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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

74-0246

B-115369

AUG. 31, 1973

The Honorable William Proxmire
United States Senate



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Dear Senator Proxmire:

In response to your request dated August 14, 1972, we have evaluated the comments in a letter to you by a correspondent who expressed concern about

- the low use of computers at naval laboratories and
- the need for the Naval Research Laboratory (NRL) to acquire a very large computer.

Your correspondent suggested that, as an alternative to acquiring a new computer, the computer facilities of several naval laboratories be combined or networked to reduce the number of computers.

USE OF COMPUTERS AT NAVAL LABORATORIES

Your correspondent alleged that audits at naval laboratories had revealed that the computers were being used only at about 40-percent capacity. The laboratories cited in the letter were the Naval Ordnance Laboratory, the Naval Weapons Laboratory, the Naval Ship Research and Development Center, the Applied Physics Laboratory, and the Naval Air Development Center. All the laboratories are in the Washington, D.C., area except the last which is in Warminster, Pennsylvania.

According to Navy officials at these laboratories, computer use has not been audited. Because we found no information in Navy internal audit reports pertaining to computer use, we could not establish the source of the 40-percent estimate made by your correspondent.

Determining how much capacity is being used or being lost is not easy, especially when it relates to the more modern computer, which are capable of processing several computer programs concurrently (multiprogramming).

The simplest (though not the most meaningful) test that can be made is the determination of the percent of available time that the computer was used. Using this test, laboratory reports showed that the computers could be used more.

The maximum time a computer can be used is 600 hours a month if it is assumed that computers are operated 73 days a month, 24 hours a day, 15 x 24 = 360 hours, and an allowance of 120 hours (17 percent) is made for scheduled preventive maintenance, renewal maintenance, and operating preparation time.¹

Using 600 hours a month as a basis for comparison, the following schedule shows the average number of hours and the average percentage of time the computers were used, as reported by the laboratories for the year ended September 30, 1972, or December 31, 1972.

<u>Laboratory</u>	<u>Computer model</u>	<u>Use</u>	
		<u>Hours</u>	<u>Percent</u>
Naval Ship Research and Development Center	CDC 6700	404	67
	CPC 6400	^a 271	^a 45
Naval Ordnance Laboratory	CDC 6400	526	88
Naval Weapons Laboratory	CDC 6700	376	63
Naval Air Development Center (2 computers)	CDC 6600	751	63
	IBM 560791	470	78
Applied Physics Laboratory NRL	CDC 3800	392	65
	CDC 3800	367	61

^aThese figures are based on averages for the year ended June 30, 1972.

For computer systems that have the capability to process several computer programs concurrently, this method is a poor indication of use. All the computers in the naval laboratories, except the two in NRL, have this multiprogramming capability. The number of programs which can be processed concurrently on these computers is limited by the availability of the computers' resources (central processor units, internal memory or core storage, and input-output equipment). Computer systems could be turned on 24 hours a day, 7 days a week, and still use only a fraction of their capacity. To meaningfully determine the use of computers, data on the number of hours they are used must be supplemented with data on the use of the computers' three resources.

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¹Factors used in GAO report to the Congress, "Review of Problems Relating to Management and Administration of Electronic Data Processing Systems in the Federal Government" (b-115369, Apr. 30, 1964).

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Performance evaluation tools and techniques have been developed to more precisely measure computer use and to aid managers in increasing the overall efficiency of their computer systems. Because the laboratories, except for one, have not used these techniques in measuring total computer use, we could not confidently assess how efficiently the computers were used.

CR In our August 22, 1972, report to the Congress, "Opportunity for Greater Efficiency and Savings Through the Use of Evaluation Techniques in the Federal Government's Computer Operations" (B-115369), we identified several instances in which computer efficiency at installations which used performance evaluation techniques, was increased by as much as 40 percent.

NRL'S NEED FOR NEW COMPUTERS

2 NRL's justification for a new computer in fiscal year 1975 was based principally on its Plasma Physics Division's projected needs for fiscal years 1975-77. The division's projects, sponsored by the Defense Nuclear Agency and the *38* Navy, involve developing mathematical models and simulations

NRL officials told us that they used computers outside their laboratory to do the Plasma Physics Division work because their computers did not have the speed or the computational capability for their simulation work. Initially NRL obtained limited use of a computer at the Naval Applied Physics Laboratory that contained these powerful computational capabilities. To meet its increasing needs, NRL negotiated an agreement with the Atomic Energy Commission's (AEC's) Oak Ridge Laboratory to use one of its powerful computers. AEC told NRL that the computer at Oak Ridge would not be available for NRL's use after the end of 1973. Accordingly, NRL negotiated an agreement with AEC's Argonne Laboratory to use one of its computers.

