

www 112672

BY THE COMPTROLLER GENERAL

# Report To The Congress

OF THE UNITED STATES

## The World Wide Military Command And Control System-- Evaluation Of Vendor And Department Of Defense Comments

On December 14, 1979, GAO issued a report to the Congress entitled "The World Wide Military Command and Control System--Major Changes Needed In Its Automated Data Processing Management and Direction" (LCD-80-22). Comments from the Department of Defense and the vendor--Honeywell Information Systems, Inc.--were not received in time to be incorporated into the report along with our evaluation. Consequently, this report should be considered an integral part of the December 1979 report.

Although the vendor agrees with the content of the December 1979 report, the Department of Defense characterizes the report as being inaccurate and misleading, containing inappropriate conclusions, and presenting inapplicable recommendations.

The Department's comments are inconsistent with known conditions, recent Department of Defense comments made to the Congress regarding the World Wide Military Command and Control System ADP program, and the results of recent Department of Defense studies of the issues discussed in the 1979 report.



112672



011133

LCD-80-22A  
JUNE 30, 1980

Single copies of GAO reports are available free of charge. Requests (except by Members of Congress) for additional quantities should be accompanied by payment of \$1.00 per copy. (Do not send cash).

Requests for free single copies should be sent to:

U.S. General Accounting Office  
Distribution Section, Room 1518  
441 G Street, NW  
Washington, DC 20548

Requests for multiple copies should be sent with checks or money orders to.

U.S. General Accounting Office  
Distribution Section  
P.O. Box 1020  
Washington, DC 20013

Checks or money orders should be made payable to the U.S. General Accounting Office.

To expedite placing your order, call (202) 275-6241.  
When ordering by phone or mail, use the report number and date in the lower right corner of the front cover.

GAO reports are now available on microfiche. If such copies will meet your needs, be sure to specify that you want microfiche copies.



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

B-163074

To the President of the Senate and the  
Speaker of the House of Representatives

This report evaluates comments from the Department of Defense and Honeywell Information Systems, Inc., on our December 14, 1979, report, "The World Wide Military Command and Control System--Major Changes Needed In Its Automated Data Processing Management and Direction" (LCD-80-22).

Comments from the Department of Defense and the vendor, Honeywell Information Systems, Inc., were not received in time to be incorporated into the report along with our evaluation. For this reason, this report should be considered an integral part of our December 1979 report.

This portion of the December 1979 report contains the Department's and vendor's comments and our evaluation of their validity and accuracy.

We are sending copies of this report to the Director of the Office of Management and Budget and the Secretary of Defense.

A handwritten signature in cursive script that reads "Milton J. Fowler".

Acting Comptroller General  
of the United States



D I G E S T

GAO's December 14, 1979, report (LCD-80-22) criticized the World Wide Military Command and Control System (WWMCCS) automated data processing (ADP) program for lacking effective management and for being unresponsive to operational needs. The report recommended that the Congress consider withholding current and future funding for the WWMCCS ADP program. (See app. I for a digest of that report.)

Comments from the vendor--Honeywell Information Systems, Inc.--and the Department of Defense were not received in time to be incorporated into the report along with GAO's evaluation. The complete text of their comments is contained in chapters 1 and 3 of this report. GAO's evaluation of those comments is contained in chapters 2 and 4.

VENDOR COMMENTS

The vendor generally agreed with the contents of the 1979 report and offered some suggestions for resolving known computer and software problems through field modifications of the computers and revised versions of the vendor-supplied software. The vendor indicated that the original WWMCCS ADP procurement specifications generally may have exceeded the then existing state of the art in computer and software technology.

GAO's major objection to making field modifications of the computer and substituting revised versions of the vendor's software, as suggested by the vendor, is that such action would have the effect of a sole-source procurement. As a result, alternative and perhaps more economical and efficient system designs by other vendors would not be considered. (See pp. 5 and 6.)

GAO does not agree that the original procurement specifications exceeded the then existing state of the art. As GAO pointed out in a 1970 report, the Department of Defense did not take advantage of the state-of-the-art computer technology that was available at the outset of the current WWMCCS ADP program in October 1971. Had the Department taken advantage of the then existing technology, it would not be experiencing many of the operational problems it is today. In addition, the Department would have found it substantially more economical to use new technologies without the need for major redesign. (See p. 6.)

#### DEPARTMENT OF DEFENSE COMMENTS

Since December 1970, several GAO studies and numerous Department of Defense studies have described essentially the same issues and problems as described in GAO's 1979 report. Even so, the Department of Defense characterizes the 1979 report as being inaccurate and misleading, containing inappropriate conclusions, and presenting inapplicable recommendations. (See pp. 8 to 22.)

GAO evaluates each Department comment and points out the inconsistency of those comments with known conditions, comments previously made to GAO, and recent Department comments to the Congress. (See pp. 23 to 65.)

#### GAO EVALUATION

After carefully considering the vendor and Department of Defense comments, GAO believes its 1979 report accurately portrayed the principal areas of concern about the WWMCCS ADP program, including the following areas.

First, after almost 30 years of using computers to support the command and control environment, the Department of Defense still has not clearly defined the functional (informational) requirements of the military commanders who must use and rely on WWMCCS ADP capabilities for their operational needs.

Instead, the Department prefers to allow the WWMCCS ADP program to continue to "evolve." It seems apparent to GAO that it is time to stop "evolving" and to begin designing a system that, when placed into operation, will provide needed support capabilities to military commanders, particularly during a time of crisis.

Second, the Department of Defense selected a computer configuration and related software that were not suited for the environment in which they were to operate. The Department seems extremely reluctant to recognize the need for change.

Third, the WWMCCS ADP program management structure was so fragmented that no one individual or organization had responsibility for its budgeting, funding, or management.

Finally, due to a combination of all these conditions, the current WWMCCS ADP program does not support the operational needs of military commanders, particularly during a time of crisis.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

C o n t e n t s

		<u>Page</u>
DIGEST		i
CHAPTER		
1	HONEYWELL INFORMATION SYSTEMS, INC., COMMENTS	1
2	GAO EVALUATION OF HONEYWELL INFORMATION SYSTEMS, INC., COMMENTS	5
3	DEPARTMENT OF DEFENSE COMMENTS	8
4	GAO EVALUATION OF DEPARTMENT OF DEFENSE COMMENTS	23
APPENDIX		
I	Digest of the report to the Congress, "The World Wide Military Command and Control System--Major Changes Needed In Its Automated Data Processing Management and Direction" (LCD-80-22, Dec. 14, 1979)	66

## ABBREVIATIONS

ADP	automated data processing
AUTODIN	Automatic Digital Network
CINCLANT	Commander-in-Chief, Atlantic
CINCPAC	Commander-in-Chief, Pacific
CINCSO	Commander-in-Chief, U.S. Southern Command
DCA	Defense Communications Agency
EUCOM	U.S. European Command
FORSCOM	U.S. Army Forces Command
FORSTAT	Force Status and Identity Report System
GAO	General Accounting Office
GCOS	General Comprehensive Operating Supervisor
IMP	Interface Message Processor
JOPS	Joint Operations Planning System
LANTCOM	Atlantic Command
MAC	Military Airlift Command
NORAD	North American Air Defense Command
OJCS	Organization of the Joint Chiefs of Staff
OPLAN	operations plan
PWIN	Prototype WWMCCS Intercomputer Network
REDCOM	U.S. Readiness Command
TAC	U.S. Air Force Tactical Air Command
UNITREP	Unit Status and Identity Reporting System
USNAVEUR	U.S. Naval Forces, Europe
WIN	WWMCCS Intercomputer Network
WWDMS	World Wide Data Management System
WWMCCS	World Wide Military Command and Control System

CHAPTER 1

HONEYWELL INFORMATION SYSTEMS, INC., COMMENTS

Comments from the vendor--Honeywell Information Systems, Inc.--are presented below in their entirety and are cross-referenced to our evaluation contained in chapter 2.

**Honeywell**

FOR GAO EVALUATION  
SEE: CHAPTER 2  
COMMENT NO. PAGE(S)

Robert R. Donaldson  
Vice President  
Federal Systems Operations

October 24, 1979

Mr. Richard W. Gutmann  
Director  
Logistics and Communications Division  
General Accounting Office  
Washington, D.C. 20548

Gentlemen:

Honeywell appreciated the opportunity to offer comments and suggested clarifications during the week of 15 October on the GAO draft report; "The World Wide Military Command and Control System...Major Changes Needed in its Automated Data Processing Management and Direction". Mr. C. O. Smith, Assistant Director, Logistics and Communications Division, was very helpful in clarifying portions of the draft report.

} 1 5

As a result of these discussions it is Honeywell's understanding that GAO's criticism of the WWMCCS ADP program are directed not toward Honeywell-supplied hardware and software, but rather toward the configuration and implementation of this hardware and software, as well as the many other elements of the WWMCCS ADP program; such as the communication lines, networking, management policies and procedures.

GAO's basic criticism of the program can be summarized as the failure of the Government in the past, to accurately and precisely define the information requirements of the command and control environment, thus leading to the implementation of an ADP system which in GAO terms is "...not responsive to national or local level requirements...". GAO has made it clear that many of the shortcomings of the system listed in the "Digest" portion of the report, such as unreliability, inability to transfer data, high cost to exploit ADP technology, and impairment of each command's operational back-up capability, are criticisms of the ADP program as a whole, including requirements definitions, and do not necessarily refer to limitations of the Honeywell-supplied hardware and software architecture; but rather to the implementation thereof.

} 2 5

R. W. Gutmann  
October 24, 1979  
Page two

FOR GAO EVALUATION  
SEE: CHAPTER 2  
COMMENT NO. PAGE(S)

Honeywell feels that the GAO's corrections and clarifications to its draft report, as discussed and agreed to, will strengthen the report and provide a clearer definition of the basic problems. The following examples illustrate significant clarifications:

"Prior to acquisition of the present computer system, many officials within the Department of Defense recognized the need for a system that fully reflected the on-line interactive mode needed for operation in the command and control environment."

3 5

"The specification and evaluation process resulted in the selection of a computer configuration and related software that was not suited for the environment in which it was to operate. A major factor contributing to this condition was DoD's failure to properly and clearly define the information requirements of the various commands comprising the WWMCCS community."

Honeywell agrees that the "circuitry" of the current WWMCCS standard computer system should be modified (and in fact, this modification can be accomplished in the field) to make these systems responsive to the command and control environment. Further, Honeywell agrees that the current "military version of GCOS" which consists of a "...commercial version of GCOS (which) has been substantially modified in the WWMCCS ADP program", should be updated to operate efficiently in the command and control environment. "The military version has not kept up with its commercial counterpart"...and the problems are created by the "...fundamental deficiencies in the military version of GCOS which WWDMS (Data Base Management System utilized by WWMCCS ADP program until recently) must utilize to update files and retrieve information." This version of GCOS is over five years behind current Honeywell software technology.

4 5-6

5 6

Honeywell agrees that in 1970, the request for an on-line interactive data base management system in the original WWMCCS procurement specification was appropriate; however, it generally exceeded at that time the state-of-the-art. Enhancements to the then current commercial data base management system supplied by Honeywell resulted in the WWDMS product. The resultant facility was recognized to be less than optimal. With this recognition, and advances in the state-of-the-art, the WWDMS

6 6

has been superseded as the standard data base management system by a more recent Honeywell product. However, Honeywell is compelled to indicate that an even more recent software product is available for implementation as the WWMCCS standard data base management system that is most suitable to the on-line interactive command and control environment.

6 6

If an internetting capability for the WWMCCS ADP program was recognized prior to issuance of specifications, this requirement was not identified in these procurement specifications. GAO's criticisms of the complexity of the WIN network are predicated solely on the requirement that a terminal must gain access to the network through a host machine. Advances in networking technology have now made this requirement obsolete and Honeywell has been prepared to implement a solution to this problem for several years. Other than this single item, the network "topgraphy" and "configuration diagrams" contained in the report are reflective in general of the complexity associated with digital networks.

7 6-7

Honeywell concurs that the reliability of the WIN is a composite factor of the many components of the network including such things as power, supplies, communications lines, modems, crypto sets, management procedures, software and the IMP processors. Most of these items were not furnished by Honeywell. The systems currently deployed as IMP processors represent 15 year-old technology and, in fact, replacement of this hardware by state-of-the-art Honeywell hardware currently available to the WWMCCS community may be an appropriate measure if, in fact, it can be determined that a major increase in reliability can be achieved through this substitution after corrective actions are taken in other areas outside Honeywell's purview.

8 7

Honeywell agrees that a multi-level security requirement is essential to WWMCCS and concurs with the GAO findings that several major efforts, funded by both private and public funds, are "...underway, addressing the computer security issue.... none of these efforts has yet been certified secure by the National Security Agency or the Department of Defense, nor have they developed a method for such certification."

3 5

R. W. Gutmann  
October 24, 1979  
Page four

FOR GAO EVALUATION  
SEE: CHAPTER 2  
COMMENT NO. PAGE(S)

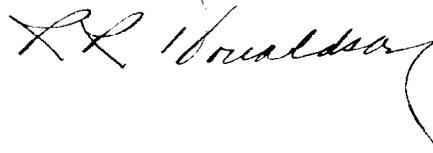
In summary, Honeywell agrees with GAO's in depth analysis of the Honeywell hardware/software architecture which indicates that configuration changes (not necessarily architecture changes) are required. Although the DoD management structure of the WWMCCS ADP program is not within Honeywell's purview, recent activities within the area of management structure and requirements definition on the part of DoD appear to be positive steps toward making the WWMCCS ADP program responsive to the requirements of the command and control environment.

} 9 7

Honeywell is proud of its past and continuing relationship with this vital National Defense effort and although we do not agree with the implication that none of the objectives of the WWMCCS ADP program are being satisfied, we do agree that the technology exists for substantial improvement. With the completion of DoD's efforts to further define requirements and update the 1976 WWMCCS Architecture Study, Honeywell is prepared to assist and support DoD in following the recommended approach of this architecture study of evolving the 1977 "Baseline System: Federated" through the "Interconnected" and "Coordinated" phases to the fully "Integrated" phase.

Again, Honeywell appreciates the opportunity to discuss this forthcoming report with GAO.

Sincerely,



CHAPTER 2

GAO EVALUATION OF HONEYWELL INFORMATION

SYSTEMS, INC., COMMENTS

1. We concur. We do not in any way imply that Honeywell has not fulfilled its contractual obligations. The Department of Defense must make that determination. Our concern is that the World Wide Military Command and Control System (WWMCCS) automated data processing (ADP) program has not met its intended objectives and that the program requires major changes in its management structure and direction to achieve those objectives.

2. We generally concur. The users generally agree that the WWMCCS standard computer system and software are not well suited to meet the needs of a command and control environment. The principal reason for the users' concern is the batch processing orientation of the vendor-supplied WWMCCS standard computer system, including the military version of the General Comprehensive Operating Supervisor (GCOS) software and the World Wide Data Management System (WWDMS). A batch processing orientation is a genuine bottleneck in the flow of essential information in a command and control environment, particularly during a crisis.

