

Annual maintenance = 12mon/yr X $500/mon = $6,000/year

Annual cost savings left to amortize initial investment:

$11,500 - 6,000 = $5,520

Present value of annuity of $5,520 @ 10 % for 8 years:

$5,520 X 5.597 = $30,895

Scenario 2

Minicomputer investment with $400/month maintenance costs and 8 year life

Annual maintenance = 12mon/yr X $400/mon = $4,800/year

Annual cost savings left to amortize initial investment:

$11,520 - 4,800 = $6,720

Present value of annuity of $6,720 @ 10 % for 8 years:

$6,720 X 5.597 = $37,612

Scenario 3

Minicomputer investment with $400/month maintenance costs and 5 years life

Present value of Annuity of $6,720 @ 10 % for 5 years:

$6,720 X 3.977 = $28,634

CROSSTABULATION OF BUDUT UTILITIES BUDGET BY NEEDADP DO THEY NEED ADP SUPPORT?

BUDUT	COUNT / ROW PCT / COL PCT / TOT PCT	NEEDADP YES 1	NO 2	ROW TOTAL
$0-1M	1	5 41.7 12.8 9.1	7 58.3 43.8 12.7	12 21.8
$1-2M	2	12 92.3 30.8 21.8	1 7.7 6.3 1.8	13 23.6
$2-3M	3	3 60.0 7.7 5.5	2 40.0 12.5 3.6	5 9.1
$3-4M	4	2 50.0 5.1 3.6	2 50.0 12.5 3.6	4 7.3
$4-6M	5	8 88.9 20.5 14.5	1 11.1 6.3 1.8	9 16.4
$6-9M	6	4 80.0 10.3 7.3	1 20.0 6.3 1.8	5 9.1
$>9M	7	5 71.4 12.8 9.1	2 28.6 12.5 3.6	7 12.7
	COLUMN TOTAL	39 70.9	16 29.1	55 100.0

NUMBER OF MISSING OBSERVATIONS = 13

CROSSTABULATION OF OVLBUD OVERALL PWD BUDGET BY NEEDADP DO THEY NEED ADP SUPPORT?

OVLBUD		COUNT / ROW PCT / COL PCT / TOT PCT	NEEDADP YES 1	NO 2	ROW TOTAL
$0-2M	1	COUNT	2	3	5
		ROW PCT	40.0	60.0	9.3
		COL PCT	5.7	15.8	
		TOT PCT	3.7	5.6	
$2-4M	2	COUNT	4	2	6
		ROW PCT	66.7	33.3	11.1
		COL PCT	11.4	10.5	
		TOT PCT	7.4	3.7	
$4-7M	3	COUNT	6	4	10
		ROW PCT	60.0	40.0	18.5
		COL PCT	17.1	21.1	
		TOT PCT	11.1	7.4	
$7-10M	4	COUNT	5	3	8
		ROW PCT	62.5	37.5	14.8
		COL PCT	14.3	15.8	
		TOT PCT	9.3	5.6	
$10-15M	5	COUNT	3	6	9
		ROW PCT	33.3	66.7	16.7
		COL PCT	8.6	31.6	
		TOT PCT	5.6	11.1	
$15-20M	6	COUNT	9	0	9
		ROW PCT	100.0	0.0	16.7
		COL PCT	25.7	0.0	
		TOT PCT	16.7	0.0	
$>20M	7	COUNT	6	1	7
		ROW PCT	85.7	14.3	13.0
		COL PCT	17.1	5.3	
		TOT PCT	11.1	1.9	
	COLUMN TOTAL		35	19	54
			64.8	35.2	100.0.

NUMBER OF MISSING OBSERVATIONS = 14

OVLPER OVERALL PWO PERSONNEL C R O S S T A B U L A T I O N O F BY NEEDADP DO THEY NEED ADP SUPPORT?

