DEPARTMENT OF DEFENSE

TECHNICAL ASSESSMENT REPORT

PRECISION MEASUREMENT EQUIPMENT LABORATORY AUTOMATED MANAGEMENT SYSTEM

Report No. 95-004 **October 4, 1994**

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Acronyms

ADP	Automated Data Processing
CAMS	Core Automated Maintenance System
C-CS	Communications-Computer Systems
IMDS	Integrated Maintenance Data System
PAMS	Precision Measurement Equipment Laboratory Automated Management System
PMEL	Precision Measurement Equipment Laboratory
REMIS	Reliability and Maintainability Information System
TMDE	Test, Measurement, and Diagnostic Equipment

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
400 ARMY NAVY DRIVE
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October 4, 1994

MEMORANDUM FOR ASSISTANT SECRETARY OF THE AIR FORCE
(FINANCIAL MANAGEMENT AND COMPTROLLER)
INSPECTOR GENERAL, DEPARTMENT OF THE
AIR FORCE

SUBJECT: Technical Assessment Report of the Precision Measurement Equipment Laboratory Automated Management System (Report 95-004)

This report is provided for your information and use. We conducted the Technical Assessment in response to a Hotline allegation that the Air Force was wasting resources by not using Commercial-Off-The-Shelf products to satisfy Precision Measurement Equipment Laboratory Automated Management System (PAMS) requirements. PAMS is an Air Force-developed computer system that automates the administrative aspects of metrology and calibration. Management comments on a draft of this report were considered in preparing this report. Air Force comments conformed to the requirements of DoD Directive 7630.3 and resolved all issues. Therefore, additional comments are not required.

The courtesies extended to the Technical Assessment Division staff are appreciated. If you have questions on this assessment, please contact Mr. Kenneth H. Stavenjord, Technical Director, at (703) 604-8952 (DSN 664-8952) or Mr. Gregory R. Donnellon, Project Manager, at (703) 604-8946 (DSN 664-8946). The distribution of this report is listed in Appendix D. The technical assessment team members are listed inside the back cover.

David K. Steersma

David K. Steersman
Deputy Assistant Inspector General
for Auditing

Office of the Inspector General, DoD

Report No. 95-004 **October 4, 1994**
(Project No. 3PT-8016)

TECHNICAL ASSESSMENT OF THE PRECISION MEASUREMENT EQUIPMENT LABORATORY AUTOMATED MANAGEMENT SYSTEM

EXECUTIVE SUMMARY

Introduction. The Precision Measurement Equipment Laboratory Automated Management System (PAMS) is an Air Force-developed computer system that automates the administrative aspects of metrology and calibration.

We received a Hotline complaint asserting that the Air Force has wasted resources by continuing to use PAMS when more capable Commercial-Off-The-Shelf products are available at lower costs. The complainant cited three specific deficiencies concerning the development of PAMS to support this conclusion. These deficiencies were:

o PAMS was not developed in accordance with Air Force directives,

o the Air Force was planning to reverse-engineer PAMS and convert the software from the Basic computer language to Ada, and

o an independent validation and verification of PAMS was never completed.

The complainant believed that the PAMS software would be difficult and expensive to maintain and that reverse-engineering and converting the PAMS software to Ada would be very costly. The complainant, therefore, concluded that Air Force could save money by replacing PAMS with a Commercial-Off-The-Shelf product.

Objective. The objective of our technical assessment was to determine whether the Air Force had wasted resources by using PAMS instead of a Commercial-Off-The-Shelf product.

Technical Assessment Results. The Air Force did not waste resources by using PAMS instead of a Commercial-Off-The-Shelf product (Finding A). The complainant correctly identified several PAMS deficiencies, but the Air Force has also recognized these deficiencies and corrected them for the most part.

As a result, the PAMS software has not been overly troublesome or expensive to maintain. Further, the PAMS users are satisfied with the system. Consequently, the complainant's recommendation that PAMS be replaced with a Commercial-Off-The-Shelf product could not be supported.

The Air Force, however, has yet to correct one PAMS problem that stems from the deficiencies identified by the complainant. The Aerospace Guidance and Metrology Center routinely does not receive PAMS data from approximately

40 percent* of the Precision Measurement Equipment Laboratories because PAMS cannot communicate with other Air Force maintenance management systems (Finding B). PAMS does not communicate with these other systems as the result of two factors:

o PAMS was not fully integrated into a Communications-Computer Systems (C-CS) architecture when the system was developed, and

o a PAMS Program Management Directive was not implemented when the PAMS program management responsibility transferred from the PAMS Design Office to the Standard Systems Center.