3. We concur.

4. While we recognize that these systems could be field modified, we do not recommend this course of action because:

--A field modification could be very expensive and it might be more cost effective to replace the equipment with newer computers whose circuitry is specifically designed to operate in an online interactive mode, as required by the command and control environment. Neither Honeywell nor the Department of Defense has provided us with cost estimates for either approach.

--A field modification of the circuitry only addresses one part of the problem--the hardware. It does not address the related and substantially more costly software problem.

--In effect, a field modification of the WWMCCS standard computer systems would be the equivalent of a sole-source procurement because the current vendor automatically would be retained. Alternative system designs from other vendors would not be considered. Without considering alternative designs, it would be impossible to determine whether a field modification would be the most cost beneficial over the WWMCCS life cycle.

5. We concur. Without considering alternatives available from other vendors, however, it cannot be determined which method of software acquisition--using a more current version of GCOS and WWDMS or replacing them--would be most cost effective over the WWMCCS life cycle.

6. We generally concur with the Honeywell assessment of the problems experienced by selecting WWDMS. However, we do not agree that the original WWMCCS procurement specification generally exceeded the then existing state of the art. In our December 1970 report 1/ to the House Committee on Appropriations, we pointed out that the Department of Defense did not take advantage of the ADP technology that was commercially available at the time the requirements for WWDMS were developed and before the Honeywell computers were selected for use in the WWMCCS ADP program. It should be noted that the Honeywell computers were purchased for the WWMCCS ADP program on October 15, 1971, almost 10 months after this problem was first brought to the Department's attention. (See, also, our comments on pp. 23 to 25 for more details on the state-of-the-art issue.)

7. While we are critical of the Department of Defense's requirement that a terminal must gain access to the network through a host machine, our primary concern with the WWMCCS Intercomputer Network (WIN) is that it does not effectively meet user requirements, particularly during a crisis. Our concern is broader and more substantive than just the method of terminal access and includes the reliability of the system.

---

1/"Problems in the Acquisition of Standard Computers for World-Wide Military Command and Control System" (B-163074).

Since WWMCCS and its major component, the National Military Command System, are intended to be the most responsive, reliable, and survivable system that can be provided with the resources available, the WWMCCS ADP program should make a substantive contribution toward achieving these goals. The intercomputer network is an essential element of that ADP program. However, as we demonstrated in chapter 6 of our 1979 report, WIN is not reliable for its intended purpose, in part, because the host computer circuitry and related software are batch-oriented.

8. Although Honeywell mentions that the WWMCCS network "topography" and "configuration diagrams" contained in the 1979 report (pp. 45 and 49) reflect the complexity associated with digital networks, the real issue remains one of network design and resulting network reliability. Network design and the use of appropriate hardware technology are essential factors influencing network reliability. A sound network design must be based on a valid network analysis. Such an analysis is yet to be completed by the Department of Defense. Thus, we believe that a complete and thorough network analysis may require the design and development of a new architecture to meet the response time and reliability requirements of WWMCCS users.

9. We do not indicate that configuration changes, instead of architecture changes, are required. Rather, we suggest that the Department must first define user needs and then evaluate what architecture will best meet these needs. If the selected architecture is different than the current WWMCCS ADP architecture, then the Department should make the necessary changes.

Regarding Department management structure issues, we reserve judgment. We would want to review the future WWMCCS ADP plans that the Department has furnished to the Congress with the 1981 budget before we evaluate the Department's planned redirection. Specifically, we would want to review the nature of the recent management changes to determine how well the Department has in fact centralized WWMCCS ADP management and whether the changes will resolve the problems associated with a fragmented management structure.

CHAPTER 3

DEPARTMENT OF DEFENSE COMMENTS

Department of Defense comments are presented below in their entirety and are cross-referenced to our evaluation contained in chapter 4. Generally, the Department's comments are inconsistent with the facts, recent Department of Defense statements to the Congress, numerous Department of Defense studies on the WWMCCS ADP program, and information recently obtained by the Department from WWMCCS ADP users.



ASSISTANT SECRETARY OF DEFENSE  
WASHINGTON, D.C. 20301

FOR GAO EVALUATION  
SEE: CHAPTER 4  
COMMENT NO. PAGE(S)

COMMUNICATIONS COMMAND  
CONTROL, AND INTELLIGENCE

NOV. 19, 1979

Honorable Elmer B. Staats  
Comptroller General of the  
United States  
Washington, D.C. 20548

Dear Mr. Staats:

This is in reply to your letter to the Secretary of Defense regarding GAO's draft report dated September 10, 1979, "The WWMCCS - Major Changes Needed in Its Automated Data Processing Management and Direction" (OSD Case 5274).

- The GAO report criticizes the WWMCCS ADP Program for lacking effective management, for failing to keep pace with technological changes, for requiring large expenditures, and for being unresponsive to operational needs. The report recommends that the Congress consider withholding current and future funding for the WWMCCS ADP Program. } 1 23-25
- Generally, with the exception of some observations regarding the management structure, the principal conclusions of the report are not correct. As a result the recommendations are not applicable and the report is misleading. } 2 25
- The report compares a system acquired in the early 1970s against 1980 technology, and leaves the overall impression that money has been expended with little or no capability having been achieved. In point of fact a capable system does exist. WWMCCS Intercomputer Network (WIN) is viewed by the operational community as a major success. It effectively supports day-to-day operations, exercises and real world crisis/emergency situations. The report recommends that all activity come to a halt while a new system is acquired. Such a decision would be an overreaction to a problem which is being worked as quickly as acquisition of new technology allows. Moreover, it would ignore the important services that WWMCCS ADP provides and the immediate needs of our forces. And finally it would disregard the improvements and modernization of the system which have taken place. } 3 26-28
- Existing systems are providing support to functions such as nuclear planning, deployment planning, force status monitoring, aerospace surveillance, and strategic airlift management. These functions cannot be performed without the ADP support furnished through the WWMCCS. The } 4 28-29
- Existing systems are providing support to functions such as nuclear planning, deployment planning, force status monitoring, aerospace surveillance, and strategic airlift management. These functions cannot be performed without the ADP support furnished through the WWMCCS. The } 5 29

report implies that excessive expenditures were made as a result of the WWMCCS ADP Program. In reality, as a result of the program, major economies have been realized. Substantially higher costs which would have been incurred through separate ADP programs supporting several WWMCCS headquarters have been avoided.

5 29

The criticism of WWMCCS ADP program management presents an overly simplified picture of a complex situation which involves the management of a wide range of operational and technical activities spread across the OJCS, the Services and the Defense Agencies. Changes to improve and clarify the WWMCCS ADP management structure have recently been undertaken. These emphasize the policy and requirements responsibility of the JCS and the technical responsibility of the DCA. The need for additional change will be considered and included as part of WWMCCS Information System (WIS) modernization planning. In accordance with the request by the House Armed Services Committee, we intend to provide the Congress with our modernization plans along with the 1981 Budget Request. The WWMCCS Council is overseeing modernization planning; however, specific architectural decisions are not expected to be completed until 1981. Withholding funds at this time from the very programs which support this modernization would be counterproductive.

6 30

The enclosure contains specific comments on the GAO findings and conclusions.

Sincerely,



Gerald P. Dinneen

Enclosure

SPECIFIC COMMENTS

FOR GAO EVALUATION  
SEE: CHAPTER 4  
COMMENT NO. PAGE(S)

1. DIGEST

- a. The assertion that "there has been little, if any, improvement" in the WWMCCS ADP system since inception of the WWMCCS ADP Program even though the Department of Defense "has spent \$1 billion (GAO underlining) for this purpose" (p. ii) is inaccurate and misleading. Major improvements have been made in the automatic data processing support provided to the WWMCCS as a result of the WWMCCS ADP Program. } 7 30-31
- b. Before the inception of the WWMCCS ADP Program, each WWMCCS site was left to its own resources to acquire ADP systems and develop software, resulting in costly procurements, incompatible systems and duplication of effort. As a result of the WWMCCS ADP Program, a baseline system of compatible computer systems has now been acquired that will support the development of an interconnected and integrated system for the 1980s. Thirty-five computer systems were acquired in fiscal years 1972 and 1973 for \$55.9 million, \$35.7 million less than the cost estimated by OSD in the original Development Concept Paper for the program. This single source multi-year buy resulted in a savings estimated by the GSA to be as much as 70% below the GSA catalog prices for Government procurements. (Without the WWMCCS ADP Program, most of the older command and control computer systems would have been individually upgraded or replaced and many unautomated command and control activities would have acquired computers at the GSA catalog prices.) } 8 32-33
- c. Economies have also been realized through centralization of system software development, selective standardization of application software, centralization of technical support, centralization of training and improved personnel utilization, centralization of supply and maintenance, and centralization of contract administration under the WWMCCS ADP Program. The systems in place today as a result of the WWMCCS ADP Program have been designed in such a way that they can utilize new technologies such as computer-to-computer data exchange and distributed data bases as they become available without need for major redesign. Further, continuity of operations is enhanced by the program compatibility of all WWMCCS ADP systems. All of the above improvements, and many more, are totally ignored by the GAO with its assertion that "little, if any, improvement has been realized by the Department of Defense since the inception of the program." } 9 33-34
- d. Responses to other statements made in this section of the report follow in the specific chapters as referenced.

2. CHAPTER 1 - WHAT IS THE WORLDWIDE MILITARY COMMAND AND CONTROL SYSTEM?
- a. The date given for the Deputy Secretary of Defense approval of the WWMCCS ADP procurement is incorrect. Correct date is 4 June 1970. } 10 34
- b. The statement that DoD Directive 5100.30 established the WWMCCS ADP Program is incorrect. The program was established by the Deputy Secretary of Defense in his approval of the WWMCCS ADP procurement. DoD Directive 5100.30 applies to the WWMCCS as a whole; not just to the WWMCCS ADP Program. }
- c. The list of organizations which is described as the principal users of WWMCCS is incomplete. Omitted are the Headquarters, US Navy; Headquarters, US Air Force; Headquarters, US Marine Corps; CINCSO; and CINCPAC. Also it includes some commands which are not part of the WWMCCS, e.g., the V Corps; 8th Infantry Division; 3rd Armor Division; VII Corps; 3rd Infantry Division; and Headquarters, 1st Armor Division. } 11 34
- d. The statement that access was restricted to most of the information considered pertinent is completely untrue. See the comments in paragraph 9 relating to Chapter 8 - Access to Records. } 12 34-35
3. CHAPTER 2 - WHAT IS WRONG WITH THE WWMCCS ADP PROGRAM?
- a. The statement that standard WWMCCS programs "do not meet the needs of local commands" is incorrect. Standard programs do not meet all the needs of local commands but they do meet many needs. } 13 35
- b. The statement that "a command's operational and backup capabilities are seriously impaired because the WWMCCS Intercomputer Network is not reliable" is incorrect. The WIN adds capabilities that were not previously available; it does not take away any capabilities. } 14 35
- c. The statement that the standard computer "cannot be made to function in an on-line interactive mode" is incorrect. These computers are functioning daily in an on-line interactive mode. } 15 35-36
4. CHAPTER 3 - WHO IS IN CHARGE OF THE WWMCCS ADP PROGRAM?
- a. The WWMCCS ADP Program management is multi-layered and steps have been taken to streamline it. The Command, Control, and Communications Directorate has been established within the OJCS. This Directorate will be the central focus for operational policy and guidance for command and control systems management and involve the Unified and Specified Commands, both of which were fundamental objectives of the Defense Science Board Task Force. } 6 30

b. There is also established a Flag Level WWMCCS ADP Operators Group, supported by an O-6 level Coordinating Committee. The Operators Group consists of users of WWMCCS ADP from the OJCS, the Services, and the Defense Communications Agency (DCA). The purpose of this group is to exercise judgments and make recommendations as to where efforts and resources should be placed in the furtherance of WWMCCS ADP operational objectives.

6 30

c. A transfer of technical management functions from the OJCS to DCA has taken place. This realignment has been implemented to improve the WWMCCS ADP management structure by emphasizing the policy and requirements responsibilities of the JCS and the technical responsibilities of the DCA.

d. The statement, "Another sound management practice that has not been used in the WWMCCS ADP Program is life cycle management", is misleading. The WWMCCS is composed of designated command and control facilities, associated data collection/processing support, selected warning systems, and communications through which command and control is exercised. ADP resources used for command and control and communications systems are excluded from the provisions of DoD Directive 7920.1, which was established 17 October 1978. However, these systems have their own life cycle management procedures which contain the attributes of DoDD 7920.1, and have their own review process which considers overall system evolution and applications as well as specific data processing characteristics. Furthermore, the DoD plans for and supports valid operational requirements through the Planning Programming and Budget System (PPBS). Validation and costing of requirements are made in accordance with the JCS publications and appropriate Service regulations. Cost effectiveness is attained through a thorough evaluation and validation of the requirements.

16 36-37

e. The statement "as presently used in the WWMCCS ADP Program, the evolutionary approach has impaired the employment of good system development and management practices" must be challenged: WWMCCS must evolve and grow as the threat changes and as technology offers new capabilities or improvements. Replacing hardware and software simultaneously would be a disaster. The DSB report recognizes that systems must evolve in place and the traditional notions of going through various formal phases of an acquisition cycle are not possible or applicable; rather, one must secure an initial "trial" capability with sufficient capacity for growth or modernization. Upon that, and based on evolving needs, the system should be built. The report also stresses the need for involvement in the evolutionary process of the operational commander and his staff who operate the systems. These recommendations are pertinent, relate strongly to WWMCCS, and the OJCS supports them.

f. The statement "--The Assistant Secretary of Defense (Comptroller) was made the central focal point for ADP procurement, reporting, and utilization" is incorrect. It should read "--The Assistant Secretary of Defense (Comptroller) was directed to maintain central focal point cognizance for ADP procurement, reporting, and reutilization."

17 37

5. CHAPTER 4 - HOW RESPONSIVE, RELIABLE AND SURVIVABLE IS THE WWMCCS STANDARD COMPUTER SYSTEM?

a. The statement that "Prior to the acquisition of the present computer system, many officials within the Department of Defense recognized its design deficiencies for operation in a command and control environment" is not understood. Documentation for this statement should be provided for verification.

18 37-38

b. The statement that when first marketed the Honeywell 6000 series computer systems "were known as the GE-600 series" is incorrect. The design, construction, and capabilities of the Honeywell 6000 are considerably different from the GE-600's. These differences include circuitry, memory design and functionality.

19 38-39

c. The statement that the Honeywell 6000 series "was designed for batch or sequence processing and did not contain a capability to function efficiently or effectively in an on-line interactive mode" is incorrect. The series 6000 was specifically designed to meet the requirements of a multi-dimensional environment, not a batch sequential environment. The term "multi-dimensional environment" is defined as an environment in which many different users make simultaneous demands of an unrelated nature on the computer resources, through various access devices (e.g., remote keyboard terminal devices, remote high speed hardcopy printing devices, devices located directly in the computer room, such as consoles, card readers, etc.). The overwhelming majority of Honeywell 6000 series systems, both Governmental and commercial, have been installed by their users to meet the requirements of such a multi-dimensional environment. A Honeywell system is used by NASA at the Kennedy Space Center as the main computer in the Central Data Subsystem supporting the manned Space Shuttle Program in an on-line monitoring and control function up to and including post-ignition processes in the lift off and firing sequence. The WWMCCS ADP environment is similarly multi-dimensional, and the Honeywell Series 6000 installed equipment and software are well suited to meet current WWMCCS requirements.

