Audit Report

OFFICE OF THE INSPECTOR GENERAL

STAFFING REQUIREMENTS FOR THE DEFENSE MEGACENTERS

Report No. 95-140 March 9, 1995

Department of Defense

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Acronyms

CPU	Central Processing Unit
DASD	Direct Access Storage Device
DISA	Defense Information Systems Agency
DMC	Defense Megacenter
IBM	International Business Machines, Incorporated
MIPS	Millions of Instructions Per Second
WESTHEM	Western Hemisphere

INSPECTOR GENERAL
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March 9, 1995

MEMORANDUM FOR DIRECTOR DEFENSE INFORMATION SYSTEMS AGENCY

SUBJECT: Audit Report on Staffing Requirements at the Defense Megacenters (Report No. 95-140)

We are providing this report for your review and comments. Comments on a draft of this report were considered in preparing the final report. This report is the first of two on the Defense megacenters. This report discusses the personnel staffing requirements for all 16 Defense Megacenters. The second report will discuss the operations at the Defense Megacenter St. Louis, Missouri.

DoD Directive 7650.3 requires that all audit recommendations be resolved promptly. We revised Recommendations 2. and 3. to clarify actions to be taken. Therefore, we request that by April 10, 1995, the Defense Information Systems Agency provide additional comments on the revised recommendations.

If you have questions on this audit, please contact Ms. Mary Lu Ugone, Audit Program Director, at (703) 604-9529 (DSN 664-9529) or Ms. Cecelia A. Miggins, Audit Project Manager, at (703) 604-9542 (DSN 664-9542). The distribution of this report is listed in Appendix E. The audit members are listed inside the back cover.

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Office of the Inspector General, DoD

Report No. 95-140
(Project No. 4RE-5034)

March 9, 1995

STAFFING REQUIREMENTS FOR THE DEFENSE MEGACENTERS

EXECUTIVE SUMMARY

Introduction. We performed the audit in response to a request from the Inspector General, Defense Information Systems Agency (DISA), for assistance in reviewing the operations of the Defense megacenters. As the operational manager of the Defense megacenters, DISA Western Hemisphere (WESTHEM) developed the staffing requirements for those centralized information processing facilities.

Objective. The announced audit objective was to evaluate the efficiency and effectiveness of operations of the Defense Megacenter St. Louis, Missouri. This report discusses the objective pursued by this segment of the audit--the method selected by DISA Western Hemisphere to determine staffing requirements for the Defense megacenters. We also evaluated internal controls applicable to the DISA WESTHEM methodology for determining estimates of staffing requirements. A subsequent report will discuss the operations of the Defense Megacenter St. Louis, Missouri.

Audit Results. DISA Western Hemisphere did not use an appropriate methodology to estimate the staffing requirements for the 16 Defense megacenters. As a result, the projected staffing requirements could lead to either overstaffing or understaffing of the Defense megacenters. In addition, the cost analysis showing $183 million in personnel costs and benefits from the Defense megacenters consolidation needs to be revised before presentation to Congress in March 1995. Details are in Part II.

Internal Controls. We identified no material internal control weaknesses relating to the methodology used by DISA WESTHEM to determine the staffing requirements for the Defense megacenters. The implementation of DISA's internal management control program will be discussed in the report on the audit of the Defense Business Operations Fund-Defense Information Services Organization Financial Statements for FY 1994 and in the report on the audit of the Management of the Defense Megacenter, St. Louis, Missouri.

Potential Benefits of Audit. Recommendations, when implemented, will provide measurable workload factors to use in determining staffing requirements, accurate staffing requirement estimates for the Defense megacenters, and accurate projections of costs and benefits for the consolidation of data processing facilities (see Appendix C).

Summary of Recommendations. We recommend that in determining staffing requirements for the Defense megacenters, the Director, DISA Western Hemisphere, use workload functions performed by computer personnel rather than the speed at which the computer processes an instruction; revise the staffing requirement estimates and adjust the budgets for the Defense megacenters based on using measurable workload factors; and postpone presenting the cost analysis to Congress until the projected staffing requirements are revised using measurable workload factors.

Management Comments. DISA disagreed with our assessment of the method it used to determine estimates of staffing requirements for the Defense megacenters. DISA stated that it determined the staffing requirements for the Defense megacenters based on a method that used work load derived from how fast the computer processes instructions because that method is the only reasonable alternative available. DISA used the KMPG Peat Marwick "Best Data Center Practices" Study (the Study) to support its position that millions of instructions per second is an appropriate method for determining staffing requirements. A discussion of management comments is in Part II of the report, and the complete text of the comments is in Part IV.

Audit Response. We disagree with DISA's position that work load derived from how fast the computer processes instructions is the only reasonable workload factor available for determining staffing requirements for the Defense megacenters. DISA incorrectly applied the results of the Study to support its use of that workload factor in determining staffing requirements. We request that DISA provide additional comments on the final report by April 10, 1995.

Table of Contents

Executive Summary i

Part I - Introduction 1

Background 2
Objectives 2
Scope and Methodology 2
Internal Controls 3
Prior Audits and Other Reviews 4

Part II - Finding and Recommendations 5

Determining Staffing Requirements at the Defense Megacenters 6

Part III - Additional Information 17

Appendix A. DISA WESTHEM Development of Personnel Staffing Requirements for the Defense Megacenters 18
Appendix B. Variances in MIPS Ratings Affect Work Load Expressed in MIPS 19
Appendix C. Summary of Potential Benefits Resulting From Audit 21
Appendix D. Organizations Visited Or Contacted 22
Appendix E. Report Distribution 23

Part IV - Management Comments 25

Defense Information Systems Agency Comments 26

Part I - Introduction

Background

Defense Information Systems Agency's Designation as Central Manager of Defense Information Infrastructure. The Defense Management Report Decision 918, September 15, 1992, designated the Defense Information Systems Agency (DISA) as the central manager for the Defense Information Infrastructure. In that capacity, DISA is responsible for information technology security, standards, long-haul communications, telecommunications certification, and data processing facilities. DISA established the Defense Information Services Organization,[1] now DISA Western Hemisphere (WESTHEM), to manage the data processing facilities and to provide information technology services to DoD customers. In 1993, DISA developed and coordinated, with the FY 1993 Commission on Base Closure and Realignment, the DoD Data Center Consolidation Plan (the Consolidation Plan) to consolidate data processing facilities into 16 Defense megacenters. The megacenters will provide centralized information processing for DoD customers. DISA WESTHEM efforts to consolidate the facilities into 16 Defense megacenters began in the third quarter of FY 1993 with completion estimated for the fourth quarter of FY 1997.

