MEETING THE DAILY INFORMATION NEEDS OF RETAIL SUPPLY MANAGERS: A DECISION SUPPORT SYSTEM FOR BASE LEVEL SUPPLY

THESIS

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Table of Contents

Page

Acknowledgments ii

List of Figures v

List of Tables vi

Abstract vii

I. Introduction 1

- Overview 1
- Background 2
- Statement of the Problem 8
- Research Objective 9
- Research Questions 9
- Scope of the Study 9
- Justification 10
- Assumptions 10
- Organization of the Report 11

II. Literature Review 12

- The Air Force Standard Base Supply System 12
  - Organization of Base Supply 13
  - Management Reports 16
- Decision Support Technology 19
  - What are Decision Support Systems? 20
  - Components of a DSS 21
  - DSS in Inventory Management 24
  - The Future of Decision Support 26
- Chapter Summary 28

III. Methodology 29

- Overview 29
- Phase I: System Development 29
  - The Modular Approach 29
  - DSS Development as an Iterative Process 31
  - First Iteration 32
    - Step One: Organizational Survey .. 32
    - Step Two: Requirements Definition 34
    - Step Three: Systems Development .. 36
    - Step Four: Implementation 39
  - Second Iteration 40
    - Step One: Organizational Survey .. 40
    - Step Two: Requirements Definition 42
    - Step Three: Systems Development .. 43
    - Step Four: Implementation 44
- Phase II: Systems Evaluation 44
- Chapter Summary 51

Page

IV. Findings and Discussion 52

Overview 52
Research Question One 53
Summary of Previous Research 53
Summary of Personal Interviews 56
Hierarchy of Supply Information Needs.. 60
Appropriateness of Chosen Data 65
Research Question Two 67
Summary of Personal Interviews 67
Research Question Three 72
Database Subsystem 73
Modeling Subsystem 76
User Interface 80
Research Question Four 83
Relative Efficiency of DMA 84
Relative Effectiveness of DMA 86

V. Summary, Conclusions, and Recommendations 89

Summary and Conclusions 89
Implementation Considerations 91
Recommendations for Further Research 94

Appendix A: Supply Personnel Involved in Study 95

Appendix B: Personal Interview Questionaire 96

Appendix C: Supply Personnel Critique of DMA 97

Appendix D: DMA Data Dictionary 98

Appendix E: DBASE3 PLUS Program Code 103

Appendix F: QUATTRO MACROS 140

Appendix G: MS-DOS Program Code 141

Bibliography 142

Vita 146

List of Figures

Figure		Page
1.	Organizational Structure of Base Supply..........	15
2.	System Development Timeline......................	33
3.	Typical Base Supply "How Goes It" Chart..........	68
4.	General Structure of DMA Database................	75
5.	Customer Support Effectiveness Database Structure	75
6.	Options of How to Examine DMA Data...............	82

LIST OF TABLES

TABLE		PAGE
1.	D-14 Daily Report Data Elements..................	16
2.	D-14 Data Elements Satisfied by DSS............	20
3.	Comparison of Task Completion Times..............	65
4.	Comparison of Effectiveness Ratings..............	66

Abstract

The Air Force Standard Base Supply System (SBSS) produces a number of standard management reports to provide the statistical data necessary for managing an effective supply account. One of these reports, the D-14, is meant to provide base supply decision makers with the information they need to manage their accounts on a daily basis. However, because of the volume of data contained in this report, its ability to provide useful information is suspect. The objective of this research was to transform the data currently provided by the SBSS in the D-14 daily report into information that is more useful to supply managers by applying the principles of decision support technology.

The researcher applied a four-step, iterative methodology to the systematic development of a decision support system (DSS) designed to meet daily base supply information needs. In the process, 181 specific elements of D-14 data, identified as important to managing effective supply accounts, were included into the database subsystem of the DSS. The resulting software, dubbed the Daily Management Analysis program (DMA), allows a supply analyst to automatically analyze up to two months worth of these data. In addition, managers can quickly scan the data loaded into DMA's database for areas of the D-14 in which preset upper and lower limits have been exceeded. DMA was evaluated by supply personnel at six Air Force bases and was determined to be both an efficient and effective means of managing supply accounts on a daily basis. A copy of the DMA program is kept on file with the Air Force Institute of Technology.