Although the Air Force is aware of the PAMS communications problems, it has not addressed the causes of these problems. Instead, the Aerospace Guidance and Metrology Center has instituted a short-term solution that bypasses the communications problems; the TMDE data are being mailed to the Aerospace Guidance and Metrology Center on computer discs. While this solution is expected to improve the percentage of data that reaches the Aerospace Guidance and Metrology Center, it is person-power intensive and an inefficient use of the Air Force's computer resources. Two additional reasons warrant the timely correction of the PAMS communications problems. First, the Air Force will pay less for the necessary corrections the sooner that the problems are addressed. Second, by correcting the PAMS communications problems, the Air Force will lay a solid foundation for future PAMS improvements, whether they be upgrades to the current PAMS configuration or Commercial-Off-The-Shelf products.

Summary of Recommendations. We made no recommendations in Finding A. In Finding B, we recommended that the Air Force correct the PAMS communications and management problems by fully integrating PAMS into a Communications-Computer Systems architecture for Air Force maintenance management systems and establishing a PAMS Program Management Directive.

Management Comments. The Air Force agreed with the substance of the recommendations, but provided an alternative approach for implementing the recommendations. The Air Force agreed that PAMS functionality should be integrated into a Communications-Computer Systems architecture for Air Force maintenance systems and that a corresponding Program Management Directive is warranted.

Technical Assessment Comments. The Air Force's comments were responsive and consistent with our recommendations. Consequently, additional comments on this final report are not required. Further information on management comments is in Part II, and the complete text of the comments is in Part IV.

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*The 40 percent value is based on an input of 38 percent from Air Force representatives familiar with the problem and a 40 percent value calculated from the Aerospace Guidance and Metrology Center's Maintenance Data Collection reports for the month of March 1993 (zero Test, Measurement, and Diagnostic Equipment (TMDE) data was received from 62 of 155 PMELs).

Table of Contents

This report was prepared by the Technical Assessment Division, Audit Planning and Technical Support Directorate, Office of the Assistant Inspector General for Auditing, DoD.

Part I - Introduction

Background

The Air Force relies on precise measurement equipment (oscilloscopes, for example) to ensure that safety and mission-critical instruments (such as altimeters and pressure gauges) are properly maintained. The precise measurement equipment are more commonly termed Test, Measurement, and Diagnostic Equipment (TMDE) and are themselves sensitive instruments that must be periodically calibrated to ensure that they are operating properly.

For optimum efficiency, the calibration intervals of TMDE must be closely monitored. The calibrating of TMDE requires that the equipment be removed from service; therefore, the calibration periodicity must be balanced to eliminate unnecessary calibrations while still ensuring that the TMDE remains accurate. To achieve this balance, data are collected whenever a piece of TMDE is calibrated.

A computer system is necessary to manage the Air Force's TMDE data. The Air Force utilizes more than 860,000 pieces of TMDE and data must be collected on each piece of measurement equipment. The data are used for several purposes, including:

o tracking the maintenance history and status of each individual piece of measurement equipment and

o updating the TMDE calibration intervals.

The Air Force developed the Precision Measurement Equipment Laboratory (PMEL) Automated Management System (PAMS) to effectively collect, manage, and disseminate TMDE data. Before the development of PAMS, the Air Force manually conducted these tasks; however, this process was time-consuming and could be more readily accomplished by a computer.

We received a Hotline complaint asserting that the Air Force was wasting resources by utilizing PAMS when more capable Commercial-Off-The-Shelf products are available at lower costs. The complainant cited the following problems with PAMS:

o PAMS was not developed in accordance with Air Force Regulations[1];

o the Air Force has planned to reverse-engineer[2] PAMS and convert the software from the Basic computer language to Ada; and

[1]The 700 series of the Air Force Regulations govern the development of Automated Data Processing systems, such as PAMS.

[2]In this case, reverse-engineer means taking the existing PAMS code and working backward to document the software's structure.

o an independent validation and verification[3] has never been conducted for PAMS.

The complainant believed the PAMS software would be difficult and expensive to maintain and that the reverse-engineering and conversion of the PAMS software to Ada would be very costly. Consequently, the complainant concluded that the Air Force could save money by replacing PAMS with a Commercial-Off-The-Shelf product.