Reason for Audit. We performed the audit in response to a request from the DISA Inspector General for assistance in auditing the newly consolidated data processing facilities.

Objectives

The announced audit objective was to evaluate the efficiency and effectiveness of operations of the Defense Megacenter (DMC) St. Louis, Missouri. The objective for this segment of the audit was to evaluate the method selected by DISA WESTHEM to determine the staffing requirements for the Defense megacenters. We also evaluated internal controls applicable to the DISA WESTHEM methodology for determining estimates of staffing requirements. A subsequent report will discuss the efficiency and effectiveness of the operations of DMC St. Louis, Missouri.

Scope and Methodology

Audit Scope. We evaluated the measurability of the workload factor DISA WESTHEM used in determining the staffing requirements for DMC St. Louis. DISA WESTHEM used the same workload factor in determining the staffing requirements for the other 15 Defense megacenters. We reviewed

[1] Formerly, Defense Information Technology Services Organization.

documentation, dated from February 1993 through November 1994, that described the DISA WESTHEM development of staffing requirements, workload factor expressed in millions of instructions per second (MIPS), and workload factors expressed in computer output functions. We did not evaluate the contractor-proprietary model that computed the staffing requirements.

Audit Methodology. Technical staff from the Inspector General, DoD; DISA; National Defense University; Army; Navy; and Air Force provided assistance in evaluating the workload factor used in determining staffing requirements at the Defense megacenters. The Quantitative Methods Division, Audit Planning and Technical Support Directorate, Office of the Assistant Inspector General for Auditing, DoD, provided assistance in reviewing the KPMG Peat Marwick "Best Data Center Practices" Study. Also, the Technical Assessment Division, Audit Planning and Technical Support Directorate, Office of the Assistant Inspector General for Auditing, DoD, obtained information on workload factors and methods used by commercial computer firms in determining staffing requirements for a data processing facility. Three of the four firms manufacture the computers used by the Defense megacenters, and one firm uses similar computer models. The Technical Assessment Division also provided definitions and explanations of technical computer terms. Also, we obtained similar information on workload factors and staffing methods used by the Army Forces Integration Support Agency, the Air Force Management Engineering Agency, the Navy Manpower Information Resource Management Division, and the DISA Management Analysis and Internal Review Division. We did not rely on computer-processed data or statistical sampling procedures to achieve the audit objective.

Audit Period, Standards, and Potential Benefits. We performed the audit from May through October 1994 at the organizations listed in Appendix D. We performed this economy and efficiency audit in accordance with auditing standards issued by the Comptroller General of the United States as implemented by the Inspector General, DoD. We included such tests of internal controls as considered necessary. Appendix D lists the organizations visited or contacted during the audit.

Internal Controls

We evaluated the internal controls applicable to the DISA WESTHEM methodology for determining estimates of staffing requirements for the Defense megacenters. We identified no material internal control weaknesses.

We will discuss DISA WESTHEM's implementation of its internal management control program in the report on the audit of the Defense Business Operations Fund-Defense Information Services Organization Financial Statement for FY 1994, Project 4RE-2005. We will discuss the DMC St. Louis implementation of its internal management control program in the report on the audit of the Management of the Defense Megacenter, St. Louis, Missouri, Project No. 4RE-5034.01.

Prior Audits and Other Reviews

The Defense megacenter staffing requirements have not been audited in the last 5 years.

Part II - Finding and Recommendations

Determining Staffing Requirements at the Defense Megacenters

The Defense Information Systems Agency, Western Hemisphere did not use a good methodology to determine staffing requirements for the 16 Defense megacenters.

The workload factor, millions of instructions per second (MIPS), has no direct relationship to workload functions, such as computer tape changes, console commands, input and output functions, or paper changes, performed by computer personnel. MIPS is an expression of how fast the computer central processing unit can process instructions. In addition, using MIPS to compute staffing requirements is inconsistent with the methods used by DoD and commercial organizations to compute staffing for a data processing facility.

As a result, the projected staffing requirements, which are not supportable for the 16 Defense megacenters, could lead to either overstaffing or understaffing of the Defense megacenters. In addition, the cost analysis showing $183 million in personnel costs and benefits from the consolidations into Defense megacenters needs revision prior to presentation to Congress in March 1995.

Background

Definition of MIPS. MIPS represents the number of instructions the central processing unit (CPU) of a computer can process in a second. MIPS defines the speed of a CPU based on its architecture and operating speed. A MIPS rating for a CPU represents the throughput[2] of the processor and is determined by running a computer analysis software program. The software program takes into account the:

- o peripheral devices connected to the CPU,
- o number of devices,
- o internal communications between CPU and devices,
- o external communications connecting the user to the CPU, and
- o type and configurations of operating systems software.

[2] Throughput is the rate at which a request (instruction) is answered by the CPU. CPU throughput is measured in MIPS.

MIPS does not measure the work load performed by computer personnel at a data processing center. Rather, MIPS expresses the speed at which a computer processes instructions.

Variances in MIPS Ratings for the Same Model of Computer. A MIPS rating for a specific model of computer will vary among data processing facilities that use the same model of computer. A MIPS rating will vary because of various computer configurations and software analysis programs that determine MIPS ratings.