20 39-42

d. The statement that "WWDMS requires a skilled programmer with special training to use it" is inaccurate. WWDMS is more complex than most data base management systems in that it provides for most of the

21 42-43

5

programming update, retrieval, and report producing functions; therefore, preparation of a retrieval function may be more complex for the preparation of an original requirement. However, WWDMS lends itself to cataloging and use of preconceived or "canned" queries which can easily be modified by inexperienced personnel for their specific needs. Therefore, modification and use of precataloged functions provides for a speedy and efficient query.

21 42-43

e. The statement that WWDMS "requires the computer to look at many files in sequence until it finds the desired one rather than immediately selecting the desired file without looking at any others" is incorrect. WWDMS can immediately access any file it desires in any sequence.

22 43

f. The statement that "The Director (sic), WWMCCS ADP Management Division in the Joint Chiefs of Staff informed us that none of these modifications have resolved the problems inherent in the GCOS and WWDMS basic architecture although some minor improvements in operations have been realized" is a misquote. The statement was that significant, not minor, improvements had been realized.

23 43

g. In the paragraph entitled "WWMCCS Standard Computer System Does Not Have Uniform and Independent Sources of Electrical Power", the following statement should be substituted in that it is the same as the DCA response given to the GAO previously.

"Other WWMCCS reliability problems relate to the availability of electrical power and air conditioning. A uniform criteria for required availability of electric power does not exist for WWMCCS ADP, reflecting the fact that each ADP installation tends to have different needs and arrangements for maintaining necessary continuity of operations. For example, the WWMCCS Standard Computer System that supports the National Military Command Center has electric power supplied by two independent commercial power sources providing protection from local blackouts, power-grid brownouts and irregularities in the commercial power. This commercial power feeds motor-generator sets that provide further protection against electrical transients and power level fluctuations. In addition, for the NMCC, there is a back up generator for more catastrophic failure. The Alternate National Military Command Center is supplied by an internal redundant generating capability and uses commercial power as a back up. NORAD utilizes commercial power with a back up internal generating capacity. The Strategic Air Command utilizes commercial power and an uninterruptable power supply. The uninterruptable power supply contains a batter system which regulates voltage and maintains power for as long as 20 minutes in a blackout, then switches to back up power.

24 44

"Other WWMCCS computer systems do not have the same degree of reliable sources of power."

6. CHAPTER 5 - DOES WWMCCS APPLICATIONS SOFTWARE SUPPORT THE COMMAND AND CONTROL ENVIRONMENT?

a. The statement that all WWMCCS applications software can be grouped into three categories: "WWMCCS standard software, software under consideration for designation as WWMCCS standard software and software developed by the various commands to meet their needs because of deficiencies in WWMCCS standard software" is erroneous and misleading. It implies that all applications software should be standard, ignoring the fact that commands have differing missions and different requirements. Command unique applications software, that software developed by each command to support its unique missions, make up a large part of the total WWMCCS applications software. This is not undesirable; it is necessary to meet command unique requirements. Only that applications software, which is needed by more than one WWMCCS site, is even considered for standardization.

25 44-46

b. The statement that "Many commands are using other systems in addition to or in lieu of the partially standard Force Status system because it does not meet their needs" fails to recognize that use of command unique software and systems, instead of the FORSTAT (UNITREP) standard system, is required for three reasons:

(1) The command's needs are for a greater detail of data to manage its resources while OJCS needs are of an informational summarized status of forces.

(2) Since the major commands collect and prepare input transactions to the standard system, they already hold the detailed information in their local system and have no reason to wait for JCS processing in order to use it.

(3) Major commands primarily are concerned with their own unit reporting data and do not have a need for the full FORSTAT (UNITREP) data base and may or may not elect to use the standard UNITREP system.

26 46-47

c. The description of FORSTAT (UNITREP) data checks is incomplete. In addition to the checks described, logical and relational data checks are made in the file maintenance as well as field value ranges. In addition, the Quality Control Section in DCA (CCTC) monitors the transactions and data base daily for validity and accuracy with the Services and CINCs.

27 47

- d. The statement that JOPS "was largely a manual system which was converted to run on the WWMCCS standard computer system" is misleading. JOPS is the set of "policies and procedures for the development, coordination, dissemination, review and approval of joint plans for the conduct of military operations and planning the execution thereof." Prior to WWMCCS, each command began developing its own unique ADP software to support plan development. With the standardization of ADP introduced by WWMCCS, a standard JOPS ADP system was designed to support the development and review of operation plans. } 28 47
- e. With regard to the development of the Deployment Management System (DEPMAS) by the U.S. Readiness Command, it should be pointed out that this is a good example of a command unique software requirement. Missions and requirements differ among WWMCCS commands. Not all commands have identical software requirements. } 29 48
- f. With regard to the statement that JOPS is "inadequate for planning in a dynamic environment such as an exercise or crisis," it should be pointed out that the JOPS ADP support was not designed to be a time-sensitive system. Although there is a Crisis Action System (CAS) within JOPS, JOPS ADP was not designed to support that system. However, the Joint Deployment Agency (JDA) is now developing software to be used in support of CAS. } 30 48
7. CHAPTER 6 - IS THE WWMCCS INTERCOMPUTER NETWORK RESPONSIVE AND RELIABLE? }
- a. Beginning with an incorrect statement of the purpose of the Prototype WWMCCS Intercomputer Network (PWIN) and ending with the unsupported conclusion that the only way to improve the WWMCCS Intercomputer Network (WIN) is through redesign and replacement of equipment, the Chapter on WIN is particularly rife with error; facts and figures taken out of context; and misleading. } 31 48-50
- (1) The statement that the intent of the Prototype WWMCCS Intercomputer Network (PWIN) was "to provide the National Command Authorities, the Joint Chiefs of Staff, and Subordinate Commanders a capability for direct computer-to-computer or remote terminal-to-computer exchange of information using distributed data base concepts and workload sharing techniques in a multi-level secure environment" is incorrect. The purpose of PWIN as stated in the Management Engineering Plan for the Prototype WWMCCS Intercomputer Network (PWIN), dated April 1975, is as follows:

The PWIN is a research and development activity, for the development of operational concepts, networking capabilities, and requirements. The concepts resulting from the PWIN program will be considered in the design concepts for the development of an operational network. The PWIN project will provide a vehicle for the test and evaluation of WWMCCS ADP concepts such as distributed data bases, resource sharing, and remote job entry techniques.

31 48-50

PWIN was an experiment. It was never intended that PWIN would provide the capabilities attributed to it by the GAO. It was particularly well known that multi-level security would not be available in the PWIN timeframe.

(2) Reliability results presented on pages 75-76 were presented out of context, are based on incomplete data that are not real indications of network performance, and are misleading. The chart on page 76 includes all negative data but none of the positive data which is available. Also, of all data available on PWIN/WIN reliability from three exercises, this chart focuses on the first and worst of the three exercises with no mention of the later exercise results which reflected improvements in WIN reliability over time. Addition of a column showing the number of successful connections would have shown 286 successes out of 295 attempted log-ons for LANTCOM, 118 out of 124 for EUCOM, 241 out of 290 for REDCOM, and 62 out of 63 for TAC. The chart and discussion of reliability also fail to take into consideration that with each log-on, numerous transactions may have been completed before an abnormal termination. In many instances, a terminal may be logged-on for many hours, processing hundreds of transactions before a termination occurs. The chart thus contains incomplete and misleading data, and only that data which biases the reader toward the worst case. This is done despite the warning in the report from which the data were taken that "The reader should consider the data in this analysis as the performance of a specific state of the system under specific conditions. It should not be used to predict future performance of the system."

32 50-56

(3) The GAO has quoted figures from the 1977 Prime Target exercise which show the reliability of WIN to be questionable. The following figures are provided from the most recent world crisis, Guyana, and the JCS-sponsored exercise, Power Play, to indicate the improvements that have taken place in the last two years.

33 56-58

AVERAGE COMPONENT AVAILABILITY

	<u>Guyana Crisis</u> 20-26 Nov 78	<u>Power Play</u> 6-23 Mar 79
Circuits	98.1%	97.7%
IMPs (WIN Switches)	99.4%	98.8%
Hosts (WWMCCS Computers)	96.1%	94.2%
Network*	95.5%	93.5%

33 56-58

\*Network availability is computed on the basis of the combined availability of the network components and, hence, is somewhat less than availability of the individual components.

(4) User comments on the utility of PWIN and WIN during exercises also were not used. There was widespread and enthusiastic acceptance of networking by users, as exemplified by some of the user comments quoted below:

(a) "A method of solving problems not previously available."

(b) "Increased the effectiveness of CINCLANT and improved this staff's ability to adapt to ever changing events and respond more effectively to crisis situations."

(c) "PWIN proved to be a very effective system for obtaining weather products ... for the first time, a capability existed for TAC to effectively manage weather assets which must be committed to support FORSCOM/TAC operations."

34 58-59

(d) "Through the use of PWIN, MAC, as a Transportation Operating Agency (TOA), was able to reduce significantly the amount of time necessary to receive and process air movement requirements."

(e) "Use of teleconferencing on a permanent basis in a crisis environment proved beneficial for the rapid exchange of information and for completing rapid action officer to action officer exchange..."

(f) "...MAC witnessed and participated in the force list preparation of the supported CINC, this capability offered by PWIN permitted early notice of requirements and early identification of the units to deploy."

10

(g) "Once the total available of MAC assets in support of a crisis or exercise are determined... Preliminary movement tables can be prepared ... PWIN permitted the completion of this step in the planning cycle for the first time. It was accomplished because of the speed with which data was exchanged." NOTE: The movement tables were developed and distributed during the exercise because of PWIN. The development of these tables had never before been completed during a JCS exercise.

34 58-59

(5) The statement that "On July 19, 1977, subsequent to exercise PRIME TARGET 77 and before PWIN's reliability was known, the Joint Chiefs of Staff approved the operational requirements (sic) of PWIN and authorized it to be extended to other WWMCCS sites as the WWMCCS Intercomputer Network (WIN)" (p. 77) is incorrect. PWIN's reliability was known. The Joint Chiefs of Staff directed the implementation of WIN in spite of its known limitations. While by no means the ultimate system, the WIN today is serving several very useful purposes. In addition to being used in support of day-to-day operations, in support of JCS worldwide exercises, and in support of real world crises/emergencies, the WIN is providing the invaluable experience to users required to learn how to operate in an internettted environment. A network must evolve, as it is doing in WIN, with user participation. Maximum use now by operational users is necessary to ensure that the design of the follow-on system is responsive to user requirements.

35 59

(6) The statement that WIN does not provide multi-level security capabilities is true. Providing multi-level security capabilities was not an objective of PWIN or WIN. We know of no certified internettted system that provides this capability, although R&D efforts are being directed to this end. The statement that the WIN "is not sufficiently responsive, reliable, or secure" (p. 9i) is not true. While responsiveness and reliability are subject to value judgment, there is reason to believe that the system is secure. It has been determined that the degree of risk is acceptable and therefore the system is in use daily to exchange operational data up to and including TOP SECRET.

36 59-60

(7) With operating experience and continued development, the WIN will improve. The problems discussed as "reliability problems" on pages 82-83 are really procedural problems which can and are being solved. Surfacing procedural problems such as these is one of the purposes of WIN development. It is not considered appropriate to take the drastic action recommended in the GAO report that: "The Department must replace the WWMCCS host computers and related software with items designed to function

37 61-62

in an interactive mode and redesign the network to simplify equipment configurations" (p. 85). Even if it were possible to buy a fully developed perfectly finished product and put it in place, which is not considered technically possible, the costs involved in replacing all WWMCCS hardware and software would be prohibitive. This recommendation is considered unrealistic, impractical, and not justified by the facts.

37 61-62

b. PWIN/WIN was designed upon existing technology. The operational benefit achieved by the computer networking capability must not be degraded. Reliability and availability problems are recognized and efforts within resource constraints are being made to eliminate this shortfall. The existing capability must be retained during the evolution to the required level of performance.

38 62

8. CHAPTER 7 - WHAT ACTIONS WERE TAKEN TO CORRECT PROBLEMS IDENTIFIED IN PREVIOUS WWMCCS ADP PROGRAM STUDIES?

a. Most of the information from the reports stated in this section, were valid, have been incorporated into current programs and improvements.

39 62-63

b. The Department of Defense recognizes that the current H6000 series system mainframe computers may have only 6-10 years left of normal vendor support, and is currently developing plans for the next generation system through the WWMCC System Engineer. Known deficiencies in the current system are being taken into account in planning for the follow-on WWMCCS Information System (WIS).

9. CHAPTER 8 - ACCESS TO RECORDS: PROBLEMS ENCOUNTERED

a. The statement in the third paragraph that "As of June 1979, we were able to obtain complete access to only 66 percent of the total information we considered pertinent..." is misleading in that it implies denial or partial denial of 34 percent of the documents requested during the course of the WWMCCS audit.

12 34-35

b. In reality, only 21 of the 112 documents requested by the GAO from the JCS were "denied". Of these 21 documents, one was withdrawn by the GAO and 10 were considered by the JCS to have been satisfied. The GAO, when counting a document as denied, considers a denial as any instance wherein briefings were offered in lieu of the whole document, when access was provided but without the physical release of the document, and when only a portion of the document requested was released. Also, multiple requests for the same document, e.g., five separate requests for USNAVEUR and EUCCOM OPLAN 4102, were counted as separate denials.

12

c. The statement that "In several instances, we withdrew selected requests because of the difficulty in obtaining the information," also included in paragraph three, is misleading. JCS records reveal that only four requests made to the JCS by the GAO were actually withdrawn. These withdrawals were made after the JCS demonstrated that the requests either had previously been honored or that the information requested was not sufficiently defined to permit identification of the data.

d. The statement in paragraph 6 that the JCS denied GAO access to operations plans, specifically USNAVEUR OPLAN 4102, is correct. However, in all such cases where OPLAN information was denied, the JCS offered GAO a briefing in lieu of the actual documents themselves.

e. The statements made in paragraphs 8 and 9, that "unnecessary delays and inadequate responses" were encountered because the JCS requested that GAO put their requests in writing, are thoroughly subjective. The Director, Joint Staff, requested these queries be put in writing in order to ensure a timely, thorough response to the GAO's requirements. A total of 227 requests were made to the DoD during the course of this audit, 112 of which were for JCS documents. Without some sort of control -- putting each request in writing -- the sheer volume of these requests would have become totally unmanageable.

f. A certain amount of delay in responding to such a large volume of requests for information was unavoidable. During the course of this audit, the fifth audit GAO has done on the WWMCCS since 1970, the JCS had one Lieutenant Colonel working full-time responding to the GAO's requests for information.

g. In the statement "The Department of Defense has spend approximately \$10-15 billion on this program since its inception," it should be noted that these figures are for the entire WWMCCS and not just WWMCCS ADP.