Objectives

The overall objective of this technical assessment was to determine whether the Air Force was wasting resources by using PAMS instead of a Commercial-Off-The-Shelf product. More precisely, our objectives were to determine the validity of each specific problem cited by the complainant; whether the Air Force had corrected these problems; and whether these problems resulted in wasted resources that could have been saved by replacing PAMS with a Commercial-Off-The-Shelf product.

Scope and Methodology

We traced the chronological history of the specific problems cited by the complainant. We first evaluated whether the complainant had accurately identified the PAMS problems. We assessed the actions taken by the Air Force to correct the problems and analyzed whether the problems resulted in wasted Air Force resources. We also reviewed several potential PAMS improvement options, including the replacement of PAMS with a Commercial-Off-The-Shelf product.

The Technical Assessment was conducted from May through September 1993. We met with representatives from the Aerospace Guidance and Metrology Center; the Standard Systems Center; and the Headquarters, U.S. Air Force. We also discussed the PAMS assessment with the Air Force Director of Metrology; the Air Force Material Command's Logistics Applications of Automated Marking and Reading Symbols office; a Headquarters, U.S. Air Force, computer policy representative; and the Air Force Materiel Command's PMEL representative. Additionally, we visited a PMEL at Andrews Air Force Base, Maryland, for a hands-on demonstration of PAMS. Appendix C lists the organizations that we visited or contacted.

[3]Independent verification and validation is a technique used to reduce risk in software development. An independent party tests the software and ensures that the software satisfies all system-level requirements.

The assessment team consisted of members from the Technical Assessment Division, Audit Planning and Technical Support Directorate. The team members have experience in computer science, engineering, and acquisition management.

Part II - Findings and Recommendations

Finding A. PAMS Development

The Air Force had not wasted resources by using PAMS instead of a Commercial-Off-The-Shelf product. Although the complainant identified valid PAMS discrepancies, the Air Force also recognized these problems and corrected them for the most part. The Air Force, however, has yet to correct one PAMS problem that stems from the deficiencies identified by the complainant (See Finding B). In general, the extent of the PAMS problems have not been as significant as alleged by the complainant.

Discussion

At the time of the allegation, the complainant had identified valid PAMS discrepancies. PAMS was not developed in accordance with Air Force directives, the Air Force had plans to reverse-engineer PAMS and convert the software to Ada, and the Air Force had not conducted an independent validation and verification of PAMS.

However, the Air Force also recognized the PAMS discrepancies and, in general, has corrected them. At the time of our assessment, the status of the problems cited by the complainant were as follows:

o the Standard Systems Center had reviewed the PAMS development documentation for compliance with Air Force regulations. Some documentation was inadequate and was being updated. In general, however, the Aerospace Guidance and Metrology Center and the Standard Systems Center were managing PAMS in accordance with the applicable directives and regulations (the notable exceptions are discussed in Finding B);

o the Air Force had canceled its plans to reverse-engineer PAMS and convert the software to Ada; and

o the Standard Systems Center validated (tested) the PAMS software when the PAMS Program Management transferred to the Standard Systems Center. Several software errors were identified and the Standard Systems Center upgraded the software accordingly. The revised software was distributed to the PAMS users for "operational" validation and verification.

The complainant believed that the PAMS discrepancies would have two major effects. First, the PAMS software would be difficult and expensive to maintain. Second, the reverse-engineering and converting of the PAMS software to Ada would be extremely costly. Given the status of the PAMS system at the time of the allegation, the complainant was right. However, as a result of the Air Force's subsequent actions, the extent of the PAMS problems have not been as significant as contemplated by the complainant.

At the time of the allegation (late 1992), the Standard Systems Center had just accepted PAMS program management responsibility and the PAMS software was trouble-ridden to the extent that some PMELs would not use the latest software version. Further, the PAMS software was not adequately documented. These factors lead the complainant to conclude that the PAMS software would be difficult and costly to maintain. However, upon accepting programs management responsibility for PAMS, the Standard Systems Center implemented a recovery plan and was able to develop a much improved software version relatively quickly, without exceeding the PAMS' budget[4]. The recovery plan included not only fixing the PAMS software errors but also updating the associated documentation. Consequently, the PAMS software has not been overly difficult or expensive to maintain.

In a similar vein, the complainant's allegation that reverse-engineering PAMS and converting the software to Ada would be costly was correct. However, significant resources were never expended on this effort. At the time of the allegation, the Standard Systems Center had initiated a project to reverse-engineer and convert the PAMS software to Ada. The Standard Systems Center had planned to use the Ada software on other Air Force systems. Little work was actually accomplished on this project, however, before the Air Force recognized that the project was not cost-effective and cancelled it.