The software analysis programs used by the computer manufacturer and third party organizations could provide different MIPS ratings for the same CPU because of differing computer configurations. Also, the software analysis programs frequently do not consider the complexity and efficiency of the functional applications operating on the CPU.

Work Load Performed by Personnel at a Data Processing Facility. Measurable work load performed by personnel at a data processing facility is composed of those tasks or functions that produce a consistent and verifiable output. The types of output include computer tape changes, console command, input and output, or paper changes. Staffing requirements vary with the number and type of tasks or functions performed within a given time period. For example, personnel at data processing facilities perform one to three types of computer tape changes. The types of computer tape changes determine the type and number of personnel needed to perform these tasks.

o Personnel are needed to physically locate, mount, thread, and start each round tape change.

o Personnel are needed to physically locate and insert tape cassettes into the tape reader.

o Personnel are not needed to operate robotic tape drives; however, the console operator monitors robotic tape drives.

DISA WESTHEM Basis in Determining Staffing Requirements

Use of MIPS as the Workload Factor in Determining Staffing Requirements. DISA WESTHEM used MIPS because DISA WESTHEM viewed MIPS as the only single common denominator among all 16 Defense megacenters. Additionally, because it determined that other alternatives were not workable, DISA WESTHEM decided to use MIPS.

For example, DISA WESTHEM did not use the services of the DISA Management Analysis and Internal Review Division (Management Analysis Division), which performs studies of staffing requirements for DISA. In January 1993, DISA WESTHEM discussed the determination of staffing

requirements at the Defense megacenters with personnel from the Management Analysis Division. DISA WESTHEM believed that historical data needed by the Management Analysis Division were not available and would take too long to obtain. However, we confirmed with representatives from the Management Analysis Division and DMC St. Louis that historical data were available and that staffing requirements could have been determined within 1 year. DISA WESTHEM issued the preliminary staffing requirements in January 1994, revised them in September 1994, and finalized them in January 1995. Appendix A provides details on the development of the staffing requirements at the Defense megacenters.

Concerns on Using MIPS in Determining Staffing Needs. Representatives from DISA WESTHEM Computer Operations Support Directorate, Capacity Management Division; Defense Megacenters St. Louis and Huntsville; and Resource Management Division were concerned about using MIPS as the workload factor in determining staffing requirements at the Defense megacenters. Those concerns included the following.

o MIPS is not an acceptable workload factor because MIPS is a measurement that widely fluctuates, depending on the work load processed and the individual or organization that provides the MIPS rating. Appendix B illustrates the MIPS ratings used by DISA WESTHEM, DMC St. Louis, and a commercial organization for the same model of computer.

o Work load expressed in MIPS has no measurable elements.

o Numerous factors, such as type of processing, customer services provided, and variance in processing environments should be considered in determining staffing requirements.

o MIPS does not correlate to measurable workload outputs produced by a data processing facility.

o MIPS does not account for the operations of the data processing facility. Some of the operational elements included tape mount changes, print changes, input and output functions, amount of automation, and the kinds of applications and data bases being used.

o DISA WESTHEM did not document the decision justifying the use of MIPS for staffing requirements.

Relationship of the MIPS Ratings to Staffing Requirements. DISA WESTHEM estimated that for every two MIPS processed, one person was needed. However, advancements in information technology that provide for more processing capability do not necessarily increase staffing requirements. Also, robotic tape functions would require fewer staff than manual tape functions. Conversely, less processing capability does not necessarily reduce staffing requirements. The complexity of the functional applications processed on the computer and the associated workload functions could result in an increase in personnel.

Staffing requirements vary with the number and type of tasks or functions performed at a data processing facility within a given time frame. By using a work load factor that does not measure functions performed by personnel at a data processing facility, the megacenters could be either overstaffed or understaffed. Understaffed facilities cannot perform their missions and functions effectively, and overstaffed facilities cannot provide efficient operations.

Military Departments' Methods for Determining Staffing Requirements

Army's Method In Determining Staffing Requirements at a Data Processing Facility. The mission of the Army Forces Integration Support Agency (Support Agency), Special Action Division, is to perform surveys or reviews of staffing requirements for organizations that are unique in design or mission. The Support Agency's method for determining work load and staffing requirements is based on measurable workload functions and the number of individuals needed to support those functions. A representative of the Support Agency gave the following examples of the quantitative historical data on some data processing functions that would be needed to determine the number of individuals needed to support a data processing facility:

- the number of computer tape mounts and how long it takes to mount a tape;
- the number of paper changes and how long it takes to change the paper;
- the number of system failures, type of failures, number of failures, and the amount of time taken to make the system operational; and
- the amount of time the system is down and no work is processed.

Using MIPS as a workload factor is inconsistent with the Army's method for determining staffing requirements at a data processing facility.

Navy's Method for Determining Staffing Requirements. The Navy Total Force Manpower Requirements Handbook (the Handbook) outlines the basic methods and techniques for determining staffing requirements for the Navy Total Force Manpower Requirements Program. The Handbook does not specifically discuss staffing requirements for a data processing facility. However, the Handbook provides guidelines for the selection of potential workload factors and defines a workload factor as a unit of measure that is consistently relatable and predictable to the work needed to accomplish organizational responsibilities.

Specifically, workload factors should be:

o directly related to the time and effort expended on the task;

o susceptible to audit, so that the accuracy of the work load can be readily verified;

o clearly identifiable when production is in process or has been completed; and

o individually standardized in terms of the procedures required to complete production.

The definition of MIPS does not meet the Navy's criteria for a workload factor used in determining staffing requirements.