12

34-35

10. CHAPTER 9 - WHAT CAN BE DONE TO IMPROVE THE WWMCCS ADP PROGRAM?

a. Concur in the recommendation that management of the WWMCCS be strengthened. However, do not concur in the GAO's recommendation that funds be withheld from vital WWMCCS ADP improvement projects. It is true that the WWMCCS ADP system of today is not perfect, but withholding funds from the very programs that have been designed to correct its shortcomings and improve its capabilities would be counter-productive, and would deny WWMCCS users many critically needed improvements.

40

63

13

b. The statement that the WWMCCS Architecture Study provides the necessary information on the operational utility of ADP is incorrect. The operational utility of the ADP Program seeks to determine what form ADP should take to maximize its utility to the command and control function, and to solve the problems that are known to exist. The Architecture Study provided several alternatives to improve WWMCCS ADP. The WWMCCS Council did not think there was enough information to make a decision, so established the R&D in Operational Utility Program.

41 64-65

c. Life Cycle Management and cost accounting, as stated before, are items of concern and are being addressed. These items will be key planning factors for the follow-on WIS.

42 65

d. The DoD has been actively addressing the modernization of the WWMCCS Information System (WIS) since July 1978. The WWMCC System Engineer under tasking by ASD/C<sup>3</sup>I, began at that time planning in conjunction with the operational community to identify next generation WIS target system alternatives which would satisfy existing and future requirements, allow for evolutionary modernization and take full advantage of teleprocessing networks. WWMCCS Council decisions based upon informational needs, capability requirements, costs, schedules, risks, and acquisition strategies are scheduled for December 1981. This planning effort has now been merged with the House Armed Services Committee request that a WWMCCS ADP modernization plan be furnished to Congress with the 1981 Budget. On-going efforts are being accelerated. In addition, a steering committee chaired by the Principal Deputy ASD(C<sup>3</sup>I) with the Director, Command, Control and Communications Systems, OJCS, and the Director Defense Communications Agency has been formed. The WWMCCS Council has reviewed work to date and has approved the approaches being taken.

6 30

## CHAPTER 4

### GAO EVALUATION OF DEPARTMENT OF DEFENSE COMMENTS

1. The 1979 report does not criticize the Department for not keeping pace with technological changes nor does the report compare a system acquired in the early 1970s against 1980 technology. The report does criticize the Department for not taking advantage of the ADP technology that was available and needed to meet the needs of the operational community at the outset of the program. ADP technology involves two important considerations--hardware and software.

The basic issues underlying the Department's problems are that the WWMCCS standard computers and related software, the military version of GCOS and WWDMS, are designed for batch processing and do not function efficiently or effectively in a command and control environment. For example, on page 20 of our 1979 report we state that:

"The WWMCCS computer system's circuitry was designed for batch or sequence processing, and although well suited for this type of processing, it does not contain a capability to function economically, efficiently, or effectively in an on-line interactive mode. By the late 1960s several vendors, including Honeywell Information Systems, Inc., had marketed computer systems that were designed to operate in this fashion." (Emphasis added.)

Computers whose circuitry was and is designed for an online interactive mode of operation use "paging" technology. To illustrate how paging technology and software function together, we state on pages 23 and 24 of our 1979 report that:

"The military version of GCOS is an efficient, single-site, batch-oriented set of software. As a batch-oriented set of software, it does not provide an efficient, effective, or economic means for processing data or information in an online interactive environment. The basic design of the operating system requires it to allocate the main memory of the WWMCCS standard computers in large blocks of characters equivalent to those contained in a complete applications program. On the average, such a

block may contain 25,000 to 40,000 characters. This characteristic creates a "traffic jam" within the computer because each application program must request and be provided sufficient space in memory for the entire program rather than being allocated only the space in memory it needs to execute each set of instructions. The time required to move large blocks of characters into and out of space in main memory seriously limits the computer's processing capabilities and its responsiveness, particularly during a time of high volume use, such as a crisis. Additional memory and secondary storage are required to handle these large blocks of characters. However, the movement of so many unnecessary characters complicates the use of these computers in an internettted multisite environment. One of these complications concerns the fact that there is a physical limitation as to the amount of additional memory and secondary storage capability that can be added to the WWMCCS standard computers. To help the operation in an internettted multisite environment, the same application program must at the same time reside in the main memory of each computer. If one computer does not have sufficient main memory available when needed, data and information cannot be exchanged between the two computers. Thus, the WWMCCS standard computers complicate the synchronization of information exchange in an internettted environment and make the processing of high priority applications difficult \* \* \*.

"In contrast, other computers use smaller blocks of characters in main memory to assist operation in an internettted environment. On the average, these computers use 3,000 or 4,000 characters for a page of an application program. The use of paging allows for better utilization of main memory and facilitates multisite operations because only the needed portions of the application program are called into and used in main memory rather than the entire program. This capability allows more sites to use the computer simultaneously, thus, facilitating the internettting capability of the users. Computers using the paging technology have been commercially available from a number of vendors, including Honeywell, since the 1960s." (Emphasis added.)

The heavy batch processing orientation of the WWMCCS ADP program has been well known in the Department for many years. For example, on pages 63 and 64 of our 1979 report we quote the following from a 1975 study performed for the Defense Communications Agency by the Center for Advanced Computation at the University of Illinois:

"The ADP community in general and the WWMCCS ADP community in particular have a strong batch orientation. Many of the systems being developed for the WWMCCS Intercomputer Network take a batch approach. Unfortunately, the command function is a highly interactive function and bears little resemblance to batch operations. Also intercomputer networking is an inherently interactive technology as opposed to a batch technology." (Emphasis added.)

Further, the need for ADP technology that functions efficiently in an interactive mode was known in the Department at least 13-1/2 months before the WWMCCS standard computers and related software were purchased. See, for example, the correspondence between General Seth J. McKee, Commander-in-Chief, North American Air Defense Command, and General John D. Ryan, Chief-of-Staff, U.S. Air Force. Copies of this correspondence were included as appendixes I and II in our September 21, 1978, report to the Congress, "NORAD's Information Processing Improvement Program--Will It Enhance Mission Capability?" (LCD-78-117). In addition, in our December 1970 report, we demonstrated that the Department did not take advantage of the then existing software technology, particularly data management technology. Thus, we had pointed out this problem area almost 10 months before the Department purchased the WWMCCS standard computer and related software.

Since paging technology and related software have been commercially available before the Department's purchase of the WWMCCS standard computers and related software, and since it was well known within the Department before that purchase that there was a valid need for a system that fully reflected an online interactive computer capability, it is difficult for us to understand how the Department of Defense can state that we compared a system acquired in the early 1970s against 1980 technology.

2. The conditions described in the report are self-evident. Such a comment represents a common Department of Defense response to an audit report critical of the Department's operations.

3. Our 1979 report, as did our previous five reports and numerous Department studies undertaken and completed since 1970, identified and described the problems the Department said in 1966 must be resolved to provide a reliable, responsive, and survivable command and control system. These reports and studies clearly demonstrate that the problems are yet to be resolved even after spending \$1 billion to achieve that goal. For this reason, money has been spent with little or no increased capability having been achieved.

There appears to be a substantive difference of opinion between the Department's view and the operational community's view of whether WIN is a major success and effectively supports day-to-day operations, exercises, and real world crisis/emergency situations. For example, we quote the following from the Department's January 1980 document entitled "Planning for the Modernization of the WWMCCS Information System (WIS)":

#### "1.0 INTRODUCTION

This document has been prepared in response to a Congressional request that the Department of Defense (DOD) submit, with the FY [fiscal year] 1981 budget, a plan for modernizing the current automated data processing (ADP) systems which support the World-wide Military Command and Control System (WWMCCS).

#### 3.0 CURRENT OPERATIONAL PERFORMANCE

To help ascertain the current operational performance of WWMCCS ADP, an in-depth survey of the users of the system was conducted by DCA/WSE [Defense Communications Agency/WWMCC System Engineer] during the summer and early fall of 1979. The survey addressed several levels of WWMCCS ADP users, from the Commander-in-Chief (CINC) to the individual action officers and ADP managers at the key WWMCCS sites. A total of 272 interviews were conducted. The results of the user survey are summarized as follows:

##### Crisis/Conflict Support

- o WWMCCS ADP support of command and control operations in a time-constrained crisis or conflict environment is not viewed as adequate or responsive to user needs.

Recognizing that ADP support for time-constrained crisis/conflict situations is significantly less developed than support of day-to-day operations, attention must be focused on the following performance limiting factors.

### Limiting Factors

- o The on-line query/response and associated information retrieval capabilities of the Honeywell-based system are clearly not up to the state-of-the-art, nor is system reliability viewed as satisfactory. Limitations of the current WWMCCS ADP hardware and software are, however, not considered to be the primary obstacle to improved operational performance in time-constrained crisis/conflict situations.
- o The timeliness, accuracy, and completeness of the source information is a far more fundamental issue affecting the operational adequacy of WWMCCS ADP support. Much of the basic data input to WWMCCS ADP applications programs originates at the operating forces, and is provided in accordance with existing reporting procedures. These procedures are embodied in the Joint Reporting Structure (JRS) and in associated Service/Command reporting systems. The Allied Command Europe Reporting System (ACEREP) also comes into play once European forces are assigned ("chopped") to their NATO commanders.
- o Significant improvement in ADP support of crisis/conflict management will require more current, accurate, and therefore, credible information.
- o Other factors impacting operational performance include the reliability of the supporting communications, and the limited availability of experienced and well-trained personnel at the individual sites. Survivability of command facilities and their supporting information systems is an extremely important additional concern.

The user perspectives summarized above significantly influence the DOD assessment of the current situation and the basic objectives and approach to accomplishing the needed modernization."

Although the Department has been aware of major problems pertaining to WWMCCS ADP and related system support functions for 9 years, it has not effectively redirected the WWMCCS ADP program.

For these reasons, we are concerned about the inconsistency in the Department's response to our report and the Department's statements to the Congress, particularly in light of the Department's recent survey of WWMCCS ADP users.

4. The report does not recommend that all activity come to a halt while a new system is acquired for the very reasons cited by the Assistant Secretary of Defense (Communications, Command, Control, and Intelligence).

What the report does recommend is that the Department stop acquiring additional computer and WIN equipment until the information needs of the military commanders are known and the current equipment and related software can be replaced with equipment and software specifically designed to operate in an online, highly interactive mode.

Specifically, our 1979 report recommends withholding funds for the completion of the study to determine the operational utility of ADP in support of WWMCCS. We believe this capability has already been demonstrated conclusively by the Department of Defense over a considerable number of years. As proposed at the time of our review, this study would not address or resolve the underlying issues associated with the current WWMCCS ADP program.

We also recommend withholding funds for WIN until the Department completes its determination of the information needed by the various commands to support command and control functions. Information, its volume and time sensitivity, determines the type and size of the computer terminals, data communication lines/links, and host computers necessary to meet the needs of the operational community. We first

pointed out the need to make these determinations in our December 29, 1970, report. We believe 9 years is more than adequate time for the Department of Defense to make this type of determination.

We further recommend withholding funds intended to upgrade the current WWMCCS standard computer system for the same reasons. Since the current computer system is not designed to operate efficiently, effectively, or economically in a command and control environment, its replacement seems inevitable. Thus, why not replace the system instead of continuing to spend money to upgrade it?

5. There is no question that command and control functions require ADP support to be responsive, particularly during a time of crisis. The real issue, however, is whether the current WWMCCS ADP program is in fact sufficiently responsive during a time of crisis to protect our national security. As pointed out by the operational community, the current ADP program does not achieve this goal.

The report does not imply that excessive expenditures have been made. What the report describes is that (1) the Department of Defense has spent \$1 billion without achieving substantive improvement in its command and control capabilities, (2) the need for an online interactive computer capability was known before the current WWMCCS standard computer system was purchased, (3) the Department was aware the system did not have an online interactive computer capability before it purchased the system, (4) these conditions have been repeatedly reported to the Department of Defense since at least December 29, 1970, and (5) the Department has taken little or no action regarding the recommendations contained in these reports and studies.

It is well known that economies can be realized through the use of standard equipment, standard data base management systems, standard programs, standard terminology, and standard data formats. Our 1979 report conclusively demonstrates that these goals are yet to be effectively achieved after 9 years of effort on the part of the Department of Defense.

6. It is true the ADP program management structure as it existed at the time of our review was complex and fragmented. The degree of complexity, however, was self-generated and maintained by the Department of Defense, the services, and the Defense agencies. Changes made in the program's management structure since the date of our review will help to eliminate some of the problems the Department is experiencing with this program. The real problem of centralized management control over the WWMCCS ADP program funding and budgeting is yet to be addressed by the Department.

We withhold judgment on the WWMCCS Information System modernization plan until we have had an opportunity to thoroughly evaluate it and to determine whether, over the long run, it will in fact provide an appropriate vehicle for resolving the Department's substantive problems with the WWMCCS ADP program.

Since the Department has submitted to the Congress a WWMCCS Information System modernization plan with the 1981 budget request, we see no valid reason for continuing to buy equipment and to develop software that will be replaced if the plan is acceptable.

7. According to the Department of Defense, the current WWMCCS, including the WWMCCS ADP program, was intended to

- make the National Military Command System the most responsive, reliable, and survivable system that can be provided with the resources available;
- centralize WWMCCS ADP management activities;
- simplify the exchange of information throughout the various commands through the use of standard equipment, a standard data base management system, standard programs, standard terminology, and standard data formats; and
- facilitate and enhance each command's operational backup capability and personnel training requirements.

As described in chapter 4 of our 1979 report, these objectives are yet to be achieved. The WWMCCS ADP program is not the most responsive, reliable, or survivable system that could have been provided with the resources made available.

In addition, the WWMCCS ADP management activities have not been centralized. An attempt to resolve this problem did not take place until June 1, 1979, when the Organization of the Joint Chiefs of Staff and the Defense Communications Agency signed a memorandum of agreement to clarify and centralize these activities and responsibilities. (See app. VI in our 1979 report for the complete text of this agreement.) It should be noted that this action took place following our April 23, 1979, testimony before the Subcommittee on Research and Development, House Committee on Armed Services.

Further, the exchange of information throughout the various commands has not been simplified, although limited improvements have been made. The simplification of information exchange was to be achieved by using standard software, standard data formats, and standard terminology. Standard software, standard data formats, and standard terminology are used only in standard WWMCCS software. However, the extent to which such software is used is essentially left to the discretion of the various commanders who do not make much use of the software because it does not provide them the information they need, when they need it, or in the proper format. Consequently, these commands continue to initiate independent and decentralized software development efforts, a very costly procedure. This was a trend the WWMCCS ADP program was to reverse.

In addition, the current WWMCCS ADP program has not facilitated or enhanced a commander's operational backup capability or personnel training requirements. The standard WWMCCS computer system is unreliable, does not have or use independent and uniform sources of electrical power, and does not provide multilevel security capabilities. All of these conditions must be met to provide a responsive and reliable operational backup capability.

Finally, personnel training requirements have been compounded because of the many and varying applications (470 locally developed command and control applications versus 17 WWMCCS standard applications) used in the command and control environment.

Since these are the Department of Defense's WWMCCS ADP program requirements, not ours, and the evidence overwhelmingly points to the fact that these objectives are yet to be achieved, it is difficult to understand how our statements can be characterized as "inaccurate and misleading."