OVLPER	COUNT / ROW PCT / COL PCT / TOT PCT	NEEDADP YES 1	NO 2	ROW TOTAL
0-99 P	1	2 25.0 5.6 3.7	6 75.0 32.3 11.1	8 14.8
100-149 P	2	9 81.8 25.0 16.7	2 18.2 11.1 3.7	11 20.4
150-199 P	3	6 75.0 16.7 11.1	2 25.0 11.1 3.7	8 14.8
200-299 P	4	6 50.0 16.7 11.1	6 50.0 33.3 11.1	12 22.2
300-449 P	5	5 71.4 13.9 9.3	2 28.6 11.1 3.7	7 13.0
450-600 P	6	5 100.0 13.9 9.3	0 0.0 0.0 0.0	5 9.3
>600 P	7	3 100.0 8.3 5.6	0 0.0 0.0 0.0	3 5.6
	COLUMN TOTAL	36 66.7	18 33.3	54 100.0

NUMBER OF MISSING OBSERVATIONS = 14

C R O S S T A B U L A T I O N   O F
NIFORG   MOSTLY NIF FUNDED   BY   NEEDADP   DO THEY NEED ADP SUPPORT?

NIFORG	COUNT / ROW PCT / COL PCT / TOT PCT	NEEDADP: YES 1	NO 2	ROW TOTAL
	1	9 60.0 22.5 14.5	6 40.0 27.3 9.7	15 24.2
	2	31 66.0 77.5 50.0	16 34.0 72.7 25.8	47 75.8
	COLUMN TOTAL	40 64.5	22 35.5	62 100.0

NUMBER OF MISSING OBSERVATIONS = 6

CROSSTABULATION OF MNTPERS NUMBER OF MAINTENANCE PERSONNEL BY NEEDADP DO THEY NEED ADP SUPPORT?

MNTPERS	COUNT / ROW PCT / COL PCT / TOT PCT	NEEDADP: YES 1	NO 2	ROW TOTAL
0-5 PERS	1	9 64.3 26.5 17.6	5 35.7 29.4 9.8	14 27.5
6-10 PERS	2	1 14.3 2.9 2.0	6 85.7 35.3 11.8	7 13.7
11-20 PERS	3	11 68.8 32.4 21.6	5 31.3 29.4 9.8	16 31.4
21-30 PERS	4	6 85.7 17.6 11.8	1 14.3 5.9 2.0	7 13.7
>30 PERS	5	7 100.0 20.6 13.7	0 0.0 0.0 0.0	7 13.7
	COLUMN TOTAL	34 66.7	17 33.3	51 100.0

NUMBER OF MISSING OBSERVATIONS = 17

C R O S S T A B U L A T I O N   O F

OPSPERS   NUMBER OF OPS PERSONNEL   BY   NEEDADP   DO THEY NEED ADP SUPPORT?

OPSPERS	COUNT / ROW PCT / COL PCT / TOT PCT	NEEDADP YES 1	NO 2	ROW TOTAL
0-5 PERS	1	5 50.0 12.5 8.5	5 50.0 26.3 8.5	10 16.9
6-10 PERS	2	8 57.1 20.0 13.6	6 42.9 31.6 10.2	14 23.7
11-20 PERS	3	8 80.0 20.0 13.6	2 20.0 10.5 3.4	10 16.9
21-30 PERS	4	3 60.0 7.5 5.1	2 40.0 10.5 3.4	5 8.5
>30 PERS	5	16 80.0 40.0 27.1	4 20.0 21.1 6.8	20 33.9
	COLUMN TOTAL	40 67.8	19 32.2	59 100.0

NUMBER OF MISSING OBSERVATIONS = 9

C R O S S T A B U L A T I O N O F

ADPERS NUMBER OF ADMINISTRATIVE PERSONNEL BY NEEDADP DO THEY NEED ADP SUPPORT?

ADPERS	COUNT / ROW PCT / COL PCT / TOT PCT	NEEDADP: YES 1	NO 2	ROW TOTAL
0-1 PERS	1	17 60.7 43.6 29.3	11 39.3 57.9 19.0	28 48.3
2 PERS	2	7 70.0 17.9 12.1	3 30.0 15.8 5.2	10 17.2
3 PERS	3	2 66.7 5.1 3.4	1 33.3 5.3 1.7	3 5.2
4-5 PERS	4	5 83.3 12.8 8.6	1 16.7 5.3 1.7	6 10.3
>5 PERS	5	8 72.7 20.5 13.8	3 27.3 15.8 5.2	11 19.0
	COLUMN TOTAL	39 67.2	19 32.8	58 100.0

NUMBER OF MISSING OBSERVATIONS = 10

C R O S S T A B U L A T I O N O F

COMMAND COMMAND SIZE BY NEEDADP DO THEY NEED ADP SUPPORT?