Air Force's Method for Determining Staffing Requirements. Air Force Regulation 25-5, "Air Force Management Engineering Program Policies, Responsibilities, and Requirements," May 16, 1988, provides details on the Air Force's Functional Review Process. Even though Air Force Regulation 25-5 does not specifically discuss staffing of a data processing facility, the Regulation defines the major characteristics of a potential workload factor. The major characteristics of a potential workload factor follow.

o Collectibility--how easily a unit can be identified, counted, reported, and validated.

o Relatability--how well the workload factor logically relates to the resources required to complete the work.

o Programmability--how well the workload factor predicts required resources for future time periods.

The characteristics of MIPS do not meet the Air Force's criteria for workload factors used in determining staffing requirements.

Commercial Methods for Determining Staffing at Data Processing Facilities

Methods Commercial Information Processing Organizations Use in Determining Staffing Requirements. Commercial information processing organizations generally do not use MIPS to determine the staffing requirements at a data processing facility. We contacted the following commercial information processing organizations because they manufacture or use the same model computers that are in operation at the Defense megacenters:

o Systems Information Support Center, International Business Machines, Incorporated (IBM), Tucson, Arizona;

- IBM Government Business Office, Washington, D.C.;
- Loral Federal Systems, Boulder, Colorado; and
- Amdahl Federal Service Corp., Reston, Virginia.

The consensus among those organizations on the approach in determining staffing requirements is to analyze all the major operations and requirements of the computer center. Such an approach requires an understanding of the operations and products of a mainframe environment, which is essential for estimating the staffing requirements that meet customer needs. The approach includes the review and analysis of:

- operator functions (tape mounts, configuration changes, print management);
- installation data storage capacity;
- number, type, and complexity of software applications;
- operating system and application software stability and reliability;
- user interface requirements; and
- technology enhancements (automatic tape handling systems, modern hands-off[3] production capabilities, or automated lights-out[4] operations).

Using MIPS in determining staffing requirements is inconsistent with commercial practices, except as discussed below.

Using MIPS in Determining Staffing Requirements. The Amdahl representative stated that the use of MIPS as the primary factor of staffing requirements is appropriate only when usage is based on historical data and the basic operations have not changed. However, operations at the Defense megacenters are in a constant state of flux as a result of ongoing consolidation efforts. DISA WESTHEM projected workload data using MIPS; the data were based on available production data at 16 Defense megacenters.

Projected Staffing Requirements to be Presented to Congress

The House of Representatives Conference Report 103-624, July 27, 1994, directs DISA to submit to the House and Senate Committees on Appropriations by March 1, 1995, a cost analysis and review results of the potential costs and benefits associated with the consolidation for each Defense megacenter. DISA is required to include in the cost analysis and review results an explanation of

[3] Hands-off means functions that do not require operator intervention.
[4] Lights out operations do not require personnel 24 hours a day 7 days a week.

the difference between the July 1993 estimate of $309 million for DoD's 5-year, one-time consolidation cost and the $417 million cost estimate in the FY 1995 budget justifications. The cost analysis and review results will include anticipated personnel costs and benefits based on projected staffing requirements derived from using MIPS as the workload factor. If the projected staffing requirements are not revised using a measurable workload factor, the anticipated personnel costs and benefits from the data processing facility consolidations will be inaccurate.

Conclusion

MIPS, the workload factor DISA WESTHEM used in determining staffing requirements at a data processing facility is not a measurable workload factor. MIPS does not consider operations and input and output functions of computer personnel, which are essential in determining associated staffing needs. The MIPS methodology for determining staffing requirements is inconsistent with the estimating techniques used by the Army, Navy, Air Force, and commercial entities, such as IBM and Loral. As a result, DISA could either overstaff a megacenter and create inefficiencies or understaff a megacenter and cause it to operate ineffectively. Also, in the near term, any cost analysis based on personnel costs and benefits that were computed using the staffing requirement estimates derived from the MIPS calculation will be inaccurate.

Management Comments on the Finding and Audit Response

Management Comments. DISA nonconcurred with the finding. DISA stated the audit conclusion that the use of MIPS was an inappropriate basis for estimating staffing requirements at the Defense megacenters is contrary to the conclusion reached by KPMG Peat Marwick (Peat Marwick) in its "Best Data Center Practices" study (the Study). DISA also stated that although using MIPS to determine staffing does not explicitly recognize technical concerns specified in the audit report, using MIPS in determining staffing requirements does recognize that the Defense megacenters must become as efficient as the commercial competition to remain in business.

In 1992, Peat Marwick prepared the Study for DISA to document how the best performing data processing facilities in the commercial world operate. DISA stated that:

o the research performed by Peat Marwick conclusively showed that MIPS is an appropriate workload measurement for estimating staffing requirements for mainframes,

o Peat Marwick calculated work load as a function of MIPS used by the data processing facility, and

o the research performed by Peat Marwick established the correlation between MIPS used by a data processing facility and other data processing facility workload functions.

DISA stated that in the absence of other measures related to functions performed by personnel, MIPS can be used to estimate the total staffing required to process a specified work load.

DISA stated that internal organizational turmoil had inhibited determining staffing requirements based on measurable workload factors and that a review using tools that measure workload volume, accomplishment times, and personnel unit cost per output could now be accomplished. DISA has scheduled reviews for FY 1995 to attempt to develop interim staffing requirements based on measurable workload factors. If the effort is successful, the methodology using measurable workload factors may be applied to other Defense megacenters that are "stable but not yet optimized." The complete text of management comments is in Part IV.

Audit Response. We disagree that the Peat Marwick Study concluded that MIPS could be used as a workload factor in determining staffing requirements at a data processing facility. In fact, the Study did not intend to provide statistically proven relationships between the number of MIPS used by a data processing facility and staffing required for a data processing facility. Rather, in the Study, Peat Marwick provided a quantified, but notional description of best practices observed at more than 150 computer operations in the commercial environment. Peat Marwick derived those best practices using data maintained in its Automated Peer Group Comparison data base. The Study stated:

> ". . . We believe that Automated Peer Group Comparison clients should only use benchmark data to identify opportunities for improvements at the data center being evaluated . . . . *Therefore, it is important to not read too much into the numbers themselves but to recognize the value they play as performance indicators* . . . ." [emphasis added]
>
> While the typical DoD data center may be inherently different from commercial data centers in some respects, it is hoped that many of the suggested "best practices" discussed in this report can be readily adopted by DoD . . . KPMG Peat Marwick developed the Automated Peer Group Comparison tool in order to effectively perform benchmarking and develop performance indicators (or metrics) for our clients' data centers . . . Benchmarking allows the evaluator to identify opportunities for potential improvements . . . ."