This computer contained more powerful computational capacity than the one at Oak Ridge, and NRL estimated that its computer needs could be met through fiscal year 1974. NRL believed, however, that as its needs for computers with large computational capabilities increased, it would have to find a reliable source that could meet future NRL workload requirements.

For these reasons NRL believes it will require a computer similar to the one at the AEC Argonne Laboratory but with multiprocessing units or more powerful computers similar to the ones being installed by the Advanced Research Projects

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Agency (AFPA) of the Department of Defense and by the National Oceanic and Atmospheric Administration.

The Assistant Secretary of the Navy (Financial Management) approved NRL's plans to acquire a very large computer system. The Navy furnished the request for proposal to prospective vendors in early July 1975.

We did not evaluate NRL's projected workload for fiscal years 1975-76 because it involved many technical considerations. However, we discussed the proposal with an official of the Federal Automatic Data Processing Simulation Center-- which assists Government agencies in determining what computer systems can meet their workloads-- and he said the Navy study appeared to be complete and adequately documented. He indicated that, since some of the computer systems being requested were very new and since information on these systems would have to be obtained, a determination of what computer systems could handle NRL's workload could take as long as a year. An official of the National Bureau of Standards also told us that considerable effort and technical knowledge would be required to meaningfully assess NRL's projected needs.

On the basis of the operating characteristics of NRL's computers and information on NRL's computer needs, we have concluded that the two computers at NRL do not have the capacity to do the computations required by the Plasma Physics Division.

COMPUTER NETWORKING

There are two types of computer networking. One type provides for the interconnection, via common-carrier circuits (telephone companies), of dissimilar computers at widely separated computer centers. NRL uses this type. The second type is similar to a time-sharing system, that is, a computing technique in which numerous terminal devices use a central computer complex concurrently for input, processing, and output functions. This type is used by AEC's Lawrence Radiation Laboratory.

Your correspondent stated that one means of improving the use of computers in naval laboratories was to network some of them, to reduce the number of computers. He suggested that NRL use the concept developed at the Lawrence Radiation Laboratory because he believed the programs at Lawrence could be used on the identical type of computers at some of the naval laboratories.

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NRL officials told us they did not consider that networking similar to Lawrence's could be suitable to meet MEL's projected needs because it required computers with larger computational capabilities than those at the naval laboratories and at Lawrence. They stated that the principal reason they had used MEL's very large computers was to obtain these larger capabilities.

We asked NRL officials whether they had considered meeting future needs by participating in the ARPA network, because ARPA was seeking users for a very large computer being installed in its network that could meet NRL's needs. NRL officials told us that they had not considered participating because, in their judgment, serious capacity problems would be involved and because the speed of ARPA's existing data communication lines was limited. They estimated that, to meet future needs, NRL would use all the time available on the ARPA communication lines to transmit the data to the appropriate ARPA computers, as well as time available on these computers to process NRL data. NRL officials also told us that security problems would have to be resolved because much of the data that would be transmitted on communication lines would be classified.

An ARPA contracting official who handles requests from prospective participants told us that ARPA plans to install segments of higher speed communication lines to the new, very large computer and that it would consider installing additional ones if a participant needed them. We believe, therefore, that the Navy did not adequately consider the alternative of using the computers in the ARPA network.

GAO CONCLUSIONS AND AGENCY COMMENTS

Computer use

Additional computer time is available at naval laboratories. However, we do not know the amount of such time because performance evaluation tools and techniques have not been used. NRL officials agree that additional time is available, but they believe that it cannot be used for the nuclear simulation workload. Also, they believe that about 60-percent capacity is optimum use for computers in a research environment.

Computational capacity

The computers apparently do not have the computational capacities to handle the nuclear simulation workload. AEC

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computers with more potential computational capacities are and will be used to satisfy AFSS needs through fiscal year 1974, but additional computational capacities will be needed for nuclear simulation work starting in fiscal year 1974. The Navy did not adequately evaluate the reliability of using the computers in the AFSS network to satisfy its future needs. Although S-1 officials believe the computers in the ARPA network could satisfy their current needs, they strongly believe the computers would not satisfy their future needs.

Combining facilities

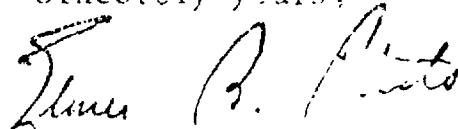
Since our review began, the Navy has started to study the feasibility of networking or combining computer facilities. Included in the Navy study is a reexamination of the projected automatic data processing needs of all laboratories and the most effective and efficient means to meet these needs.

We plan to look at the results of the Navy study when it becomes available.

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We trust this information is responsive to your request. We are returning the document that you sent us with your request.

Sincerely yours,



Comptroller General
of the United States

Enclosure