Further, the PAMS users were satisfied with the system. Several PAMS users were interviewed and all indicated a general satisfaction with PAMS performance. Additionally, these users felt that the Standard Systems Center and the PAMS Configuration Control Board were adequately responding to the users' requirements. Although some users indicated that PAMS should be upgraded in the future, none stated that PAMS should necessarily be replaced with a Commercial-Off-The-Shelf product. In short, a detailed cost analysis between PAMS and the Commercial-Off-The-Shelf products would need to be performed to justify the acquisition of a new system. While the Standard Systems Center had begun to research possible PAMS upgrades, the PAMS communications requirements must be clearly established before a cost comparison of the various options can be performed. The need to clearly define the PAMS communications requirements is further discussed in Finding B.

Conclusion

At the time of the allegation, the complainant cited several valid PAMS problems, which could have resulted in waste. However, the Air Force has corrected these problems for the most part. Consequently, resources have not been wasted on PAMS that could have been saved by replacing PAMS with a Commercial-Off-The-Shelf product.

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[4]The Standard Systems Center spent approximately $650,000 in 1992 and 1993 on PAMS.

Finding B. PAMS Communications

The Aerospace Guidance and Metrology Center routinely did not receive TMDE data from approximately 40 percent of the Precision Measurement Equipment Laboratories. This condition existed because the PAMS communications[5] requirements and management responsibilities have never been clearly defined. A short-term solution to the PAMS communications problems has been implemented, but the management causes have not been addressed. In resolving these problems, the Air Force will alleviate the need for inefficient short-term solutions, avoid the higher costs of correcting the problems later, and lay a solid foundation for future PAMS enhancements.

Discussion

The Aerospace Guidance and Metrology Center routinely does not receive TMDE data from approximately 40 percent of the Precision Measurement Equipment Laboratories because of PAMS communications problems. PAMS relies on other Air Force maintenance management systems to transfer TMDE data from the Precision Measurement Equipment Laboratories to the Aerospace Guidance and Metrology Center. However, PAMS often cannot communicate with these other systems. The details on the PAMS communications problems are in Appendix A, but, in general, PAMS cannot communicate with these other systems because the communications requirements (such as data flow paths and interfaces) between the systems have not been clearly defined. From a management perspective, the PAMS communications requirements have not been clearly defined for two reasons:

o PAMS was not adequately integrated into a Communications-Computer Systems (C-CS) architecture when the system was developed, and

o a PAMS Program Management Directive was not established when the PAMS program management responsibility transferred from the PAMS Design Office to the Standard Systems Center.

The integration of PAMS into a C-CS architecture and the establishment of a Program Management Directive are management issues that result in technical problems. The Air Force has recognized this fact and established procedures to prevent the PAMS-type problems from occurring. However, these procedures were not followed when PAMS was developed. Specifically, PAMS was not fully integrated into a C-CS architecture (that is, PAMS interface and data flow requirements were not defined), contrary to Air Force Regulation 700-2,

[5]In this report, communications means the transfer of information from PAMS to another computer system, regardless of means (e.g., modem or computer discs).

"Communications-Computer Systems Planning and Architectures." In general, Air Force Regulation 700-2 directs that all Automated Data Processing (ADP) systems be integrated into C-CS architectures to minimize interface problems. The purpose of integrating ADP systems in C-CS architectures is more fully explained in Air Force Pamphlet 700-50, Volume I, Air Force Communications-Computer Systems Architecture, which states:

> The architectures make sure validated communications-computer systems requirements are satisfied with integrated, affordable technical solutions. Their purpose is to provide standards, systems, protocols, interfaces, and so forth, that must be considered when developing, implementing, or modifying Air Force communications-computer systems.

PAMS was not fully integrated into a C-CS architecture for a variety of reasons. Among the significant reasons were:

o the Air Force wanted to field PAMS as expeditiously as possible,

o several computer systems that PAMS was to communicate with were being updated or replaced, and

o the responsibility for developing the necessary interfaces was levied upon the non-PAMS systems management.

The net result was that PAMS was fielded with little regard for interfaces or integration with other systems, which is precisely the situation that Air Force Regulation 700-2 was intended to avoid.