COMMAND	COUNT / ROW PCT / COL PCT / TOT PCT	NEEDADP: YES 1	NO 2	ROW TOTAL
SMALL	1	3 33.3 7.1 4.7	6 66.7 27.3 9.4	9 14.1
MEDIUM	2	13 76.5 31.0 20.3	4 23.5 18.2 6.3	17 26.6
LARGE	3	17 65.4 40.5 26.6	9 34.6 40.9 14.1	26 40.6
SUPER	4	9 75.0 21.4 14.1	3 25.0 13.6 4.7	12 18.8
	COLUMN TOTAL	42 65.6	22 34.4	64 100.0

NUMBER OF MISSING OBSERVATIONS = 4

* * * * * * * * * * * * * * * * * * C R O S S T A B U L A T I O N O F * * * * * * * * * * * *
RESPON QUESTIONAIRE RESFONDENT . BY NEEDADP DID THEY NEED ADP SUPPORT?
* *

RESPON	COUNT / ROW PCT / COL PCT / TOT PCT	NEEDADP YES 1	NO 2	ROW TOTAL
PWO	1	13 59.1 33.3 21.3	9 40.9 40.9 14.8	22 36.1
APWO	2	5 55.6 12.8 8.2	4 44.4 18.2 6.6	9 14.8
MGMT ANL	3	7 100.0 17.9 11.5	0 0.0 0.0 0.0	7 11.5
UT ENGR	4	4 80.0 10.3 6.6	1 20.0 4.5 1.6	5 8.2
UDD	5	3 60.0 7.7 4.9	2 40.0 9.1 3.3	5 8.2
SHP ENGR	6	1 100.0 2.6 1.6	0 0.0 0.0 0.0	1 1.6
UT SPVR	7	2 50.0 5.1 3.3	2 50.0 9.1 3.3	4 6.6
OTHER	8	4 50.0 10.3 6.6	4 50.0 18.2 6.6	8 13.1
	COLUMN TOTAL	39 63.9	22 36.1	61 100.0

NUMBER OF MISSING OBSERVATIONS = 7

CROSSTABULATION OF STM PRODUCE STEAM BY NEEDADP DO THEY NEED ADP SUPPORT?

STM	COUNT / ROW PCT / COL PCT / TOT PCT	NEEDADP YES 1	NO 2	ROW TOTAL
YES	1	31 72.1 72.1 46.3	12 27.9 50.0 17.9	43 64.2
NO	2	12 50.0 27.9 17.9	12 50.0 50.0 17.9	24 35.8
	COLUMN TOTAL	43 64.2	24 35.8	67 100.0

NUMBER OF MISSING OBSERVATIONS = 1

CROSSTABULATION OF ELEC PRODUCE ELECTRICITY BY NEEDADP DO THEY NEED ADP SUPPORT?

ELEC	COUNT / ROW PCT / COL PCT / TOT PCT	NEEDADP YES 1	NO 2	ROW TOTAL
YES	1	9 50.0 20.9 13.4	9 50.0 37.5 13.4	18 26.9
NO	2	34 69.4 79.1 50.7	15 30.6 62.5 22.4	49 73.1
	COLUMN TOTAL	43 64.2	24 35.8	67 100.0

NUMBER OF MISSING OBSERVATIONS = 1

C R O S S T A B U L A T I O N O F WTR PRODUCE WATER BY NEEDADP DO THEY NEED ADP SUPPORT?

WTR	COUNT / ROW PCT / COL PCT / TOT PCT	NEEDADP YES 1	NO 2	ROW TOTAL
YES	1	21 67.7 48.8 31.3	10 32.3 41.7 14.9	31 46.3
NO	2	22 61.1 51.2 32.8	14 38.9 58.3 20.9	36 53.7
	COLUMN TOTAL	43 64.2	24 35.8	67 100.0

NUMBER OF MISSING OBSERVATIONS = 1

C R O S S T A B U L A T I O N O F SEWAGE PROCESS SEWAGE BY NEEDADP DO THEY NEED ADP SUPPORT?