MEETING THE DAILY INFORMATION NEEDS OF RETAIL SUPPLY MANAGERS: A DECISION SUPPORT SYSTEM FOR BASE LEVEL SUPPLY

I. Introduction

Overview

We live today in an exciting and dynamic period of history, one in which society is being transformed by the increasing availability of information (Naisbit, 1982:23). Dubbed the "information revolution", its impact on our lives would not have been possible without the advent of the computer. Since the switch was thrown for the first electronic computer in 1946, computer technology has witnessed a remarkable rate of growth. Such technology has progressed through a series of four stages, referred to as generations, in which quantum leaps in computing capability have occurred (Howard, 1983:2-4). First generation computers, characterized by their use of vacuum tubes, were, by today's standards, large, slow, expensive, unreliable, and of limited capability. In 1959, transistors were introduced to herald the second generation and a marked increase in computer usage. Third generation computers were ushered in by another technological innovation, the semiconductor. And now, made possible by the integrated circuit, today's fourth generation computer is many thousands of times more powerful than its early predecessors (Davis, 1983:3).

The Air Force Standard Base Supply System (SBSS) ushered in its own information revolution with the long overdue replacement of the UNIVAC 1050-II (White Paper, 1983:2). This computer, based on second generation technology, was installed at Air Force bases during the mid 1960s, and was the supply system's primary computing resource for almost twenty years (Howard, 1983:15). In 1983, the Air Force began replacing this system with the "state of the art" fourth generation Sperry UNIVAC 1100/60 (Howard, 1983:15). In addition to its increased computing power, the 1100/60 eliminates the need for punch cards by providing the capability to tie into the system via terminals. These terminals may be specifically designed for such a purpose, or they may be actual microcomputers made to emulate a "dumb" terminal through a software package.

Background

With such advancements in technology, one would expect that the information now available to supply managers for making decisions would have shown similar improvements as well. In 1983, HQ USAF/LEY tasked a panel of Air Force supply experts with providing guidance and recommendations to be used in developing new Air Force supply policy. Their recommendations included increasing the scope of most retail supply accounts; providing direct customer support with a minimum of required customer action; and creating the capability to provide customers with real time information. One of the assumptions stated by the panel in developing their recommendations was that "Technology advances will continue to offer opportunities for increased efficiency and productivity (in spite of) a decreasing pool of manpower resources to draw upon" (White Paper, 1983:3).

But have such increases in efficiency and productivity been realized since the 1100/60 came on line? Moreover, are managers of today's base level supply accounts in any better position to make informed decisions than their predecessors who relied on second generation technology?

To answer these questions, one must look at the information that is available under the present system. As part of its routine, the SBSS generates a series of standard computer products that take the form of management reports (AFM 67-1, 1988:Ch 1, 36). These reports are produced daily, monthly or quarterly, depending on the type of report. Two of the most important reports, the D-14 ("D" for daily) and the M-32 ("M" for monthly), provide indicators used by managers to analyze the health of their accounts (Howard, 1989). These reports each provide similar data, the only significant difference being the time frame under consideration. Data in a tabular format can be produced for over ten thousand variables and, depending on the size of the account, require up to one hundred pages of computer output to complete. Simply processing these and other reports can take up to sixteen hours per day of off-line computer time (AFLMC Projects, 1988:88). Because of the volume of data contained in the D-14 and M-32, their ability to provide useful information to base supply decision makers is suspect.

The problem of inundating supply managers with data that have little information value is not new. In a report entitled "An Improved Management Information System for Chiefs of Supply," the Air Force Logistics Management Center (AFLMC) at

Gunter AFB noted the same problem when still operating under the second generation technology of the 1050-II. Their report found:

> These management reports, however, rarely provide obvious signs to stimulate a decision, but, rather provide endless computer pages of raw data. To derive (information) signs, the data in management reports must be manually manipulated, an anachronistic task in our high tech decade. (Rhodey, 1984:2)

The problem addressed in this report may have seemed more reasonable when most bases were still under the old technology, but has not the situation reversed itself now that the switch to the Sperry 1100/60 is complete? Unfortunately, this has not been the case.