Additionally, Air Force regulations were not followed when the PAMS program management responsibility transferred to the Standard Systems Center. PAMS program management responsibility transferred from the PAMS Design Office to the Standard Systems Center in the summer of 1992, but a PAMS Program Management Directive was not implemented as required by Air Force Regulation 700-53, "Management of Standard Systems."[6] Although the lack of a Program Management Directive did not directly cause the PAMS communications problems, it has prevented the timely correction of the problems. To illustrate this point, a review of some objectives of Air Force Regulation 700-53 is necessary. These objectives include:

o providing a review process for standard systems at the appropriate levels within the Air Force,

o ensuring involvement of all appropriate Air Force organizations and other agencies early in the planning process, and

[6]Air Force Regulation 700-53 directs that Program Management Directives be implemented for Standard Systems; PAMS is a Standard System because more than one major Command utilizes the system.

o ensuring that standard systems meet Air Force Communications-Computer Systems architectural guidance.

To meet these objectives, Air Force Regulation 700-53 requires that the Air Force Functional Manager (in PAMS case, the Aerospace Guidance and Metrology Center) develop a Program Management Directive. In general, the purpose of a Program Management Directive is to designate the organizational responsibilities for the maintenance of a standard system.

As of the time of this assessment, however, a PAMS Program Management Directive had not been established. Consequently, the corrective actions for the PAMS communications problems had not been funded. In general, the responsibilities for ensuring that one computer system can interface with another system must be clearly defined so that the proponents of each system can properly plan and fund for changes to the interface. In PAMS case, these responsibilities have not been defined. As a result, several Air Force maintenance systems have made changes that impacted their interface with PAMS but no funds have been budgeted to correct the communications problems.

While Air Force Regulations 700-2 and 700-53 should have been implemented earlier in PAMS development, three factors warrant that the Air Force "retroactively" implement these regulations. These factors are:

o the PAMS communications capabilities have continued to deteriorate, forcing the Aerospace Guidance and Metrology Center to impose an additional person-power burden on the Precision Measurement Equipment Laboratories;

o the longer the Air Force delays fixing these problems, the higher the cost of implementing the fixes; and

o until the Air Force corrects the PAMS communications problems, the Air Force will not have a solid foundation upon which to base future PAMS improvement decisions.

The most pressing reason for fully incorporating PAMS into a C-CS architecture is that the PAMS communications capabilities continue to deteriorate. Since being fielded, PAMS has been able to communicate with other Air Force systems to varying degrees. Some problems have been site-specific; but, in general, PAMS communications have continued to deteriorate because changes have been made to other maintenance management systems without regard to the PAMS communications requirements. An example best illustrates this point. On at least one occasion, the Core Automated Maintenance System (CAMS) software was upgraded but the PAMS community was not informed of the upgrade until after the changes had been made. As a result of these changes, PAMS was not able to communicate with CAMS. The problem was fixed only after the PAMS technical representatives met with representatives from the CAMS community. In this particular case, the problem was simple so significant resources were not required to remedy the situation. However, such is not always the case. For instance, at the time of

the assessment, another CAMS upgrade was planned that would again prevent PAMS from effectively communicating with CAMS. This problem involves the type of communications lines CAMS uses and had yet to be resolved.

Because many PAMS communications problems have not been easily corrected, the Air Force has implemented a short-term solution. At the time of this assessment, the PAMS community had been trying to correct the PAMS communications problems for at least a year with little success. Consequently, in May 1993, the PMELs were instructed to mail their TMDE data to the Aerospace Guidance and Metrology Center on computer discs. While this approach is expected to improve the percentage of TMDE data that is received at the Aerospace Guidance and Metrology Center, it imposes a greater person-power burden on the PMELs and is an inefficient use of Air Force computer resources.

Given the circumstances, the Air Force's solution makes sense for the short-term. Nonetheless, a long-term solution needs to be implemented, and the sooner, the better, because the sooner that the PAMS communications problems are corrected, the lower the overall cost. In general, correcting the PAMS communications problems will entail software modifications. While the cost of developing the necessary modifications should not increase significantly over time, the overall cost of the fixes can be expected to increase. This increase will result because the other Air Force maintenance management systems can be expected to continue evolving without regard to PAMS communications requirements. In these instances, the changes may need to be re-worked or additional modifications may be required to support PAMS requirements, thus raising the overall cost. While the extent of these types of problems cannot be forecasted, the historical evidence of similar problems indicates fairly strongly that these types of problems will continue in the absence of Air Force action.