DISA's assertion that the Study provided empirical metrics correlating staffing to work load based on MIPS is incorrect. Peat Marwick provided data on staffing ratios based on MIPS used by a data processing facility to demonstrate that large data processing facilities are more efficient than small data processing facilities. DISA inappropriately used the Study to correlate staffing requirements for a data processing facility defined as "average" to staffing requirements for a data processing facility defined as "best practice." DISA incorrectly assumed that a "best practice" data processing facility had a lower staffing need than the "average" site because of the MIPS used by the data

processing facility rather than because of other factors, such as hardware and software configurations. DISA's assertion that the Study conclusively related staffing to work load based on MIPS is also flawed because:

o the significant difference between the staffing needs at the "average" site and the "best practice" site indicates that the underlying data are highly variable with no statistically significant or proven correlation;

o not one of the companies whose data was used to compile the data in the "Staffing Based on Workload" chart was a totally "average" site or a totally "best practice" site, which is needed for a statistically significant and proven relationship; and

o the Study does not explain the specific practices needed in each functional area for a data processing facility to achieve the staffing ratios shown in the chart, which are necessary for a statistically significant and proven relationship.

Again, the premise that MIPS is an appropriate workload factor for determining staffing requirements at the Defense megacenters is flawed. As stated in comments[5] from the National Defense University, Department of Defense, on the Peat Marwick Study and on our draft audit report:

> ". . . MIPS is a measure of CPU (Central Processor Unit) capability. It is one of many such measures which have proven invalid for comparing machines of different architectures, selecting a computer for a particular suite of applications or determining the structure of the staff needed to execute that suite of applications. Any detailed study of DPI operations will demonstrate sensitivity to specific combinations of equipment, staffing mix, and the application portfolio . . . Simple measures of workload such as used MIPS cannot capture this interaction. As a result, MIPS has a bad reputation among manpower organizations, acquisition organizations and equipment manufacturers . . . Detailed configuration studies are needed to select equipment and prepare job descriptions . . . ."

Accordingly, DISA did not use an appropriate methodology to determine the staffing requirements at the Defense megacenters.

Recommendations, Management Comments, and Audit Response

Changes to Recommendations. We revised Recommendations 2. and 3. to clarify the actions to be taken after DISA revises the staffing requirements for Defense megacenters. Therefore, we request that the Director, Defense

[5] DISA requested that the National Defense University comment on the Study and on our draft audit report.

Information Systems Agency provide comments on the revised recommendations in response to the final report.

We recommend that the Director, Defense Information Systems Agency, Western Hemisphere:

1. Use measurable workload functions that are performed by computer personnel rather than the speed in which the computer processes an instruction (as expressed in millions of instructions per second) in determining the staffing requirements for the 16 Defense megacenters.

Management Comments. DISA nonconcurred with the recommendation, stating that the only reasonably accurate measurement it has on future operations at the Defense megacenters is total projected work load measured in MIPS. DISA also stated that the methodologies described in our report that could be used to estimate the staffing requirements require quantitative historical data to produce staffing estimates and that the earliest the required information would be available is the end of FY 1995. DISA intends to continue developing final staffing requirements using projected work load in MIPS. DISA also stated that it will attempt to develop interim staffing requirements based on measurable workload factors to include workload volume, accomplishment times, and personnel unit cost per output.

Audit Response. As discussed in the prior audit response, work load measured in MIPS is not an appropriate basis for determining staffing requirements for the Defense megacenters. Additionally, in January 1993, DISA WESTHEM contacted the DISA Management Analysis Division about developing staffing requirements for the Defense megacenters, but chose not to have the Management Analysis Division determine the staffing requirements for the Defense megacenters. It is true that building regression models to determine appropriate relationships requires historical data; however, none exist in exactly the size and form needed for the 16 new Defense megacenters. Therefore, a prospective approach using engineered work measurement standards for staffing could be used. But more important, DISA's use of MIPS to estimate staffing requirements puts DoD at risk of having Defense megacenters that are not competitive because they are either understaffed and not effective or overstaffed and not efficient.

2. Revise the staffing requirements for the 16 Defense megacenters based on using the measurable workload factors discussed in Recommendation 1 and make associated budget adjustments in the spring 1996 Program Objective Memorandum.

Management Comments. DISA nonconcurred with the draft report recommendation. DISA will continue to develop the final staffing requirements using projected work load in MIPS because no other viable option is available. DISA will attempt to use measurable workload factors in FY 1995 to establish interim staffing requirements during the period in which work load transitions to the megacenters.

Audit Response. If DISA is able to use measurable workload factors to determine the interim staffing requirements, DISA should use a similar method for estimating the final staffing requirements. Therefore, in determining staffing requirements, DISA should use a methodology that uses measurable workload functions. We revised the recommendation so that DISA WESTHEM will make the concomitant budget adjustments derived from estimating staffing requirements based on measurable workload factors.

3. Postpone presenting to Congress the cost analysis and review results of the potential costs and benefits associated with the consolidation of the 16 Defense megacenters until the projected staffing requirement estimates have been revised as prescribed in Recommendations 1 and 2.

Management Comments. DISA nonconcurred with the draft report recommendation. DISA stated that it will be using the most accurate staffing requirements available at the time the cost analysis is presented to Congress in March 1995.