8. It is true that before the inception of the current WWMCCS ADP program, each WWMCCS site was left to its own resources to acquire systems and to develop software. However, these problems have not materially changed since the inception of the current program. Each command, through its individual service sources, still acquires and funds system acquisitions and software development efforts.

We accept the fact that the Department saved hardware procurement money in the original purchase. However, we demonstrate conclusively that the \$1 billion expense for WWMCCS ADP resulted from the acquisition of computers and related software that were not designed to function efficiently or effectively in the command and control environment. As a result, the \$35.7 million in hardware acquisition cost savings has been more than offset by hundreds of millions of dollars spent for additional equipment and software to overcome the basic deficiencies in the design of the standard WWMCCS computer and related software. It is well known in the computer industry that hardware costs represent only about 10 to 20 percent of the total system development costs. Thus, software development and maintenance represent the substantive costs. For example, the Department of Defense has invested more than \$78 million to try to adapt, retrofit, and improve WWDMS and related software because they were not designed or developed for efficient or effective use in a command and control environment.

Also, the North American Air Defense Command experienced a \$100 million cost overrun to acquire equipment basically used to overcome deficiencies in the standard WWMCCS computer and related software. In another example, the Strategic Air Command spent an estimated \$5.3 million to develop a reliable system which provides warning and attack assessment information to the National Command Authorities, a mission the WWMCCS ADP program was intended to perform. A final example also involves software development. The Military Airlift Command, the Tactical Air Command, the U.S. Army Forces Command, and the Commander-in-Chief, Pacific Fleet, are just a few of the commands that have independently developed command and control software because the standard WWMCCS software did not meet their needs for timely information. Such unnecessary, additional costs more than offset any savings realized by the Department's WWMCCS hardware procurement practices.

For these reasons, we do not believe the Department of Defense has developed a baseline system of compatible computer systems that will support the development of an interconnected and integrated system for the 1980s.

Finally, there is no requirement that computer equipment be acquired at General Services Administration catalog prices. For major procurements, vendors generally sell their equipment to the Government at prices substantially below General Services' catalog prices.

9. Although some economies may have occurred in the claimed centralization, we demonstrate that major software programs, such as the Force Status and Identity Report System, are batch-oriented and have been ineffective at the command level. We show how this claimed centralization has resulted in the creation of new systems to support force status monitoring and other missions at the command level, because the standard WWMCCS software does not meet the needs of many of the commands. For example, several unique file access facilities have been implemented or are in final planning stages:

--Force Management Information System (Strategic Air Command).

--Storage and Retrieval System (Military Airlift Command).

--MAC Integrated Management System (Military Airlift Command).

The Department claims that the WWMCCS ADP program has been designed to use new technologies as they become available, such as computer-to-computer data exchange and distributed data bases, without need for major redesign. There is no basis in fact for this claim. We have shown in the above examples where standard WWMCCS ADP systems could not be adapted in any economical manner, and the commands were required to develop new systems rather than to try to redesign the standard systems. (See pp. 39 to 41 of our 1979 report for additional details.)

The Department of Defense claims that WWMCCS ADP systems have resulted in many improvements that are totally ignored by us with our assertion that "little, if any, improvement has been realized by the Department of Defense since the inception of the program." This position is not sustained by the facts. For example, we have discovered that, because the WWMCCS standard computer system does not provide sufficient and reliable processing capabilities, several other systems have been developed and are being maintained by individual commands to meet their needs. Two of these systems are:

--An online interactive computer system which the Department of Defense calls the Command Center Processing and Display System. This is an early warning system providing the National Command Authorities with tactical warning and attack assessment information.

--A computer system that generates the Single Integrated Operations Plan for use in case of nuclear attack.

In each of these cases, there is no Honeywell hardware or software providing the required critical information processing support. Therefore, these WWMCCS systems are not based on the standard hardware or software to meet critical WWMCCS information needs.

10. According to the Department of Defense, the WWMCCS ADP program was established by the Deputy Secretary of Defense on June 4, 1970, when he approved the WWMCCS standard computer and related software procurement.

Notwithstanding the Department's claim that the June 4, 1970, decision established the WWMCCS ADP program, we previously reported that the Deputy Secretary of Defense approved on November 5, 1969, a plan for buying the WWMCCS computers and software. (See our Dec. 1970 report.) The phasing in of this equipment was to be provided to the fixed headquarters of the WWMCCS and the Intelligence Data Handling System. Therefore, it can be argued that the WWMCCS ADP program was established as early as 1969.

On December 2, 1971, the Department approved Department of Defense Directive 5100.30 which established the WWMCCS criteria which each WWMCCS system must support. This included the WWMCCS ADP system. Unfortunately, this directive came after the procurement of the WWMCCS standard computers and the defacto establishment of a WWMCCS ADP program.

11. The list in the draft report is defined as the locations where we performed our audit, and we have corrected the narrative on page 3 of our 1979 final report accordingly.

12. We have a statutory right of access under section 313 of the Budget and Accounting Act, 1921 (31 U.S.C. 54). We believe the Department's denial, without legal justification to provide us with complete access to the documents we considered pertinent, had an adverse impact on our ability to be responsive to a congressional inquiry. As stated on page 67 of our 1979 report, we were able to gain access to

only 66 percent of the total information we considered pertinent to our evaluation of the WWMCCS ADP program. We are responsible for our findings, conclusions, and recommendations, and we cannot discharge this responsibility if the Department selects what part of the original documentation is available to us on a partial basis or summarized in briefings.

13. The Department states that WWMCCS standard programs meet many needs. In contrast, we have shown in case after case that the commands cannot and do not rely on the standard WWMCCS programs.

WWMCCS standard software does not meet the needs of local commands. Rather, the local commands run standard WWMCCS software because they are directed to use it to report to higher headquarters, such as the Joint Chiefs of Staff. We found that the majority of the WWMCCS ADP resources at the command level are used for local applications. The use of local applications ranges from a low of 56 percent at the U.S. Army Forces Command to a high of 98 percent at the Military Airlift Command and 94 to 98 percent at the Strategic Air Command.

14. It is true WIN is intended to add capabilities that were not previously available. However, the batch-oriented circuitry of the host computer and related software, the lack of uniform and independent sources of electrical power, and the lack of multilevel security capabilities compound the problem of providing a reliable operational and backup capability. The present computer configuration and its batch orientation is further compounded by adding on computer terminals which substantially overtax the ability of the computer to process the known workloads, particularly during a time of crisis. The addition of the terminals increases the reliability problems the Department is experiencing with the configuration, which in turn, further impairs a commander's operational and backup capability needed to maintain continuity of operations.

15. As stated previously, the command and control environment requires a particularly demanding online interactive processing capability. To make it appear that the standard WWMCCS computer system and related software function in an online interactive mode, extensive amounts of additional and costly equipment and software retrofits and modifications have been required. The \$100 million cost overrun at the North American Air Defense Command is an example of how costly it can be to try to make it appear that the standard WWMCCS computer is functioning in an online interactive mode. When additional equipment is added, it tends to impair the reliability of the entire system.

In our 1979 report, we cite other online interactive mode problems with the WWMCCS ADP program to demonstrate the basis for our position. For example, we found that during the Guyana emergency, problems occurred when a power outage caused access to the teleconference to be lost. When the Joint Chiefs of Staff crisis action team attempted to rejoin the conference, the computer could not be accessed because it did not accept the request to "sign on" from the terminal.

Further, Honeywell stated on October 24, 1979, that WWDMS was recognized to be less than optimal regarding the 1970 specification for an online interactive data base management system as defined in the original WWMCCS ADP procurement specifications. (See p. 2.)

For these reasons, we believe that, if the Department's view is that the system is functioning in an online interactive environment, the system is doing so at maximum cost and is highly inefficient and ineffective given other available alternatives.

16. Our concern addresses the unduly heavy emphasis the Department of Defense places on the "uniqueness" of providing ADP support in a command and control environment. As stated in our December 1970 report, the Department began using ADP to support the functions of command and control in the latter part of 1950. How long must such support evolve before the Department, the services, and the Defense agencies can agree on the type, nature, volume, and time sensitivity of the information needed to support the operational needs of military commanders, particularly during a time of crisis? Our December 1979 report shows that the determination of those informational requirements is yet to be achieved. Yet, the Department has spent \$1 billion to purchase equipment and software; modify, upgrade, and enhance the equipment; and retrofit, modify, and develop software that still does not support the operational needs of military commanders.

Our 1979 report also shows that the Department of Defense, partially due to the fragmented WWMCCS ADP program management structure, has not employed sound management practices normally associated with the conceptualization, development, design, implementation, operation, and use of complex ADP systems. Such sound and reliable practices have been employed in other complex ADP system operations within the Department for a number of years.

(See, for example, Secretary of the Navy Instruction, P 10462.7, dated April 16, 1959.) Department of Defense Directive 7920.1 regarding Life Cycle Management of Automated Information Systems only made current what has been known for years within the Department about the proper way to develop, design, implement, operate, and use complex ADP systems. During our review, we found nothing unique about command and control ADP support systems that would or should exclude them from employing sound and reliable management practices.

One of the real problems underlying this whole issue is funding. As stated on page 17 of our 1979 report:

"Although the Department prefers to use the 'evolutionary approach,' to develop command and control systems, this 'approach' has not been used successfully in the WWMCCS ADP program. In a command and control environment, the ability to collect, process, store, retrieve, and display information when and where needed is an essential characteristic. The ability to perform these functions efficiently rests solely on the adequacy with which the users--the battlefield commanders--have identified and validated their information requirements and assured themselves such requirements have been incorporated into the system. Since each service funds its own WWMCCS command and control system development efforts, there is little, if any, incentive for the services to work together cooperatively."

Until the funding for the WWMCCS ADP program becomes more centrally controlled than it has been in the past, there will be little incentive for the Department, the services, or the Defense agencies to work together more cooperatively.

17. The Department's wording appears to add no further clarification of the Assistant Secretary's duties.

18. The standard WWMCCS computers were purchased on October 15, 1971. In response to the Department's request for documentation on this point, we refer first to the August 12, 1970, letter from General Seth J. McKee, Commander-in-Chief, Headquarters, North American Air Defense Command, to General John D. Ryan, Chief-of-Staff, U.S. Air Force. (See app. I of our Sept. 21, 1978, report, "Norad's Information Processing Improvement Program--Will It Enhance Mission Capability?" (LCD-78-117).

In addition, a September 7, 1971, Joint Chiefs of Staff memorandum (No. 593-71) which had as an attachment guidance for the research, development, test, and evaluation program in support of the WWMCCS standard systems, contained the following statement:

"It is expected that major improvements to the WWMCCS New Standard DMS [Data Management System] will be required to achieve the target DMS capability and to develop a state-of-the-art DMS capable of operating in the target WWMCCS ADP System under a concept of distributed data bases in an intercomputer network, with remote online and multilevel security features."

Although in September 1971, the Joint Chiefs of Staff expressed reservation, in part, about the possibility of meeting the online interactive requirements for the command and control community, the Navy had identified at least one data base management system which would potentially meet these demands. This information is based upon recommendations that were approved by the Chief of Naval Operations in a letter dated June 30, 1969 (serial No. 256P91).

19. The Department's understanding of the evolution of the Honeywell 6000 series computer is inconsistent with the computer's actual evolution. Datapro states that the predecessor of the series 6000 was the GE-600 series (later called the Honeywell Series 6000).

Specifically, Datapro states (70C-480-11a):

"After acquiring the GE [General Electric] computer business, Honeywell assigned a high priority to the introduction of an improved large-scale computer family that would retain the GE-600 series customer base and appeal to as many new buyers as possible. Honeywell naturally took full advantage of the GE development work that was in progress at the time of the acquisition. The result was the Series 6000, a strongly GE-flavored product line that blazed no new technological trails but exploited the current state of the art in a highly cost-effective manner." (Emphasis added.)

DATAPRO, a Datapro Research Corporation publication, provides an independent analysis and history of all U.S.-manufactured computers. This publication is considered to be a leading and informative authoritative source of information for the U.S. computer industry.

20. After conferring with Honeywell, we changed the statement on page 20 of our 1979 report to read:

"The WWMCCS computer system's circuitry was designed for batch or sequence processing, and although well suited for this type of processing, it does not contain a capability to function economically, efficiently, or effectively in an online interactive mode. By the late 1960s several vendors, including Honeywell Information Systems, Inc., had marketed computer systems that were designed to operate in this fashion."

The examples of "multi-dimensional" processing cited by the Department do not appear to be comparable to the time-sensitive command and control environment. For the most part, they use GCOS in a primary batch processing environment, involve limited use (one shift per day) of "multidimensional" processing, use equipment other than the H-6060/6080 (the standard WWMCCS computer system), or use operating systems other than GCOS. None of these situations are comparable to the command and control environment with its time-sensitive need to maintain continuity of operations.

For example, the National Aeronautics and Space Administration's Kennedy Space Center system cited in the Department of Defense comment does not use the H-6060/6080 standard WWMCCS computer. The Space Center uses two H-66/80 computers apparently designed to function in a multidimensional environment. The H-66/80 architecture is more advanced and efficient than is the WWMCCS standard computer H-6060/6080 architecture.

The Department's comment that the standard WWMCCS computer and software are well suited to meet current WWMCCS requirements is inconsistent with the findings contained in several of our previous reports and Department of Defense-sponsored studies. Some of these reports and studies are quoted below. (See ch. 7 of our 1979 report for more details.)

In 1976 IBM issued a series of reports on the WWMCCS architecture. These reports addressed all aspects of WWMCCS, including ADP. The architecture study concluded that ADP was marginally effective in times of crisis because the program did not meet the needs of individual users. The study identified several deficiencies with the WWMCCS hardware, systems software, and application software. The study pointed out that:

- ADP was not used, for the most part, to any great extent during actual crisis situations;
- data contained in the system was not sufficiently current, accurate, reliable, or complete;
- information was too voluminous and difficult to extract and assimilate during time-sensitive conditions;
- access to information required cumbersome procedures;
- users were not guaranteed availability when required;
- data contained in the Joint Reporting Structure was old, too detailed, poorly structured, and could not be integrated into common systems which provided meaningful displays for decisionmakers; and
- ADP application systems, such as WWMCCS, the Joint Operations Planning System, and the Force Status and Identity Report System, were so large that, at a number of sites, only one of these systems could be loaded at a time.

In March 1976 the Rand Corporation prepared a report entitled "Report on WWMCCS ADP Communications Interface Requirements," and made the following observations:

"Almost every HIS [Honeywell Information System WWMCCS] 6000 installation we visited indicated severe limitations on the amount of main memory available, or on processing capacity. Additional communications processing such as a PWIN [Prototype WWMCCS Inter-computer Network] Network Control Program or additional special purpose device handlers for new terminals or network connections put additional requirements on these already over-committed resources.

"The GCOS operating system [the military version] was not designed for terminal handling, or for the exchange of message traffic with other computer systems. Rather, it was originally intended to be a batch processing system. Consequently, it has considerable difficulty dealing with the communications loads it is now expected to handle. In the current implementation of PWIN, with the Network Control Program as part of GCOS and resident in the HIS 6000, a higher interrupt rate and an associated increase in overhead is to be expected as a result of the addition of network processing requirements."