Another reason that the Air Force should correct the PAMS problems is that, by doing so, the Air Force will lay a solid foundation for future PAMS improvements. By integrating PAMS into a C-CS architecture and implementing a PAMS Program Management Directive, the Air Force will formalize the PAMS communications requirements and management responsibilities. This information will allow the Air Force to more readily upgrade PAMS in the future, whether the improvement be a simple enhancement to the current PAMS configuration or a complete replacement of the system with a Commercial-Off-The-Shelf product. Several improvement options are discussed in Appendix B.

Conclusion

Because PAMS cannot communicate with other Air Force maintenance management systems, the TMDE data from approximately 40 percent of the PMELs routinely does not reach the Aerospace Guidance and Metrology Center. The communications problems were caused by the lack of program management structure. The requirements for communications had never been

explicitly defined and no organization was designated to correct the problems. Although the Air Force designed a short-term solution, that solution did not address the underlying cause of the problems. By correcting these deficiencies, the Air Force will not need inefficient short-term solutions, will pay less for the fixes, and will better support future PAMS system enhancements.

Recommendations for Corrective Action

1. We recommend that Chairman of the Headquarters, U.S. Air Force Communications-Computer Systems Requirements Board, ensure that the Precision Measurement Equipment Laboratory Automated Management System communications requirements are clearly defined by fully incorporating the system into an Air Force Communications-Computer Systems architecture for automated maintenance management systems in accordance with Air Force Regulation 700-2, "Communications-Computer Systems Planning and Architectures."

Management Comments. The Air Force agreed with the substance of the recommendation and provided an alternative approach for implementing the recommendation. The Air Force stated it was currently evaluating the migration of PAMS and other maintenance systems into a standard system called the Integrated Maintenance Data System (IMDS). As a part of this process, the Air Force intends to clearly define the PAMS functionality and communications requirements. The IMDS proof of concept studies will be performed in FY 1995 and a competitive acquisition strategy will be formulated for solicitation in FY 1996. The complete text of management comments is in Part IV.

Technical Assessment Response. The Air Force's comments were responsive and provided a reasonable approach for implementing our recommendation. While the Air Force's comments implied that IMDS will correct the PAMS communications problems, we could not evaluate this position as IMDS has not yet been developed. Whether IMDS is developed or not, the Chairman of the Headquarters, U.S. Air Force Communications-Computer Systems Requirements Board, will need to integrate PAMS communications requirements into a Communications-Computer architecture with other Air Force maintenance systems. Consequently, we did not change our original recommendation.

2. We recommend that the Director, Aerospace Guidance and Metrology Center, establish overall Precision Measurement Equipment Laboratory Automated Management System management responsibilities by implementing a corresponding Program Management Directive in accordance with Air Force Regulation 700-53, "Management of Standard Systems."

Management Comments. The Air Force agreed with the substance of the recommendation, stating that an IMDS Program Management Directive is currently being developed. The Air Force intends to include the required PAMS management actions in this Program Management Directive.

Technical Assessment Response. The Air Force's comments were responsive and provided a reasonable approach for implementing the recommendation. Provided that IMDS comes to fruition as planned, a separate PAMS Program Management Directive is not necessary.

Part III - Additional Information

Appendix A. PAMS Communications Paths

No direct connectivity exists between the Precision Measurement Equipment Laboratories (PMELs) and the Aerospace Guidance and Metrology Center, so the TMDE calibration data is transferred from PAMS, through several other Air Force computer systems, to the Air Force Materiel Command. Because PAMS and these other Air Force maintenance management systems employ different software protocols, they must be "interfaced" for the data transfer to occur. Once the data arrives at the Air Force Materiel Command, it is stored on magnetic tapes and delivered to the Aerospace Guidance and Metrology Center by truck. This data flow path is convoluted and complex; and routinely, the Test, Measurement, and Diagnostic Equipment (TMDE) data from approximately 40 percent of the PMELs does not reach the Aerospace Guidance and Metrology Center.

Depending on where the PMEL is located, PAMS interfaces with different systems. For most PMELs, PAMS interfaces with the Core Automated Maintenance System (CAMS). However, if the PMEL is located at an Air Logistics Center, PAMS interfaces with a subsystem of the Depot Maintenance Data Systems Network, commonly referred to as "GOO4I." GOO4I is not a computer system in the classical sense, but rather a combination of various maintenance management systems. CAMS and GOO4I are mutually exclusive systems, but both are connected to another computer system, the Product Performance System, designated as "DO56." PAMS information from CAMS and GOO4I are transferred to DO56; a magnetic tape of the DO56 output is delivered to the Aerospace Guidance and Metrology Center by truck. Figure 1 on the following page is a simplified presentation of the TMDE data flow paths.