When the 1100/60 was being programmed to take over the role of SBSS data manager from the old UNIVAC system, a decision was made by the developers of the system to continue operations as they had previously existed. This was done to make the transition as smooth as possible, since the primary focus was on developing a more efficient transaction processing system (Hibbard, 1989). Thus, although managers can now access the mainframe via terminals for certain functions including data extraction, there is no provision for manipulating the particular data a manager may be interested in (Howard, 1989). As a result, the task of deriving information in a format other than that presented in the standard reports is still accomplished manually in most cases.

Although it might be possible to reprogram the SBSS computer so that managers are provided with the capability to not just extract data, but manipulate data as well, such an endeavor has three drawbacks. First, the fundamental question of what such a program should provide in terms of output would have to be answered. This output would have to meet the information needs of all supply managers without becoming just another data system, while at the same time anticipating future needs to cover possible changes in SBSS policy (Rhodey, 1984:4).

The second drawback is the time and expense involved. The job of actually developing the code to reprogram the 1100/60 would rest with the Standard Systems Center (SSC) at Gunter AFB, whose mission is to "analyse, design, develop, test, implement, and maintain" data systems standard to the Air Force (Blake, 1987:60). In addition to base supply, the SSC serves the automated system support needs of virtually every activity in the Air Force, so their workload is great and the estimated backlog of major new projects is approximately two years (Hibbard, 1989).

Third, and perhaps most important, there is no guarantee that a new program of any consequence would be approved by the SSC. The procedures for proposing a change to SBSS programming, spelled out in AFM 67-1, are rather strict. The program may not write to or change the internal records in any way. It may not duplicate current SBSS programming, unless the change will make the process of retrieving information more efficient. Finally, the program must not take more than 250 workhours to develop. In all cases, the decision to accept or reject a proposal to change the internal programs of the SBSS rests with the Standard Systems Center (AFM 67-1, 1988:Ch 2, 41).

This is not to say that the problem of providing supply managers with an efficient method of analyzing SBSS information is being ignored. Tactical Air Command (TAC) has been especially aggressive in their attempts to create an automated, microcomputer-based data management and analysis system. Their efforts to date have culminated in a product they have named the Supply Management Analysis (SMA) Program. The purpose of SMA is to allow the user to automatically extract data from the M-32 Monthly Report onto a microcomputer, where it can then be stored and manipulated by a DBASE3 routine (TAC SMA, 1988:1). SMA can be used to output M-32 fields to the screen or printer, as well as to compute averages and track monthly trends for any desired time period stored in the data base. In fact, SMA exhibits many of the qualities of simple decision support systems (DSS) that Davis describes as band one on the spectrum of DSS applications (Davis, 1988:13).

The usefulness of SMA as a decision support tool has come to the attention the Air Force Logistics Management Center (AFLMC), whose mission is to develop, analyse, test, evaluate, and recommend "new or improved concepts, methods, systems or procedures to enhance logistics efficiency and effectiveness" (AFLMC Brochure, 1989:vii). They intend to standardize the SMA program for base supply use throughout the Air Force. The AFLMC has recently been focusing increasing attention toward the development of other microcomputer-based applications to automate several supply functions (Howard, 1989). For example, the Center recently fielded the final version of what it calls

IAP, or the Inventory Analysis Program. Programmed in DBASE3, IAP allows the user to quickly analyze monthly adjustments to inventory, a process which has traditionally required numerous man-hours to complete (IAP Users Guide, 1987:ch 1, 1). Another software application, the Equipment Management Information System (EMIS), is currently undergoing test and evaluation by the AFLMC. When implemented, this application will automate the routine tasks that are normally prone to high error rates by equipment managers (Bailey, 1988:52).

One area of supply management ideally suited for a similar application of computer automation is found in the daily monitoring of a supply account's health (Howard, 1989). Currently this is accomplished by analyzing the data contained in the D-14 Daily Management Report. The D-14 is similar to the M-32, except that the data stored in the 1100/60 are updated on a daily basis, rather than at the end of each month (Hibbard, 1989). In effect, the M-32 provides a running total of each month's D-14 reports.