The Center for Advanced Computation at the University of Illinois stated in its 1975 study:

"The ADP community in general and the WWMCCS ADP community in particular have a strong batch orientation. Unfortunately, the command function is a highly interactive function and bears little resemblance to batch operations."

In the same study, the center stated:

"Until an appropriate security technology is developed, the utilization of WWMCCS computing resources will be inefficient and the ability to share resources over a computer network will be minimal or nonexistent."

In an August 1978 study performed for the Defense Communications Agency by TRW Defense and Space Systems Group on network reliability, the following observation was made:

"Operational experience with the PWIN test bed has revealed a variety of network--reliability problems. Some of the causes of operational unreliability are egregious [i.e., remarkably bad, flagrant, outstanding for undesirable qualities]. Examples of such include gross hardware malfunctions in a host computer, front-end processor, IMP, modem, cryptographic device, or line, and certain software and procedural malfunctions. Many causes of operational unreliability, however, can be quite subtle. Examples include store-and-forward lockup in a message buffer, and a deadlock in a host-to-host protocol (each of two host computers is idle, waiting for the other to 'say something')."

In a report entitled "Concepts and Alternatives for a WWMCCS Communications Interface System" issued by the Rand Corporation in November 1977, the following comments were extracted regarding PWIN:

"The current implementation of PWIN facilities involves specialized host-resident software at six WWMCCS sites that are connected to a dedicated communication subnet. Problems with this approach include low reliability and the high processing and core [main memory] loads imposed on the host equipment with ensuing limitations on responsiveness. In some cases (e.g., file transfer), the protocols have been specialized for H6000 equipment and would not generalize easily to other hosts. Terminal access to the network is through the H6000, making access to remote systems for backup impossible when the local host has failed.

"\* \* \* No terminal-terminal connectivity is provided forcing all data to be processed by or at least pass through the H6000. Security of the terminal handling system has never been verified."

For the reasons cited above, we do not believe the WWMCCS standard computers and related software are well suited to meet known WWMCCS requirements.

21. The Department's comment that WWDMS does not require a skilled programmer with special training to use it for a speedy and efficient inquiry is inconsistent with the results of Department studies of the issue.

For example, in a report entitled "FORSTAT--Present Operation and Transition To The WWMCCS Intercomputer Network," written by the Institute for Defense Analyses, Science and Technology Division in June 1978, two data retrieval systems available to users of U.S. Army Forces Command for WWMCCS Entry Systems users were compared. The Institute made the following observations:

"The two retrieval systems available to the WES [WWMCCS Entry System] user are the SCN5 system (usually called SCAN) [the non-standard system] and the Worldwide Data Management System (WWDMS) [the standard system]. The SCN5 system is the simpler of the two, requiring little or no programming skill. In practice, it is used 5-10 times as frequently as WWDMS \* \* \*.

"The principal value of SCN5 over WWDMS is that it is a wholly online system. Runs are therefore processed much faster than with WWDMS (in an exemplary case with the same retrieval requirements, a few seconds compared to up to 20 minutes) \* \* \*.

"\* \* \* A second problem reported by users was the relative sophistication of the WWDMS Programming language compared to SCN5. Even though prototype programs are available through the system that can be modified by the user for his programming tasks, the system is still much more difficult for the inexperienced user to employ. The difficulty is compounded where multiple files must be accessed. Here, the level of programming skill required is particularly high; only a few experienced programmers at FORSCOM [the U.S. Army Forces Command] were said to have the skill to perform the necessary retrieval."

Effective support during a time of crisis is provided by answering ad hoc inquiries. This is the nature of a crisis; it is not a preprogrammed operation. In our July 21, 1975, report (LCD-75-116), we said that WWDMS was too slow for rapid response to ad hoc questions, as required during times of crisis, for the reasons cited above.

However, the Department continues to require WWMCCS users to buy and use WWDMS even though (1) it is more difficult and inefficient to use than are other systems, such as the SCN5 system, and (2) the vendor said on October 24, 1979 (see p. 2) that WWDMS had been superseded by a more recent Honeywell product.

22. On pages 25 and 26 of our 1979 report, we changed this statement to read "\* \* \* requires the computer to look at many data elements in sequence until it finds the desired one rather than immediately selecting the desired data element without looking at others."

23. On page 26 of our 1979 report, we changed the sentence to read, "The WWMCCS ADP Project Manager informed us that none of these modifications have achieved a reliable online interactive processing capability because of the problems inherent in the military version of GCOS and WWDMS basic architectures."

24. To maintain continuity of operations in as essential an environment as command and control, reliance on commercial power sources should not be considered a reliable source of power under any circumstances. Such sources can be easily interrupted by acts of God (thunderstorms) or sabotage. It should be noted that the commercial source for supplying power to the North American Air Defense Command uses independent and uniform power to operate the command's computer system because of the frequent and severe thunderstorms in the area. A continuous and uniform flow of power assures the company that customer billings for services will not be lost or incorrect and will be presented on time for payment. This protection was provided at a cost of \$60,000, which the power company believes to be "cheap insurance" for maintaining its continuity of operations. We believe WWMCCS ADP sites should make proper use of similar "cheap insurance."

Under no circumstances can battery power be considered an adequate backup and uninterruptable power supply. Battery power, as indicated by the Department of Defense, is a transient power which allows gradual degradation of computer capabilities for a period of 15 to 20 minutes. Backup power generators must be capable of providing a uniform flow of power to protect sensitive computer operations from the impact of even minor fluctuations in the power supply.

A major factor contributing to these conditions, as stated in the Department's comments, is that no uniform criteria exist for providing electric power to support the WWMCCS ADP program. We believe that such criteria are badly needed and must be implemented at all WWMCCS sites to ensure continuity of operations.

25. One of the objectives of the current WWMCCS ADP program was to minimize or eliminate the costly, independent, decentralized, and multiple (similar) software development costs experienced by the various commands. This objective was to be achieved through the simplification of information exchanged throughout the various commands by the use of standard equipment, a standard data base management system, standard programs, standard terminology, and standard data formats.

In our 1979 report, we point out (see pp. 35 to 37) that the Joint Chiefs of Staff had approved 16 applications as WWMCCS standard software and had 7 additional applications under consideration for such approval. In its January 1980 document, "Planning for the Modernization of the WWMCCS Information System (WIS)," the Department indicates that it considers approximately 470 applications to be command-unique. On page 32 of our 1979 report we state:

"However, standard software is standard in name only. Although commands may elect to use these applications as they see fit, most commands use very few of them. Usually the information is too old for many users, is not sufficiently detailed for local use, does not contain the right information in the right format, and cannot be accessed in a timely manner. As a result, each command has developed a substantial number of software applications to support its command and control functions. These applications have been developed at considerable cost. In some cases, functionally redundant standard applications are maintained to support Joint Chiefs of Staff reporting requirements which create additional workloads for the computer. The elimination of multiple (similar) software development efforts was a problem the current WWMCCS ADP program was intended to resolve."

Further, on page 39 of our 1979 report we state:

"To try to develop the automated support the various commands need for the purposes of command and control and to overcome the problems associated with WWMCCS standard software and software under consideration as WWMCCS standard, each command has initiated the development of command and control software. These software developments are initiated independently of the information needs of other commands with which they must exchange information."

Apparently, the Department of Defense has made no attempt to determine the extent to which the nearly 470 locally (command) developed software applications are essentially the same or how much of the data the systems accumulate, process, and store is the same. In addition, the Department has made no effort to determine the extent to which the reports produced by the system are the same or sufficiently similar to serve as a basis for developing a uniform or standard system. This issue is similar to the one described in our October 15, 1979, report, "Duplication in the Navy's Management Information Systems Is Costly" (LCD-79-113).

For these reasons, we believe that the Department of Defense's lack of centralized program management for WWMCCS ADP has allowed the various commands to continue the costly independent and decentralized development of software. This is a problem that the Department recognized in 1966 had to be resolved.

26. The Department offers no evidence that it has encouraged coordination for using standard systems to perform similar functions at the commands. Rather, the Department implies that it encourages command-unique systems as a general rule. Local commanders have developed their own automated support for the functions of command and control since WWMCCS standard software does not meet their needs. These software development efforts are similar and very costly to develop and operate.

In addition, locally developed software applications impair the command's ability to exchange information because they are developed independently without sufficient consideration being given to the information requirements of other commands with which information must be exchanged. The current WWMCCS ADP program was intended to resolve this problem.

Computer accounting records were not available at every site to determine computer resource utilization. However, where we were able to obtain this information, we found that locally developed command and control applications consumed much more computer resources than did standard applications, although standard applications are and should be expected to utilize the bulk of these resources if they properly supported the commander's information needs. The following table illustrates this condition:

Percentage of Computer Resources Used for Standard and Local Command and Control Applications

<u>Location</u>	<u>Percent of use for standard applications</u>	<u>Percent of use for local applications</u>
Commander, U.S. Forces, Korea	23	77
Strategic Air Command:		
Batch	2	98
Terminal connect hours	6	94
Military Airlift Command	2	98
Pacific Command	41	59
U.S. Army Forces Command	44	56

The Department believes it is desirable for unique applications software developed by each command to support its unique missions to constitute a large part of the total WWMCCS applications software. We do not agree, because we have observed many similar information needs at the command level. The development of "command-unique" software should be kept to a minimum if the Department is to simplify the exchange of information between and among commands comprising the WWMCCS community and if the Department expects these commands to be truly responsive during a time of crisis.

27. The Air Force Audit Agency reported problems with the accuracy of Force Status in January 1978. The report stated that units of all eight major commands included in the audit reported changes only 6 days a week, instead of 7 days a week as required by the Joint Chiefs of Staff. Combat readiness status was incorrectly reported at 47 percent of the units. Reports of available personnel were overstated by as much as 24 percent. For 42 percent of the units, inaccurate data was reported for a variety of data elements because of weak local procedures for ensuring its accuracy. Old and inaccurate data impairs the ability of the National Command Authorities and subordinate commanders to be fully aware of the readiness posture of our military forces at any given point in time.

If the controls referred to by the Department exist, they certainly are ineffective and inefficient for their intended purpose.

28. The Joint Operations Planning System is the set of policies and procedures for developing, coordinating, disseminating, reviewing, and approving joint plans for the conduct of military operations and planning the execution thereof.

However, a report prepared for the Defense Communications Agency by the Rand Corporation states that the Joint Operations Planning System is essentially an automated version of a manual planning procedure, taking relatively little advantage of available ADP technology and unable to fully employ recent changes in communications technology. Consequently, this system is difficult to use. For example, the Joint Operations Planning System data base is not the same format as the Force Status and Identity Report System data base. The result is incompatibility between the planning and operations (status) data bases, an intolerable condition according to the WWMCCS operational community.

29. The Department defends the development of the Deployment Management System by the U.S. Readiness Command as a good example of a command-unique software requirement. We believe the basic issue is that a significant number of the unique systems developed by the WWMCCS ADP activities are very similar to unique systems developed at other locations. The decisions for software development are generally made at the local WWMCCS command level without considering the needs of other commands with which information must be exchanged. These observations were reported by the Defense Audit Service (Report No. 79-031, Dec. 29, 1978). Although the Joint Chiefs of Staff generally agreed that the description of the WWMCCS software development environment was basically correct, the Department continues to allow the condition to persist.

30. We concur with the Department's statement that the Joint Operations Planning System was not designed to be a time-sensitive system. However, we believe that this was a major design error because of the time-sensitive and online interactive information needs to support joint operations planning, particularly during a time of crisis.

31. The Department's comment represents one of many expressing differing views of the purpose of PWIN/WIN as demonstrated in the following paragraphs.

The following Joint Chiefs of Staff memorandum (No. 593-71) has been previously quoted and predates the acquisition of the WWMCCS standard computers which were purchased October 15, 1971:

"(2) Capability Requirements. It is expected that major improvements to the WWMCCS New Standard Data Management System [DMS] will be required to achieve the target DMS capability and to develop a state-of-the-art DMS capable of operating in the target WWMCCS ADP System under a concept of distributed data bases in an intercomputer network, with remote online and multilevel security features."

In addition, another Joint Chiefs of Staff memorandum (No. 4-75(s) dated Jan. 23, 1975), stated that among the goals of the WWMCCS ADP program was the development of a capability for direct computer-to-computer or remote terminal-to-computer exchange of various levels of classified information.

Further, the memorandum stated that the integrated WWMCCS ADP system should use distributed data base concepts and workload sharing techniques that will support continuity of ADP operations.

We believe these two Joint Chiefs of Staff memorandums clearly indicate a requirement for an inter-computer network as we have stated it in our 1979 report.

In our 1979 report, we provided as appendix IV a chronology of events relating to the PWIN and the approval of WIN for the period of 1971 to 1977. This chronology shows a variety of differing departmental purposes for PWIN/WIN.

Selected highlights from the chronology are presented below to demonstrate these differing departmental positions on the reason for and objectives of PWIN:

- The Deputy Director, Office of Engineering and Implementation, Defense Communications Agency, wrote on October 11, 1973, that, in 1975, PWIN would be transitioned into an operational system.
- On November 28, 1973, approximately one week after Defense Communications Agency management had denied PWIN was to become operational, top management personnel were informed that the object of PWIN was to develop an operational WWMCCS network capability.
- A memorandum for the Chief, Software Support Division, Command and Control Technical Center, Defense Communications Agency, dated May 5, 1974, indicated that PWIN was not intended to become an operational network. However, this statement contradicted the WWMCCS objectives plan for fiscal years 1974-1993.
- In a July 21, 1975, report (LCD-75-116) to the Secretary of Defense, we strongly questioned whether PWIN would be able to meet its design objectives and criticized PWIN's excessive response times.
- On September 25, 1975, the Director, Telecommunications and Command and Control Systems, 1/ agreed with us that internetting, fully interactive operations, and multi-level computer security were goals which must be achieved. Further, in light of our report, final approval of the PWIN development plan was delayed.

---

1/This office has been replaced by the Office of the Assistant Secretary of Defense (Communications, Command, Control, and Intelligence).

This September 25, 1975, position was communicated directly to the Director of our Logistics and Communications Division in response to our report dated July 21, 1975 (LCD-75-116).

In summary, although the Department provided a conflicting statement in April 1975 on the purpose of PWIN, we believe that the real purpose of PWIN/WIN, as we have stated in our 1979 report, was reaffirmed in the Department's September 1975 response to our July 1975 report. Such differing departmental views over the years directly contribute to the WWMCCS ADP program's limited ability to properly support the operational community.

32. The reliability of PWIN/WIN has been a problem known to the Department since 1973. For example, in appendix IV of our 1979 report, Department documentation which we have referred to, in part, shows that:

- On September 4, 1973, the Defense Communications Agency management was alerted by the PWIN Test Director to the possibility of failure of the PWIN computer network.
- On October 29, 1973, the first comprehensive PWIN Test Plan was prepared and approved by the PWIN Test Director and the PWIN Project Manager. This plan emphasized that reliability was a major problem area.
- On November 19, 1973, a preliminary briefing on the PWIN project was presented to Defense Communications Agency management. This briefing was to be given to the WWMCCS ADP Project Manager in the Joint Chiefs of Staff. Reliability was emphasized as a potential problem area.
- On April 19, 1974, the MITRE Corporation prepared a report that confirmed the existence of major reliability problems in PWIN.
- On September 18, 1974, Defense Communications Agency management was urged to adopt a "Concept of Failure Plan" to provide advance planning for reliability problems rather than last-minute panic reaction to network failure. Apparently, no action was taken by management to prepare such a plan.
- On January 20, 1975, an engineering report was prepared describing the results of the first system integration test of the PWIN computer network. Major

reliability problems were noted and the failure rate was estimated to be 50 percent. The report concluded that only a direct recognition of the problem and formal effort to develop solutions could resolve the reliability problems. Apparently, no action was taken on this report by the Defense Communications Agency.