Some PAMS interfaces have been formally established; others have not. The PAMS to CAMS and CAMS to DO56 interfaces have been formally established in Memorandums of Agreement, but the data transfer process is still error prone and manual "massaging" of the data is often required. Additionally, DO56 may soon be replaced by the Reliability and Maintainability Information System (REMIS); however, REMIS is not able to process PAMS data. No interface agreement has been established between PAMS and GOO4I because each Air Logistics Center's GOO4I configuration is unique. Some Air Logistics Centers' PAMS data does reach the Aerospace Guidance and Metrology Center, however. Like DO56, GOO4I may soon be replaced by yet another computer system, namely the Depot Maintenance Management Information System.

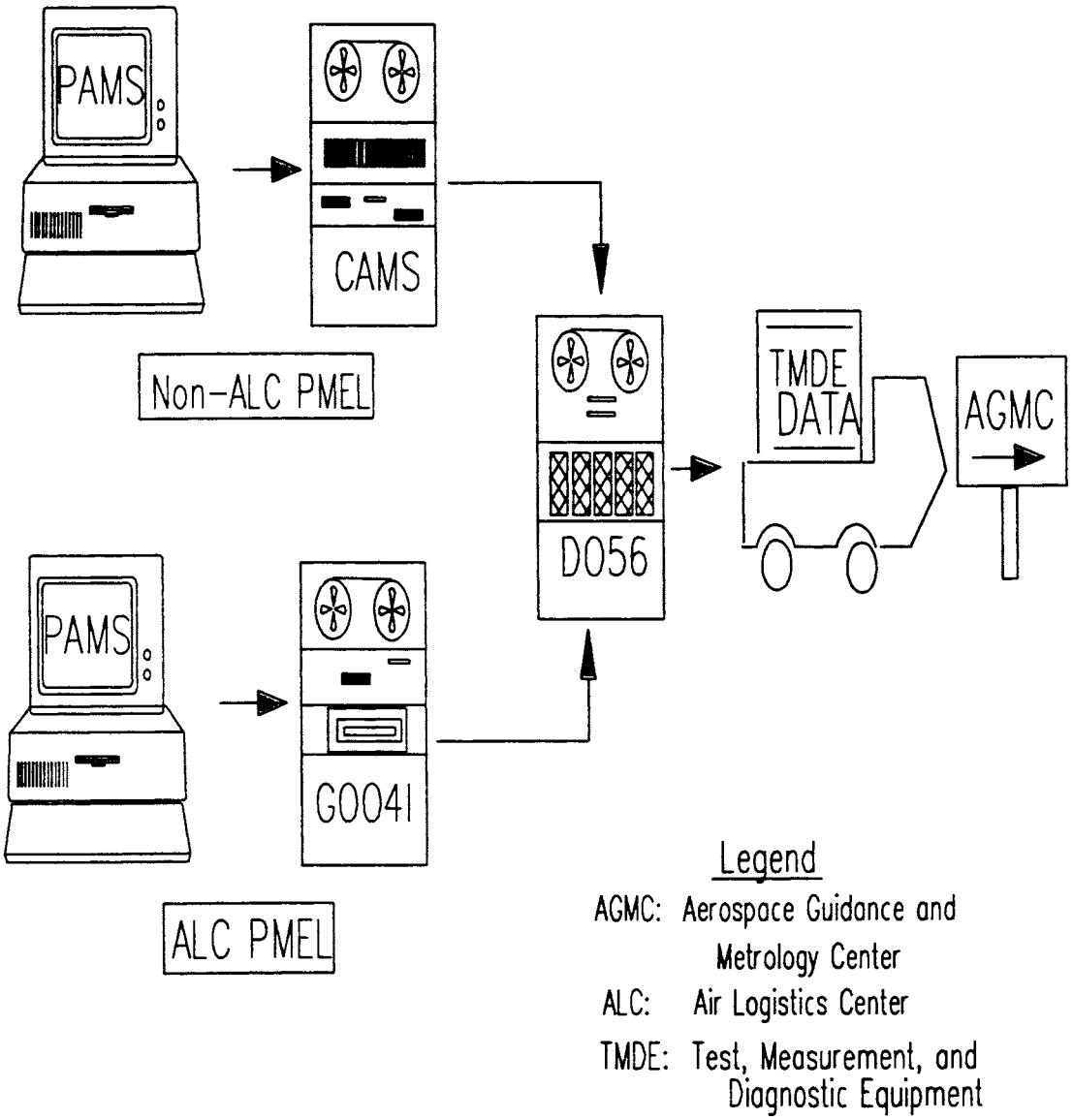

Figure 1. TMDE Data Flow Paths

Appendix B. Options for Improving PAMS

Several options exist for improving PAMS' capabilities, but recommendations concerning PAMS improvements would be premature before the Air Force has addressed the PAMS communications problems. Once the PAMS communications problems have been resolved, a market survey can be performed and the costs of the various alternatives compared to the cost of maintaining PAMS. In the interim, maintaining the current system is a reasonable option. The following discussion on upgrading PAMS is based on information that was provided by the complainant and the Air Force and is provided for information purposes only.

The options for upgrading PAMS that were reviewed are upgrading the PAMS hardware and software or replacing PAMS with a Commercial-Off-The-Shelf product. Both options are technically feasible. Other options, such as replacing PAMS with another Air Force maintenance management system or connecting the PMELs directly to the Aerospace Guidance and Metrology Center might also be feasible.

Upgrading the hardware (and to some aspects, the software) of the PAMS is feasible. The PAMS software can only be run on UNISYS® compatible computers due to the unique operating system; however, the processing (throughput) capabilities can be readily improved. Additionally, newer UNISYS computers can run MS-DOS® software applications.

Replacing PAMS with a Commercial-Off-The-Shelf product is also possible. The Standard Systems Center has reviewed several Commercial-Off-The-Shelf products that are similar to PAMS and could replace the system. The products vary in capabilities and may require replacement of the PAMS hardware at a significant cost. The new software would also have to be procured and maintained. Additionally, the Commercial-Off-The-Shelf products would require modifications to be compatible with the existing Air Force maintenance systems; this situation is essentially the same as exists with PAMS.