SEWAGE	COUNT / ROW PCT / COL PCT / TOT PCT	NEEDADP YES 1	NO 2	ROW TOTAL
YES	1	12 70.6 27.9 17.9	5 29.4 20.8 7.5	17 25.4
NO	2	31 62.0 72.1 46.3	19 38.0 79.2 28.4	50 74.6
	COLUMN TOTAL	43 64.2	24 35.8	67 100.0

NUMBER OF MISSING OBSERVATIONS = 1

CROSSTABULATION OF TORM PRODUCE TWO OR MORE UTILITIES BY NEEDADP DO THEY NEED ADP SUPPORT?

TORM	COUNT / ROW PCT / COL PCT / TOT PCT	NEEDADP YES 1	NO 2	ROW TOTAL
YES	1	23 67.6 53.5 34.3	11 32.4 45.8 16.4	34 50.7
NO	2	20 60.6 46.5 29.9	13 39.4 54.2 19.4	33 49.3
	COLUMN TOTAL	43 64.2	24 35.8	67 100.0

NUMBER OF MISSING OBSERVATIONS = 1

CROSSTABULATION OF OTHPROD PRODUCE OTHER MINOR UTILITIES BY NEEDADP DO THEY NEED ADP SUPPORT?

OTHPROD	COUNT / ROW PCT / COL PCT / TOT PCT	NEEDADP YES 1	NO 2	ROW TOTAL
YES	1	8 53.3 18.6 11.9	7 46.7 29.2 10.4	15 22.4
NO	2	35 67.3 81.4 52.2	17 32.7 70.8 25.4	52 77.6
	COLUMN TOTAL	43 64.2	24 35.8	67 100.0

NUMBER OF MISSING OBSERVATIONS = 1

CROSSTABULATION OF PWDTYPE PWD TYPE BY NEEDADP DO THEY NEED ADP SUPPORT?

PWDTYPE	COUNT / ROW PCT / COL PCT / TOT PCT	NEEDADP YES 1	NO 2	ROW TOTAL
NAVSTA	1	3	2	5
		60.0	40.0	7.8
		7.1	9.1	
		4.7	3.1	
WEAPON CENTER	2	2	2	4
		50.0	50.0	6.3
		4.8	9.1	
		3.1	3.1	
SHIPYARD	3	3	1	4
		75.0	25.0	6.3
		7.1	4.5	
		4.7	1.6	
AIR STATION	4	13	3	16
		81.3	18.8	25.0
		31.0	13.6	
		20.3	4.7	
COMM STATION	5	1	3	4
		25.0	75.0	6.3
		2.4	13.6	
		1.6	4.7	
OTHER	6	14	10	24
		58.3	41.7	37.5
		33.3	45.5	
		21.9	15.6	
MARINE CORPS DEP	7	6	1	7
		85.7	14.3	10.9
		14.3	4.5	
		9.4	1.6	
	COLUMN TOTAL	42	22	64
		65.6	34.4	100.0

NUMBER OF MISSING OBSERVATIONS = 4

CROSSTABULATION OF PWDLOC PWD LOCATION BY NEEDADP DO THEY NEED ADP SUPPORT?

PWDLOC	COUNT / ROW PCT / COL PCT / TOT PCT	NEEDADP YES 1	NO 2	ROW TOTAL
NORTHEAST	1	11 68.8 26.2 17.2	5 31.3 22.7 7.8	16 25.0
EAST	2	5 62.5 11.9 7.8	3 37.5 13.6 4.7	8 12.5
SOUTH	3	10 76.9 23.8 15.6	3 23.1 13.6 4.7	13 20.3
WEST	4	10 66.7 23.8 15.6	5 33.3 22.7 7.8	15 23.4
ATLANTIC	5	3 50.0 7.1 4.7	3 50.0 13.6 4.7	6 9.4
PACIFIC	6	3 50.0 7.1 4.7	3 50.0 13.6 4.7	6 9.4
	COLUMN TOTAL	42 65.6	22 34.4	64 100.0

NUMBER OF MISSING OBSERVATIONS = 4

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