--On March 29, 1976, a memorandum from the Release Coordinator reported major reliability problems with the PWIN network. According to this memorandum, the network failed approximately every 35 minutes.

--On July 6, 1976, the Director of PWIN operational experiments stated that:

"During recent practice sessions to prepare for a June 24, 1976, demonstration of the system, the reliability of system hardware and software was extremely poor. During approximately two weeks of demonstration practices, we were unable to complete one full run of the planned demonstration due to a variety of system hardware and software problems."

The Director then gave the PWIN project the following ultimatum:

"\* \* \* To gain assurance that the operational experiments will be conducted under conditions that will provide a reasonable degree of confidence that experiment objectives will be achieved, I have requested CCTC (Command and Control Technical Center) to demonstrate PWIN system reliability on 12 and 13 July. Based on this demonstration, a determination will be made relative to conduction of the formal PWIN Operational Experiments scheduled between 19-30 July 1976."

--On July 15, 1976, this ultimatum failed to produce the desired results. A telegram was sent by the Joint Chiefs of Staff to all WWMCCS sites participating in the PWIN project. This telegram delayed the beginning of the operational experiments because of the following problems:

- a. Instability of communication links between PWIN nodes.
- b. Uncoordinated communication fault corrections.

- c. Intermesage processor and host or main hardware/  
software failures. These failures were due to loss  
of power, air-conditioning, and component failures.
- In September and October 1976, PWIN operational  
experiments 1 and 2 were conducted. During these  
evaluations, reliability was identified as a criti-  
cal problem by several commands.
- From January to February 1977, top management in the  
Department of Defense was briefed on the PWIN project.  
The briefing also identified problem areas of system  
reliability, bulk data file transfer, and operating  
procedures. Despite these problems, it was recom-  
mended to proceed with an operational network.
- From March 1 to 16, 1977, the PRIME TARGET exercise  
was conducted and included the six participating PWIN  
sites. This exercise showed that four of the six  
sites experienced high percentages of abnormal termi-  
nations averaging 62 percent. An abnormal termination  
can be defined as a termination of operations due to  
software or hardware or combination of software/  
hardware failures. These severe reliability problems  
were apparently typical of prior exercises, such as  
ELEGANT EAGLE 76.

Although the individual hardware/software components  
in the PWIN/WIN may be highly reliable, we considered  
failure to provide the user with the capability to  
successfully achieve a given task to be indicative  
of a larger system reliability problem. For example,  
the law of reliability shows that in serial systems,  
the reliability of the system was determined by  
multiplying the component failure rates together--not  
by adding them. If there are seven components  
in a typical PWIN/WIN serial system or site with  
individual reliability of 0.99, then the overall  
site reliability equals  $(0.99)^7$  or 0.932065.  
In the six site test of PRIME TARGET 77, the serial  
system reliability for PWIN would be approximately  
 $(0.99)^{42}$  ( $42=7$  components x 6 sites)  
or 0.655659. These reliability computations are not  
necessarily the actual network reliability measures.  
However, they serve to demonstrate the relationship  
of PWIN availability with its reliability.

- On June 1, 1977, the final consolidated report for PWIN operational experiments 1 and 2 was issued by the Joint Chiefs of Staff. While the report was generally favorable, it indicated problems with reliability, data file transfer, and multilevel computer security procedures. For example, PWIN was unable to successfully transfer Force Status and Identity Report System data from either the Master or the STRIP 1/ file. According to Joint Chiefs of Staff criteria, PWIN must be able to successfully transfer Force Status and Identity Report System information.
- On July 18, 1977, despite the existence of these problems, the Joint Chiefs of Staff approved and validated an operational requirement for WIN. According to several Department of Defense officials, the decision to go operational was advisable because the users of PWIN saw it was a tool to improve their decisionmaking capability. These officials informed us that the problems identified in PWIN could only be solved by letting the system "evolve."
- On December 27, 1977, approximately 5 months after the Joint Chiefs of Staff validated the operational requirement for WIN, the Defense Communications Agency identified the following reliability and availability deficiencies with the PWIN program:
- a. Software releases and emergency changes (patches) did not always receive standard system software test and evaluation. At times, this practice resulted in release to the field software that had not been adequately tested and contained errors. The result was repeated system failure.
  - b. The present PWIN communication subnet topology was based on least cost as opposed to reliability. As a result, each site or group of sites tended to be isolated from some or all of the network.
  - c. Electrical power problems had caused network outages. Aside from total system failure at user sites when power systems failed, the network had experienced Interface Message Processor (IMP) failure during electrical storms or at other times when the power system was subjected to voltage and frequency fluctuations.

---

1/STRIP is a small segment or "strip" of a data base.

- d. IMP maintenance and operation had been inadequate. Contractor field engineers at certain sites were unable to repair the IMP because of inadequate training. On several occasions, personnel had to be sent to sites during exercises to repair the IMP. Because site operators were not qualified to diagnose problems and, in some instances, unable to load the software, excessive downtime resulted.
- e. Adequate quantities and types of spare parts were not available for the IMP. Consequently, sites had experienced excessive downtime due to lack of spares; also, spare parts had on occasion been found to be ineffective.
- f. Difficulty in determining the causes of IMP failures resulted in excessive downtime.
- g. The present network configuration did not allow for alternate site access. When an IMP or host failed, that site was isolated from the network. This was of prime concern especially when that site was a major player in a crisis situation.
- h. PWIN host software contained "errors" which caused the user to have difficulty in effectively using certain internetting features, such as teleconferencing. These errors caused programs to be aborted, resulting in excessive rerun times after aborts or loss of data.
- i. IMP and IMP/H6000 interface software contained known errors. The various software and hardware configurations in use provided a myriad of potential interface problems.
- j. Communication problems had adversely affected the reliability/availability of PWIN. Some of the major problems were: several communication lines repeatedly failed during Joint Chiefs of Staff exercises; not all sites had technical control facilities to monitor communications and help in restoration; and IMPs were located in ADP areas where they were not monitored on a continued basis.

As a result of these problems, the Director, Defense Communications Agency, conducted a WWMCCS Intercomputer Reliability Study to resolve these problems. We requested a copy of this study but were denied access because it was in draft. Therefore, we were unable to ascertain whether these problems had been satisfactorily resolved.

Regarding "log-on" problems associated with PWIN/WIN, the table from our December 1979 report is reproduced below showing the experience of four participating sites. A log-on represents an attempt to use the system. The additional data suggested by the Department of Defense has been added in the column, "No. of log-on successes." The revised percents using this additional data also have been added as a new column. Using the Department's new basis for determining successful log-ons, we find that the percent of abnormal terminations is higher than we initially calculated in each case. Also, the overall percent of abnormal terminations becomes 67 percent.

<u>PWIN sites</u>	<u>No. of log-ons</u>	<u>No. of log-on successes (note a)</u>	<u>No. of abnormal terminations</u>	<u>Percent</u>	<u>Revised percent (note b)</u>
Atlantic Command	295	286	132	45	46
European Command	124	118	54	44	46
Readiness Command	290	241	247	85	100
Tactical Air Command	63	62	44	70	71
Command and Control Technical Center	(c)	(c)	(c)	(c)	(c)
National Military Command Center	(c)	(c)	(c)	(c)	(c)
Total	772	707	477	62	67

a/A log-on of over 1 minute.

b/Figures can exceed 100 percent because the Readiness Command had more abnormal terminations than log-ons of over 1 minute. However, the value of 102 percent for the command was rounded off to 100 percent.

c/Not available because statistics were not developed for these sites.

A November 1977 report prepared for the Defense Communications Agency by the Rand Corporation states:

"System log-on procedures are a common target of users' complaints. They feel that procedures are cumbersome and unnecessarily complex. For example, at one site, users must supply about sixty separate items of information to initiate a particular application program. Errors are inevitable in such cases, and a single error (such as a misspelled word) can result in a system abort, requiring the user to start over from step one. Obviously, this is a source of great frustration to users who are frequently under time pressures to perform their tasks.

"Moreover, WWMCCS system files and applications are frequently identified by long and complex alphanumeric character strings. Users complain that the requirement to reproduce such strings can significantly increase the time necessary to perform their tasks. One reason for this is a frequent need to locate and search system manuals or listings for the string appropriate to a given application. Here, too, errors can lead to system aborts that force the user to start over. At some sites, the user also must name the storage devices (in 'system language') upon which his files reside--a requirement that adds fuel to the complaint that systems are designed primarily from the technician's point of view."

Also, the Department asserts that the chart and discussion of reliability generally bias the reader toward the worst case. This chart does not necessarily present the worst case we reported. For example, during the Guyana crisis, problems occurred with the teleconferencing software. On one occurrence, the Joint Chiefs of Staff crisis action team was out of contact with the Guyana teleconference team for over 1 hour.

The problem occurred when a power outage caused access to the teleconference to be lost. The computer could not be accessed because it did not accept the request to "sign on" from the terminal. A determination was made, subsequently, that when the outage occurred, the teleconference participant name for the crisis action team still remained "signed on" in the computer. However, the WWMCCS software did not permit a new "sign on" by the crisis action team, even though the team had been physically disconnected from the computer.

In summary, given the long history of serious PWIN/WIN reliability problems and the frequency and magnitude of user complaints on the issue, we cannot agree that the data contained in our report is inaccurate and misleading. It appears logical to use these shortfalls to predict the future performance of the system.

33. When responding to us on this issue, the Department continues to confuse a system's "availability" with its "reliability."

The use of availability figures by the Department does not present reliability levels. This distinction becomes

quite apparent when examining the methods the Department uses to determine PWIN's availability rather than its reliability and the Department's subsequent experience with WIN during the Guyana crisis, the NIFTY NUGGET exercise, and the new information on the POWER PLAY exercise.

Selected Department of Defense definitions are quoted below to illustrate the relationship of reliability to availability:

- Reliability includes not only the availability of the system to the user, but also the dependability that network capabilities perform consistently. (Briefing to Defense Communications Agency management on the PWIN, Nov. 19, 1973.)
- Relationships Between Analysis Measures.  
Availability was the time each component was able to be used. Reliability was the extent to which available components could be used, either singly or together. (Extract from PRIME TARGET 77.)
- Reliability has a definite impact on availability. That impact can be lessened by providing redundant capabilities such as alternative communication paths and backup equipment. Using redundant capabilities reduces the impact on availability of any single component or subsystem failure. (Memorandum for the Secretary, Joint Chiefs of Staff; Subject: World Wide Military Command and Control System (WWMCCS) Computer Internetworking Reliability Study, from Defense Communications Agency, No. 1100, Dec. 27, 1977, enc. 1.)

During the 1976 PWIN operational tests, the Joint Chiefs of Staff collected availability data on each major PWIN component--the host computer, IMP, and communication lines--and concluded that PWIN had an extremely high rate of availability. According to this data, the average availability of PWIN equipment ranged from 94.8 percent to 98.7 percent for the first test and from 92.1 percent to 99.3 percent for the second test. This data was somewhat misleading because the Joint Chiefs of Staff lacked the necessary techniques, methodology, and data bases necessary to properly collect and evaluate the effect PWIN's reliability had on the network's availability.

WIN was tested in the exercise NIFTY NUGGET 78. This exercise presented the Department with still another chance to realistically appraise the ability of WIN to support the functions of command and control in a major crisis situation. According to participants in NIFTY NUGGET, the response time

of the system to commanders bordered on being unsatisfactory. The following observations which have been referred to, in part, were made by the U.S. Army Forces Command NIFTY NUGGET participants:

- The WWMCCS Entry System enabled the user to have any questions answered almost immediately. However, those secure communications that used the Automatic Digital Network moved at the speed of hard copy or normal message traffic. The result of these factors was that the average age of data in WWMCCS was 8 to 12 hours old.
- WIN was inadequate because the WWMCCS standard computer system could not provide adequate ADP support for command and control during a crisis.
- The WWMCCS standard computer system could not keep up with both daily maintenance and exercise requirements.
- The major factors causing the slow response time were (1) increased complexity of questions, (2) inadequate core (main memory) storage to service the users, (3) insufficient time to process data due to increased workloads, and (4) the lack of a single comprehensive data base.
- Several semi-independent application systems affected the WWMCCS ADP capabilities. Each of these systems had its own set of data files, which contained different data. As a result, problems were encountered with obtaining information in a timely fashion.

To correct these differences, the U.S. Army Forces Command estimated it would have to increase its fiscal year 1979 program funding from \$2.314 million to \$5.934 million.

In summary, the Department is defending a position that the WIN reliability is improving by presenting availability data. This approach is not correct, because the Department is fully aware that availability is not reliability. Our concern addresses the reliability of WIN.

34. We recognize that there are possible benefits from WIN. However, our primary concern is with economy, efficiency, and effectiveness of these programs regarding WWMCCS criteria. The criteria for WIN are necessary to the National Military Command System to make it the most responsive, reliable, and survivable system that can be provided with the resources available.

We have demonstrated that WIN does not adequately meet the responsive and reliable criteria for WWMCCS. It is interesting to note that the Department's recent survey of 272 users of WWMCCS ADP agreed with our assessment of the system's reliability. The Department included the results of this survey in the WWMCCS Information System modernization plan recently submitted to the Congress. The results of the survey, as the Department reported it to the Congress, are quoted on pages 26 to 28 of this report. The results differ measurably from the Department's comment to us on this same topic.

35. The Department states that PWIN's reliability was known on July 18, 1977. However, we found that on December 27, 1977 (see p. 53), approximately 5 months after the Joint Chiefs of Staff validated the operational requirement for WIN, that the Defense Communications Agency identified many serious reliability and availability deficiencies with the PWIN program.

Perhaps the PWIN's reliability problems were intuitively known on July 18, 1977, but they appear to have been documented on December 27, 1977. Nevertheless, in defense of this position, the Department claims that a network must evolve, as it is doing in WIN, with user participation. According to the Department, maximum use now by operational users is necessary to ensure that the design of the follow-on system is responsive to user requirements.

We have demonstrated that the major user requirements for responsiveness and reliability during times of crisis are not met. "Evolving" with a poor design can be expensive, but this approach is no way to ensure a responsive and reliable system. The result of the Joint Chiefs of Staff July 18, 1977, decision to approve and validate an operational requirement for WIN was that the reliability problems continued.

The reasons for the WIN reliability problems were discussed in an August 1978 study performed for the Defense Communications Agency by TRW Defense and Space Systems Group. (See p. 41 for an extract from that study.)

36. The Department states that providing multilevel security capabilities was not an objective of PWIN or WIN. This position is not entirely compatible with the September 7, 1971, statement of the Joint Chiefs of Staff requirements as stated in Joint Chiefs of Staff memorandum No. 593-71. (See p. 39.)