Two problems arise for the supply manager attempting to analyze the status of his account by using the D-14. The first, already mentioned, is the fact that the report consists of page after page of computer output, making it difficult to extract useful information. Second, and perhaps more importantly, after the D-14 is printed, the 1100/60 software essentially drops the data stored in the report when their values are updated by SBSS program logic (Hibbard, 1989). Thus, in order to track and analyze daily trends, each data element of interest to a manager must be manually transcribed every day. Only then can the data be transformed into a useful format, such as a table or graph.

This labor intensive process precludes the use of the D-14 by many managers, who instead wait until the end of the month for the M-32 to be printed (Wright, 1989). In doing so, they are rendered virtually blind as to what each month's M-32 report will contain. They do so despite the fact that this places them in a somewhat precarious position, since Air Force supply accounts are judged and rewarded based on their performance as indicated by the M-32 reports. In addition, certain measures of the M-32 are also used by base Manpower in calculating manning authorizations for base supply organizations (Kenaston, 1989). Despite the importance of the M-32, many managers do not feel it is worth the time and effort it takes to understand how the report evolved over a given month by analyzing the D-14 on a daily basis.

Statement of the Problem

Under the current system of management reports, base supply managers are offered tremendous amounts of data, but are precluded from taking full advantage of that data to aid in their decision making due to the format in which the reports are presented. One of these reports, the D-14 Daily Report, is meant to be used in evaluating supply accounts on a daily basis. Because of the volume of data contained in this report, its ability to provide useful information to base supply decision makers is suspect. In addition, once the report has been produced and printed, the data contained in it are effectively dropped by the computer, thereby denying managers the ability to automatically track daily trends.

Research Objective

The purpose of this study was to determine whether the data currently provided by the Standard Base Supply System (SBSS) in the D-14 Daily Report can be transformed into information that is more useful to supply managers.

Research Questions

The following questions were asked and answered in an effort to accomplish the research objective:

1. What specific elements of data contained in the D-14 Daily Report are most important in maintaining an effective supply account?

2. What kinds of analysis might be possible and beneficial for base supply managers to perform on data contained in the D-14?

3. Do the problems and decisions faced by base supply managers today lend themselves to microcomputer-based decision support technology?

4. Would a decision support system, applied to the problem of daily management control, provide a more efficient and effective means of managing a base supply account on a daily basis than is possible under the present system?

Scope of the Study

As of 10 October, 1983, Air Force Manual 67-1, "USAF Supply Manual," listed 125 computer support bases hosting some 280 satellite activities throughout the Air Force, Air National Guard and Air Force Reserve. In addition to a worldwide geographic dispersion, there exists tremendous diversity in the size, complexity and mission of these organizations. Fortunately, the task of developing and implementing a system to meet their information requirements is simplified by a well defined and well documented Standard Base Supply System. An evaluation of the software application produced during this research was conducted at six Air Force base supply organizations representing the extremes in size and complexity, as well as five Major Commands. The application developed during this study, when turned over to the AFLMC for further evaluation and implementation, should be applicable to supply organizations throughout the SBSS.

Justification

The problem of SBSS management reports providing inadequate information to base supply decision makers is well documented. To deal with this problem, HQ USAF/LEY recently tasked the Air Force Logistics Management Center at Gunter AFB to analyze the way these reports are generated to determine if a more efficient and effective system can be developed (AFLMC Project Summaries, 1988:88).

Assumptions

Any software application designed during this research for use by base supply managers must include the capability for an automatic download of data from the 1100/60 mainframe to the microcomputer used to operate the program. This assumption is based on the researcher's belief that supply personnel have neither the time nor the inclination to input the hundreds of data elements manually on a daily basis. The ability to automatically download selective data does not require extensive

SBSS reprogramming, and in fact has been accomplished for other applications developed by the Air Force Logistics Management Center. The successful implementation throughout the Air Force of this software depends on the Standard Systems Center providing such a capability.