Replacing PAMS with another Air Force maintenance management system might be a viable alternative for improving PAMS. Essentially, PAMS and other Air Force maintenance management systems accomplish the same functions (database management of maintenance information) and should have common requirements. Another theoretically possible option is to connect the Precision Measurement Equipment Laboratories directly to the Aerospace Guidance and Metrology Center with a wide-area network.

Appendix C. Organizations Visited or Contacted

Department of the Air Force

Headquarters, U.S. Air Force, Pentagon, Washington, DC
Air Force Materiel Command, Wright-Patterson Air Force Base, OH
Aerospace Guidance and Metrology Center, Newark Air Force Base, OH
Standard Systems Center, Gunter Annex, Maxwell Air Force Base, AL
89th Equipment Maintenance Squadron, Andrews Air Force Base, MD

Appendix D. Report Distribution

Department of the Air Force

Assistant Secretary of the Air Force (Financial Management and Comptroller)
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House Subcommittee on Legislative and National Security, Committee on Government Operations

Part IV - Management Comments

Department of the Air Force Comments

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE

24 AUG 1994

MEMORANDUM FOR ASSISTANT INSPECTOR GENERAL FOR AUDITING,
OFFICE OF THE INSPECTOR GENERAL,
DEPARTMENT OF DEFENSE

FROM: HQ USAF/LGM
1030 Air Force Pentagon
Washington, D.C. 20330-1030

SUBJECT: Draft Technical Assessment Report of the Precision Measurement Equipment Laboratory Automated Management System (PAMS) (Project No. 3PT-8016), 13 June 94

This is in reply to your request for Air Force comments on the subject draft report. We concur in part with the recommendations to Finding B. The Air Force is currently evaluating migrating the PAMS and other maintenance data systems into a standard core system called the Integrated Maintenance Data System (IMDS). This system is envisioned to be a seamless maintenance data system integrating numerous maintenance processes. A program management directive (PMD) is currently being developed for the IMDS and it is our intent to include the required PAMS management actions in this PMD.

The IMDS System Program Office is currently being formed within the Electronic Systems Center. This program office will perform functional economic analyses to determine core process requirements for the IMDS. As a result of these analyses, PAMS functionality may be moved into the core process or evolved into a system module at which time communications requirements will be clearly defined. IMDS proof of concept studies will be performed in FY95 and a competitive acquisition strategy will be formulated for solicitation in FY96. This IMDS effort has Air Staff, Office of the Secretary of Defense, and Congressional support.

Questions may be directed to Mr Tom Girz, HQ USAF/LGMM, DSN 227-3859.

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