Further, as we have stated on page 50, we were informed on September 25, 1975, that the Director, Telecommunications and Command and Control Systems, agreed with us that inter-netting fully interactive operations and multilevel security were goals that must be achieved.

In addition, the Department claims that our statement that WIN is not sufficiently responsive, reliable, or secure (see p. 60 of our 1979 report) is not true. According to the Department, while responsiveness and reliability are subject to value judgment, there is reason to believe that the system is secure. The Department has determined that the degree of risk is acceptable, and therefore, the system is in use daily to exchange operational data up to and including top secret. However, the Department is quoting out of context because the subject at issue is multilevel security. For example, certain users, such as the Defense Intelligence Agency, have stated they will not use WIN because the system lacks multilevel security.

In another example, the Strategic Air Command was scheduled to join WIN with a terminal in October 1978 and a host computer in 1980. However, Strategic Air Command officials recently stated that the command would not provide a host computer without the protection of multilevel computer security. Such protection is required for the sensitive Single Integrated Operations Plan data processed at the Strategic Air Command.

As currently structured, WIN cannot meet the multilevel security requirements of individual commands. Operating at a system high level of top secret is not multilevel security, but it is a very costly and inefficient way of providing single level security. This inability to have multilevel security makes the use of WIN questionable in transferring certain data during time-sensitive situations. Current methods of transmitting data via the intercomputer networks will remain time consuming and expensive until multilevel security is developed and implemented. This requirement must be achieved for WIN to realize its full operational potential.

37. The Department's position is inconsistent with that of the House Committee on Appropriations (H.R. No. 96-450, Sept. 20, 1979) which is:

"The General Accounting Office (GAO) has reviewed the WWMCCS-ADP system and was highly critical of the program in its report. The major shortcoming of the WWMCCS-ADP program is the deficiencies of the computers which are the key hardware for the entire system.

"The Committee believes that considering the deficiencies of the presently operational system, the inevitability of the need for new hardware and the wastefulness of adding additional hardware to the presently operational system, the best approach is the development of a 'follow-on' WWMCCS-ADP system.

"The Committee has deleted the Defense Communications Agency's request for \$5,120,000 for WWMCCS-ADP/ Executive Aids Utility R&D [Research and Development] and added \$4,120,000 for a new program \* \* \*.

"Within the 'WWMCCS System engineering' program the Committee has deleted \$4,694,000 requested for a subprogram \* \* \*."

The Committee noted a word of caution regarding the next generation WWMCCS ADP program. According to the Committee, its criticism of the present program and the recommendation for development of a follow-on system should not be interpreted by the Department "as a carte blanche to go and develop an overly elaborate, overly costly, gold-plated WWMCCS ADP program."

The Committee also noted that the next generation WWMCCS ADP program should make optimal use of off-the-shelf equipment for its computers, networking, and related hardware. Further, the Committee noted that the software costs made up the major development cost of an ADP system and that the Department's software development for the next generation WWMCCS ADP should be at a modest and defensible level. The Department has been requested to present a plan for the new WWMCCS ADP system to the House Committee on Armed Services.

The Committee report (H.R. No. 96-166, May 15, 1979) is quoted, in part, below:

"The Committee concurs with the GAO recommendation that further funding for WWMCCS ADP improvements should be restricted until the Department of Defense presents an integrated plan that clearly indicates what type of ADP capability is required by the various commands in support of their command and control functions and how the Defense Department plans to modernize both the computer hardware and software elements of the WWMCCS in support of these requirements. The Committee requests that this plan be submitted with the fiscal year 1981 budget request."

We believe that the Department must develop a sound, reliable, responsive, and survivable WWMCCS in support of our national security. If both hardware and software need to be replaced, then they should be done if WWMCCS is to properly support the National Command Authorities, the Joint Chiefs of Staff, and the tactical commanders in the 1980-2000 time frame.

38. Apparently, the core of the reliability problems stems from the batch processing orientation of the host computer and related software; namely, the Honeywell 6060/6080 computers, GCOS, and WWDMS.

Although the existing capability must be retained, it should not be enhanced by adding more terminals to the system. The addition of more terminals will only further degrade the system and tend to make it even more unreliable until the host computers and related software are replaced.

39. We do not agree that information from our previous reports and Department studies has been incorporated into current programs and improvements. For example, our December 29, 1970, report addressed such issues as "the lack of information requirements definition." As described in both our 1970 and our 1979 reports, the definition of requirements is yet to be achieved, although no useful system can be designed and implemented without this task being accomplished.

The January 1980 Department document, "Planning for the Modernization of the WWMCCS Information System (WIS)" states:

"Heavy involvement of operational users is essential to evolve both broad concepts and a clear definition of information requirements and

associated functional capabilities (e.g., man/machine terminal features), and must continue throughout the life of the modernization program. A long-term ADP experiment/demonstration program is an important mechanism for such user involvement. The 'R&D in New WWMCCS ADP Applications' Program is oriented in this direction and will place early experimental emphasis on automated support to 'source data entry.' Such automated support, implemented in a joint reporting context, represents a possible step toward improved information quality."

The information requirements of operational users were problems the Department recognized in 1966 had to be resolved. Yet the Department still has not achieved this goal nor has it made firm plans on how to resolve this issue in the 1980 planning document. These requirements serve as the foundation in determining the type and nature of the computer equipment and related software needed to provide a reliable, responsive, and survivable WWMCCS ADP support capability.

40. We welcome the Department's recognition of the need to strengthen WWMCCS management. However, we do not agree with the Department's rationale concerning our recommendation that certain funds be withheld.

Essentially, we believe that it is counterproductive to continue to spend money for WWMCCS ADP improvement projects because the cost appears to exceed the marginal gain. This situation occurs because the fundamental batch or serial design orientation of the standard hardware and software cannot be economically modified to meet the pressing online interactive needs of the command and control community.

We believe that, aside from emergency patches to maintain current operations, new money will be better used to modernize the system. This requires a definition of user needs before funds can be provided for a redirection of the WWMCCS ADP program, including, if necessary, a new system design or a WWMCCS ADP follow-on system.

As stated on pages 61 and 63, the House Committees on Appropriations and on Armed Services shared this same concern and withheld several million dollars from the Department's fiscal year 1980 budget request for WWMCCS ADP and related programs.

41. We agree the WWMCCS Architecture Study completed in 1976 did not provide enough information regarding users' needs. However, the study could be used as a foundation upon which to further define and clarify those needs. This was the approach taken by the U.S. European Command and subordinate commands in their European C-3 Architecture Study. In this instance, using the WWMCCS Architecture Study as a base of departure, the European commands conducted a four-part study. Part one represented an assessment of the equipment and capabilities actually existing in the theatre at the time. Part two was a definitive determination of the information needs of the various commands. Part three represented an evaluation of what equipment and software were needed to satisfy the needs that had been identified and described in part two of the study. Part four represented a phased long-range plan for satisfying those needs, including replacement of the WWMCCS standard computer system and related software. Similar studies have not been initiated by other U.S. commands.

We believe that after 9 years of operation and countless Department studies of the command and control environment that the operational utility of ADP to support that environment has been more than amply demonstrated. As pointed out by the Department in its comment on pages 8 and 9 of this report, WWMCCS ADP provides important support to our military forces. For this reason, we can only conclude that the Department is also aware of the high level of operational utility ADP provides in support of the command and control environment.

Since it appears that both we and the Department agree to the operational utility of ADP in support of the command and control environment, it is time to quit studying the problem and to begin taking definitive steps toward resolving it. Our evaluation of the "Program Definition Plan for Research and Development in the Operational Utility of ADP in Support of WWMCCS"--commonly referred to as the R&D Operational Utility Study--shows that it will either ignore or duplicate much work that has already been undertaken in the Department, particularly in the European C-3 Architecture Study. Much of the users' information requirements have already been identified and could be used as a basis for modernizing the WWMCCS Information System. For example, many essential and/or critical elements of information needed by various commands are contained and listed in operation plans, such as U.S. Naval Forces, Europe, Operations Plan 4102. As a result, we see little need for continuing the R&D Operational Utility Study.

If the Department believes that, in some instances, the essential and/or critical elements of information listed in various operations plans are not sufficiently detailed to provide an appropriate base for developing and implementing a modernization plan for the WWMCCS Information System, then the Department should consider spending the funds that would have been used to complete the R&D study to further definitize the information needs of the various commands instead of continuing to study the problem. The European C-3 Architecture Study could be used as a defacto baseline for modernizing the WWMCCS Information System, the point being that the modernization program should provide all commands at least the capabilities described in the European C-3 Architecture Study.

42. We are glad the Department shares our concern regarding life cycle management and cost accounting for the WWMCCS ADP program. Sound life cycle management and cost accounting procedures would provide a complete accountability of all money spent for automated support of command and control functions, including such items as locally (command-unique) developed software, and any other computer equipment and related software used to support the command and control functions of the WWMCCS community. We plan to examine the planning for the modernization of the WWMCCS Information System for such sound management practices.

COMPTROLLER GENERAL'S  
REPORT TO THE CONGRESSTHE WORLD WIDE MILITARY  
COMMAND AND CONTROL SYSTEM--  
MAJOR CHANGES NEEDED IN ITS  
AUTOMATED DATA PROCESSING  
MANAGEMENT AND DIRECTIOND I G E S T

The World Wide Military Command and Control System (WWMCCS) (pronounced WIMEX) is an arrangement of personnel, equipment (including automated data processing (ADP) equipment and software), communications, facilities, and procedures employed in planning, directing, coordinating, and controlling the operational activities of U.S. military forces. WWMCCS and its priority component, the National Military Command System, are essential elements of U.S. national security. WWMCCS is intended to provide the President and the Secretary of Defense a means to

- receive warning and intelligence information,
- apply the resources of the military departments,
- assign military missions, and
- provide direction to the Unified and Specified Commands.

In addition, WWMCCS is intended to support the Joint Chiefs of Staff in carrying out their responsibilities.

GAO's evaluation was directed at the WWMCCS ADP program. The WWMCCS ADP program, consisting of data communication lines, an inter-computer network, computers, and software capabilities, is an essential resource that can enable WWMCCS to achieve its intended purpose. To properly support the President, the Secretary of Defense, and the Joint Chiefs of Staff, the equipment must be compatible, data communication links must provide a direct connection (or real-time relay) whenever necessary, computerized data formats must be common, and all

LCD-80-22

components of the system configuration and operation must be as efficient as possible, both in effectiveness and in the utilization of resources.

GAO's evaluation of the WWMCCS ADP program showed that its objectives are yet to be achieved, although the Department of Defense has spent about \$1 billion for this purpose since the start of the program.

Although the Department of Defense is requesting in excess of \$140 million a year to continue the WWMCCS ADP program, there has been little if any, improvement realized by the Department since the program's inception. Further, GAO believes the Department of Defense's planned future expenditures to continue this program will not resolve those problems unless the Department initiates major changes in the program's management structure and direction.

GAO's evaluation showed that the existing management structure is so complex and fragmented that no one organization or individual has a complete overview of the program or the centralized responsibility for its funding, budgeting, and management. This condition impairs the Department's ability to employ sound management practices. (See ch. 3 for details.)

As a result, the WWMCCS ADP program:

- Is not responsive to national or local level requirements.
- Is not reliable.
- Lacks economical and effective growth potential.
- Cannot transfer data and information efficiently.
- Makes it extremely difficult and costly to exploit ADP technology.
- Impairs each command's operational backup capability.

--Encourages independent and decentralized software development efforts, which are still prominent in the WWMCCS ADP program. Independent software development efforts are initiated separately without sufficient consideration being given to the information requirements of other commands with which information must be exchanged.

Generally, the equipment is not installed in survivable facilities and generates excessive maintenance costs. In addition, the inter-computer network is unable to provide multi-level security. (See chs. 4, 5, and 6 for details.)

The Department of Defense recognized all of these problems in 1966. The current WWMCCS ADP program was intended to resolve them.

These problems occurred because the Department of Defense's WWMCCS ADP program specification preparation and evaluation process resulted in the selection of a computer configuration and related software that was not suited for the environment in which it was to operate. A major factor contributing to these conditions was the Department's failure to properly and clearly define the information requirements of the various commanders comprising the WWMCCS community.

Most of these problems are not new and have been previously reported to the Department of Defense, along with recommendations for correction, by GAO and various Department of Defense study groups. The recommendations in these studies have not been implemented by the Department. (See ch. 7 for details.)

During the course of this evaluation, GAO was unable to fully discharge its statutory responsibilities or be totally responsive to the requests of the Chairman, Subcommittee on Research and Development, House Committee on Armed Services, and to Congressman Thomas J. Downey. The Joint Chiefs of Staff denied complete access to pertinent documents resulting from internal surveys, reviews, draft

reports, military exercises, operational plans, and future ADP plans. (See ch. 8 for details.)

To resolve these problems and to operate a responsive, reliable, and survivable command and control system, the Secretary of Defense should give project management authority and responsibility for all WWMCCS and WWMCCS related computer-based information systems to one central organization. As the WWMCCS project manager, the designated central organization should be given the authority and responsibility for:

- Determining the information requirements of the various commands which must use and rely on WWMCCS computer-based information systems to accomplish assigned missions, including the National Military Command System.
- Preparing comprehensive long- and short-range plans for the design, development, implementation, and operation of computer-based information systems that are responsive to and reliable for the WWMCCS primary and secondary missions.
- Implementing Department of Defense Directive /920.1 on Life Cycle Management and other sound management practices as reflected in other such directives for all WWMCCS related computer-based information systems.
- Developing and implementing a system that provides a basis for tracking actual costs incurred for designing, developing, implementing, and operating computer-based information systems in support of the WWMCCS missions.
- Simplifying the exchange of information throughout the various commands.

To encourage the Department of Defense to make the needed changes in the WWMCCS ADP program management structure and direction,

GAO recommends that the Congress consider reducing WWMCCS funding in the following manner:

- Withhold funds for completion of the study to determine the operational utility of ADP in support of WWMCCS.
- Withhold funds for the WWMCCS Intercomputer Network until the Department of Defense completes its determination of the information needed by the various commands to support their command and control functions.
- Withhold funds intended to upgrade the current WWMCCS standard computer system until the Department identifies the configuration that will replace it.

These conclusions and recommendations are more fully explained in chapter 9.

GAO discussed the findings and contents of the report with officials from the Department of Defense and Honeywell Information Systems, Inc. Informal comments from the Department of Defense and Honeywell were considered in the report. Both the Department and Honeywell were given the opportunity to provide formal written comments; however, only Honeywell did so. GAO is not including Honeywell's letter in this report because GAO plans to issue a separate evaluation of both the Honeywell and Department of Defense comments (when received).





1

1

**AN EQUAL OPPORTUNITY EMPLOYER**

**UNITED STATES  
GENERAL ACCOUNTING OFFICE  
WASHINGTON, D.C. 20548**

**OFFICIAL BUSINESS  
PENALTY FOR PRIVATE USE, \$300**

**POSTAGE AND FEES PAID  
U. S. GENERAL ACCOUNTING OFFICE**



**THIRD CLASS**