Audit Response. If DISA uses staffing requirements that are based on MIPS instead of measurable workload factors, the cost analysis scheduled for presentation to Congress in March 1995 will not be accurate. We revised the recommendation because we believe DISA should delay providing the cost analysis until a methodology based on measurable workload standards is used to estimate staffing.

Part III - Additional Information

Appendix A. DISA WESTHEM Development of Personnel Staffing Requirements for the Defense Megacenters

The Defense Information Systems (DISA) Western Hemisphere (WESTHEM) Base Realignment and Closure/Megacenter Consolidation Office (Consolidation Office) is responsible for determining the interim and final staffing requirements for each Defense megacenter. The interim staffing requirement is the number of personnel needed after the Military Departments complete the transfer of work load to a Defense megacenter and before automation commences. The final staffing requirement is the number of personnel needed after automation commences. DISA WESTHEM estimated the millions of instructions per second (MIPS) processed at a Defense megacenter and used MIPS as the basis for determining associated staffing requirements. To estimate the MIPS, DISA WESTHEM obtained utilization data, available production data, average central processing unit (CPU),[1] average peak CPU,[2] and high peak CPU[3] for all 16 Defense megacenters. The Computer Performance Management Division, Pensacola, Florida, collected the utilization data and converted it to MIPS to develop the Preliminary Sizing Studies (the Studies). The Studies estimated MIPS for International Business Machines, Incorporated (IBM), IBM compatible, and Unisys mainframe systems at the Defense megacenters and for some sites designated for closure.

The DISA WESTHEM Consolidation Office used the Electronic Data Systems' Plano Staffing Model (the Staffing Model), which is driven by a workload factor expressed in MIPS, to determine the staffing requirements for the Defense megacenters. DISA WESTHEM entered the estimated MIPS obtained from the Studies into the Staffing Model, which then produced the estimated staffing requirements for the Defense megacenter. The Staffing Model used a rating of 2.2 MIPS per person to calculate the staffing requirements at the Defense megacenters. However, DISA WESTHEM did not know the assumptions and methodology employed by the model in calculating the staffing requirements because the software for the staffing Model is contractor-proprietary.

[1] Average CPU is the utilization by hour for each month of data collection.
[2] Average peak CPU is the average CPU utilization of the busiest 20 percent of the usage for each hour.
[3] High peak CPU is the CPU utilization of the 1 hour during which utilization was highest.

Appendix B. Variances in MIPS Ratings Affect Work Load Expressed in MIPS

Work load expressed in MIPS varies significantly because MIPS ratings are not consistent. Because MIPS ratings widely fluctuate, MIPS is not a reliable workload factor for determining staffing requirements for even identical computer models. The table below shows the variances in MIPS ratings and computer work load expressed in MIPS.

The table shows three MIPS ratings for the CPU operating at DMC St. Louis as of September 1994. We obtained the three MIPS ratings from:

o the DMC St. Louis, which represents the rating applied by DMC St. Louis employees for each CPU;

o the WESTHEM Study, which represents the MIPS ratings used to develop the projected work load for the DMC St. Louis IBM Sizing Study Preliminary Report; and

o industry, which represents ratings determined by commercial computer organizations for each CPU at DMC St. Louis.

The utilization percentages in the table were shown in the WESTHEM Study. We applied those percentages to the MIPS ratings to determine the work load expressed as MIPS.

Variances in MIPS Ratings

	MIPS Ratings					Computer Work Load Expressed as MIPS			
CPU Model No.	DMC St. Louis	WESTHEM Study	Industry Measure	Largest Variance	Utilization[1] Percentage	DMC St. Louis	WESTHEM Study	Industry Measure	Largest Variance
5890 600E	74.0	83.0	65.4	17.6	55	40.7	45.6	35.9	9.7
5890 600E	80.0	83.0	65.4	17.6	13	10.4	10.7	8.5	2.2
5890 600E	80.0	83.0	65.4	17.6	20	16.0	16.6	13.0	3.6
5890 200	32.0	35.0	32.7	2.3	- -				
4381 200	03.5	03.9	N/A[2]	0.4	- -				

[1]The Utilization Percentage represents how much of the computer the work load uses. We obtained the utilization percentages from the DMC St. Louis IBM Sizing Study Preliminary Report, May 4, 1994.
[2]Not Available. The commercial computer organizations did not provide a MIPS rating for this mainframe model number.

Appendix C. Summary of Potential Benefits Resulting From Audit

Recommendation Reference	Description of Benefit	Type of Benefit
1.	Economy and Efficiency. Provides staffing requirements for the Defense megacenters based on measurable workload factors.	Undeterminable.*
2.	Economy and Efficiency. Requires revising staffing requirements for the Defense megacenters and associated budget documents to ensure accuracy.	Undeterminable.*
3.	Economy and Efficiency. Provides Congress accurate and supportable staffing requirements based on implementation of Recommendation 1.	Undeterminable.*

*DISA will be able to determine potential monetary benefits upon implementing the recommendations and determining staffing requirements.

Appendix D. Organizations Visited Or Contacted

Department of the Army

U.S. Army Forces Integration Support Agency, Fort Belvoir, VA

Department of the Air Force

Air Force Management Engineering Agency, San Antonio, TX

Department of the Navy

Manpower Information Resource Management Division, Chesapeake, VA

Defense Organizations

Defense Information Systems Agency, Washington, DC
- Western Hemisphere, Denver, CO
  - Defense Megacenter, St. Louis, St. Louis, MO
  - Defense Megacenter, Huntsville, Huntsville, AL
  - Army Information Services Center, Fort Ritchie, MD
  - Marine Corps Information Services Center, Quantico, VA
- Management Analysis and Internal Review Division, Arlington, VA

National Defense University, Fort McNair, Washington, DC

Non-Government Organizations

Amdahl Federal Service Corp., Reston, VA
Electronic Data Systems, Herndon, VA
Government Business Office, International Business Machines, Incorporated, Washington DC
Loral Federal Systems, Boulder, CO
Systems Information Support Center, International Business Machines, Incorporated, Tucson, AZ

Appendix E. Report Distribution

Office of the Secretary of Defense

Under Secretary of Defense (Comptroller)
Under Secretary of Defense (Acquisition and Technology)
Assistant Secretary of Defense (Command, Control, Communications, and Intelligence)
Assistant to the Secretary of Defense (Public Affairs)
Deputy Under Secretary of Defense (Acquisition Reform)
Deputy Under Secretary of Defense (Comptroller/Management)
Deputy Under Secretary of Defense (Comptroller/Program/Budget)

Department of the Army

Secretary of the Army
Auditor General, Department of the Army

Department of the Navy

Secretary of the Navy
Auditor General, Department of the Navy
Comptroller of the Navy

Department of the Air Force

Secretary of the Air Force
Assistant Secretary of the Air Force (Financial Management and Comptroller)
Auditor General, Department of the Air Force

Defense Organization

Director, Defense Contract Audit Agency
Director, Defense Information Systems Agency
Director, Defense Logistics Agency
Director, National Security Agency
Inspector General, Central Imagery Office
Inspector General, National Security Agency
Director, Defense Logistics Studies Information Exchange
President, National Defense University

Non-Defense Federal Organizations

Office of Management and Budget
National Security Division Special Projects Branch, Office of Management and Budget
Technical Information Center, National Security and International Affairs Division, General Accounting Office

Chairman and Ranking Minority Member of Each of the Following Congressional Committees and Subcommittees

- Senate Committee on Appropriations
- Senate Subcommittee on Defense, Committee on Appropriations
- Senate Committee on Armed Services
- Senate Committee on Governmental Affairs
- House Committee on Appropriations
- House Subcommittee on National Security, Committee on Appropriations
- House Committee on Government Reform and Oversight
- House Subcommittee on National Security, International Affairs, and Criminal Justice, Committee on Government Reform and Oversight
- House Committee on National Security

Part IV - Management Comments

Defense Information Systems Agency Comments

DEFENSE INFORMATION SYSTEMS AGENCY
701 S. COURT HOUSE ROAD
ARLINGTON, VIRGINIA 22204-2199

IN REPLY REFER TO: Inspector General

06 FEB 1995

MEMORANDUM FOR INSPECTOR GENERAL, DEPARTMENT OF DEFENSE
ATTN: Director, Readiness and Operational Support

SUBJECT: DoDIG Draft Audit Report on *Staffing Requirements at the Defense Megacenters* (Project No.4RE-5034.00)

Reference: DoDIG Report, subject as above, 12 Dec 94

1. We have reviewed the subject draft audit report per your request, and appreciate your assistance in reviewing the operations of our Megacenters. By using millions of instructions per second (MIPS) to determine staffing requirements, we were attempting to measure the size of the workload and not the capacity of the data center. The organizational turmoil that this Agency has undergone over the last two years has inhibited the systematic conduct of Efficiency Reviews (ER), and the determination of staffing requirements based on measurable workload factors. DISA is now at a point where the routine, systematic review of our total organization can be accomplished, using tools which measure workload volume, accomplishment times, and personnel unit cost per output. These reviews are scheduled to begin in FY 1995 with a prototype effort at DMC Huntsville. This Megacenter has a relatively stable environment because it is not scheduled to receive additional legacy site workload, nor has it been optimized. The prototype will attempt to develop interim staffing targets based on measurable workload factors. If this effort is successful, the methodology may be applied to other Megacenters which are stable but not yet optimized.

2. Our detailed management comments to the draft report are enclosed. The point of contact for this action is Ms. Sandra Leicht, Audit Liaison. If you have any questions, Ms. Leicht can be reached on (703) 607-6316.

FOR THE DIRECTOR:

1 Enclosure a/s

for RICHARD T. RACE
Inspector General

Copy to:
WESTHEM RIG

Quality Information for a Strong Defense

MANAGEMENT COMMENTS ON
STAFFING REQUIREMENTS FOR THE
DEFENSE MEGACENTERS (4RE-5034.00)

1. **FINDING:** The draft report states: "Using millions of instructions per second (MIPS) as the workload factor in determining the total staffing requirements of 3,073 for the Defense Megacenters is inappropriate."

RESPONSE: Nonconcur with the finding. The draft report states that using MIPS as the workload factor in determining the total Megacenter staffing requirement is inappropriate because MIPS is an expression of how fast the computer central processing unit can process instructions. The draft report goes on to cite the textbook definition of MIPS as the number of instructions the central processing unit (CPU) of a computer can process in a second. While this definition is correct, it is not complete. It is common practice in the industry to use MIPS as a measure of data processing workload, as well as processing speed. Strictly speaking, workload should be expressed as "millions of instructions (MI)" leaving "millions of instructions per second (MIPS)" as measure of processor speed. However, the grammatical subtleties tend to get overlooked when MIPS is used to indicate the size (in terms of processing capacity) of a data center, or the expected processing requirement of a new application.

The draft report claims that MIPS has no relationship to workload functions, such as computer tape changes, console commands, input and output functions, or paper changes, performed by computer personnel. This conclusion is contrary to that of KPMG Peat Marwick as documented in their report "Best Data Center Practices" developed for DISA in September 1993. The research carried out by Peat Marwick using its benchmarking data base, and the resulting report which provided a detailed, quantitative description of the best practices of data centers in the commercial environment played an important role in the development of DMRD 918 and the entire DoD data center consolidation.

In describing the benchmarking process Peat Marwick used to evaluate data center performance they write:

> "Critical to our technique is our measurement of the size of the data center. We measure size in millions of instruction per second (MIPS) used by the data center (also known as overall CPU utilization) regardless of the MIPS installed in the data center. *We measure data center size as a function of used MIPS since we are attempting to measure the size of the workload* (emphasis added), not the capacity of the data center. We have correlated used MIPS to installed MIPS in the data centers we have evaluated, and this shows a strong correlation. . ."

1

Not only does Peat Marwick employ used MIPS as a measure of data center workload, they have also carried out the research necessary to establish the correlation between used MIPS and other data center workload functions. For example, Peat Marwick has found that the correlation between installed DASD and used MIPS is .92. This means that DASD management functions dependent on the quantity of DASD tend to increase as the used MIPS increase. They have found a similar direct relationship between the number of tape mounts and used MIPS. In this case the correlation is .66, less than that for DASD, but still a strong relationship between MIPS and a workload function performed by data center personnel. Peat Marwick's report also addressed the relationship between print volume and used MIPS. In this case they provide a figure showing a clear relationship, but no correlation coefficient. Peat Marwick quantifies their evaluation of a data center in a series of key benchmark data elements. One prominent category of this series is "Staffing Based Upon Workload" which includes the following empirical metrics:

Key Data Element	Average Site	Best Practice
Total Staff Per Used MIPS	1.93	0.70
Console Operators Per Used MIPS	0.13	0.06
Systems Programmers Per Used MIPS	0.16	0.03
Capacity Planners Per Used MIPS	0.03	0.01

The research carried out by Peat Marwick demonstrates conclusively that used MIPS is an appropriate workload measure for estimating mainframe staffing requirements. It may not be the ideal workload measure(s), but in the absence of other measures related to functions performed by personnel, it can be used to estimate the total staffing required to process a specified workload measured in MIPS.

In addition to the mathematical basis for using MIPS to estimate megacenter staffing requirements, there is also a financial basis. The Defense Megacenters were established as fee-for-service operations in the Defense Business Operating Fund (DBOF). DISA was granted the right of first refusal for DoD data processing requirements for two years after capitalizing the Megacenters. After the two year window, customers are free to take their business wherever they can get the best deal. That means the Defense Megacenters will shortly be in direct competition with private sector service centers for business. To compete successfully, the Defense Megacenters must become as efficient as their commercial competition. Data on total staffing requirements per used MIPS in the private sector is available from several sources. This data was considered in establishing the staffing targets for Defense Megacenters. Although this approach does not explicitly recognize the

2

Final Report Reference

technical concerns outlined in the draft report about using MIPS to determine staffing needs, it does recognize that the Defense Megacenters must remain in business or the appropriateness of the workload measure used to establish staffing targets has no meaning.

Data center operating costs are generally split almost equally between labor and non-labor. The non-labor component consists of computer hardware, software, supplies and facility costs which will not differ significantly between a Defense Megacenter and a commercial service center. If we cannot gain an advantage in non-labor costs, that means we must realize the same level of labor efficiency achieved by the private sector in order to remain competitive. This is just another way to say that the average staff per used MIPS across all the Defense Megacenters must be reasonably close to the level realized in the commercial environment.

2. **RECOMMENDATION 1:** Use measurable workload functions performed by computer personnel rather than the speed in which the computer processes an instruction (as expressed in millions of instructions per second) in determining the staffing requirements for the 16 Defense Megacenters.

RESPONSE: Nonconcur with the recommendation. In developing staffing targets for Defense Megacenters in the optimized end state, we face the challenge of estimating how many people will be required from two to five years in the future to staff an operation which does not exist today. The draft report describes several different methodologies using measurable workload functions performed by personnel. Each of these methodologies, however, requires quantitative historical data to produce staffing estimates. We have been unable to collect historical data for an operation which does not yet exist. Moreover, we cannot even estimate workload measures for the optimized environment until we complete a comprehensive Concept of Operations which includes detailed information on the optimized hardware and software environment. This information will not be available at the earliest until the end of FY 95. In the interim, the only reasonably accurate metric we have on the future end state environment is total projected workload measured in MIPS. Given there is no other reasonable alternative, we intend to continue developing end state staffing targets using projected end state workload in MIPS.

3. **RECOMMENDATION 2:** Revise the staffing requirements for the 16 Defense Megacenters based on using the measurable workload factors discussed in Recommendation 1. Revised

RESPONSE: Concur in part with the recommendation. As noted in the response to Recommendation 1, DISA will continue developing end state staffing targets for Defense Megacenters using projected end state workload in MIPS because there is no other viable option. It is possible, however, that measurable

3

Final Report
Reference

workload factors may be used to establish interim staffing targets during the migration period before the Megacenters are optimized. DISA is now at a point where the routine, systematic review of our total organization can be accomplished, using tools which measure workload volume, accomplishment times, and personnel unit cost per output. These reviews are scheduled to begin in FY 1995 with a prototype effort at DMC Huntsville. This Megacenter has a relatively stable environment because it is not scheduled to receive additional legacy site workload, nor has it been optimized. The prototype will attempt to develop interim staffing targets based on measurable workload factors. If this effort is successful, the methodology may be applied to other Megacenters which are stable but not yet optimized.

Revised

4. **RECOMMENDATION 3:** Disclose in the cost analysis that projected staffing requirements will be revised using measurable workload factors if staffing requirements are not corrected before the cost analysis is presented to Congress by March 1995.

RESPONSE: Nonconcur with the recommendation. DISA will use the most accurate staffing targets available at the time the cost analysis is presented to Congress in March 1995. MIPs is a measurable factor, the most reasonable tool to use at this time, and does not require correction. Since the additional "measurable workload factors" addressed in the Draft report cannot be used to project staffing requirements until FY 96 at the earliest, it is not appropriate to raise this issue in the March 1995 report to Congress. The DISA Comptroller is the functional proponent for the Efficiency review, Position Management, and resource Requirements Determination process. By 1 March 95, the DISA Comptroller will develop an E schedule that will insure that a routine, systematic review of DISA's total organization is accomplished, to include the development of Most Efficient Organizations (MAO) and staffing standards for both DBOF and appropriated fund activities.

Audit Team Members

This report was prepared by the Readiness and Operational Support Directorate, Office of the Assistant Inspector General for Auditing, Department of Defense.

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