Organization of the Report

This report consists of five chapters. Chapter I, Introduction, provides background information, a statement of the problem, and the objective, scope and justification for this research. Chapter II, Literature Review, first examines the Air Force Standard Base Supply System and then turns to a discussion of decision support technology. Chapter III provides the methodologies enlisted to conduct the research. Chapter IV answers the research questions and provides a discussion of the software application developed during the research. Chapter V summarizes the research and offers recommendations where further study would be appropriate and beneficial.

II. Literature Review

The Air Force Standard Base Supply System

Air Force supply organizations vary in size, complexity and types of customer they support. This diversity is further complicated by a world wide geographic dispersion. In order to standardize such a large and complex mix of organizations, the Air Force implemented the Standard Base Supply System (SBSS). The SBSS is a computerized accounting system made up of uniform hardware, software, policies and procedures designed to standardize the Air Force supply system at base level (AFM 67-1, 1988:Ch 1, 7).

The purpose of the SBSS is to facilitate base supply organizations in meeting the needs of their customers. With it, personnel can track every item in their account via an on line data system. The hardware behind this capability is the Sperry S1100/60 computer, which automatically updates all records affected by a transaction. This computer and its associated software are managed by Headquarters Standard Systems Center (SSC/SMC) at Gunter AFB, Alabama.

As the Automated Data System (ADS) manager for the SBSS, the Standard Systems Center "acts as an extension of the Air Staff (USAF/LEY)" in most matters relating to Standard Base Supply System policy. (AFM 67-1, Ch 1:9). In particular, the SSC is responsible for reviewing recommendations for changes to the SBSS, preparing SBSS documentation, and evaluating SBSS performance data. (AFM 67-1, Ch 1:9). In 1983, the SSC began a major conversion of SBSS hardware from the twenty year old UNIVAC 1050-II to the "state of the art" Sperry S1100/60 mainframe computer (Howard, 1983:15). The purpose behind this overhaul was to take advantage of the significant improvements in computer technology that had taken place during the previous two decades to create a more efficient and capable data processing system (Hibbard, 1989). One of the objectives of this overhaul was to minimize the disruptions to daily SBSS activities caused by the conversion. Therefore, the transition was made as transparent as possible, and from the perspective of the base supply organizations who use the system, the only significant difference was the speed at which the system operated (Hibbard, 1989). Most procedures to process transactions, and the standard management reports produced by the SBSS to evaluate supply accounts, remained intact.

Organization of Base Supply.

Operating under the Standard Base Supply System are two types of accounts. Primary (Category I) supply accounts are relatively large and possess their own S1100/60 mainframe on site. Satellite (Category II/III) accounts are smaller activities whose computing requirements are provided for by the nearest primary account (AFM 67-1, Ch 2:7). In both cases, a well defined organizational structure operates to provide customers with timely supply support. At the top of this hierarchy is the Chief of Supply (COS), who is responsible for the smooth operation of his organization. To help the COS in his duties, supply accounts are divided into five branches, each with its particular area of concern. These branches are Management and Systems, Operations Support, Material Management, Material Storage and Distribution, and Fuels Management. The organizational structure of a typical Category I account as described in AFM 67-1 can be found on page 15.

Within the Management and Systems Branch is a subunit known as the Procedures and Analysis Section. Depending on the size and complexity of the account, this section may be further subdivided into a Procedures Unit and an Analysis Unit. Regardless of how the section is organized, its primary function is to provide the Chief of Supply with information about the health of his account. Armed with the information supplied by the Procedures and Analysis Section, the COS is then able to make timely and informed decisions.

Both the Procedures Unit and the Analysis Unit are tasked with their own particular area of responsibility. The Procedures Unit is concerned with ensuring that SBSS/COS policy and procedures are effectively carried out in the most efficient manner possible, while also identifying problem areas that require management's attention. Specific duties include: conducting internal "surveillance visits" of each section within the supply organization; preparing responses to discrepancies found during external inspections, audits and staff visits; and reviewing the use of all recurring, nonstandard computer products requested by each branch or section in the organization (AFM 67-1, Ch2:58, 2:133-134).

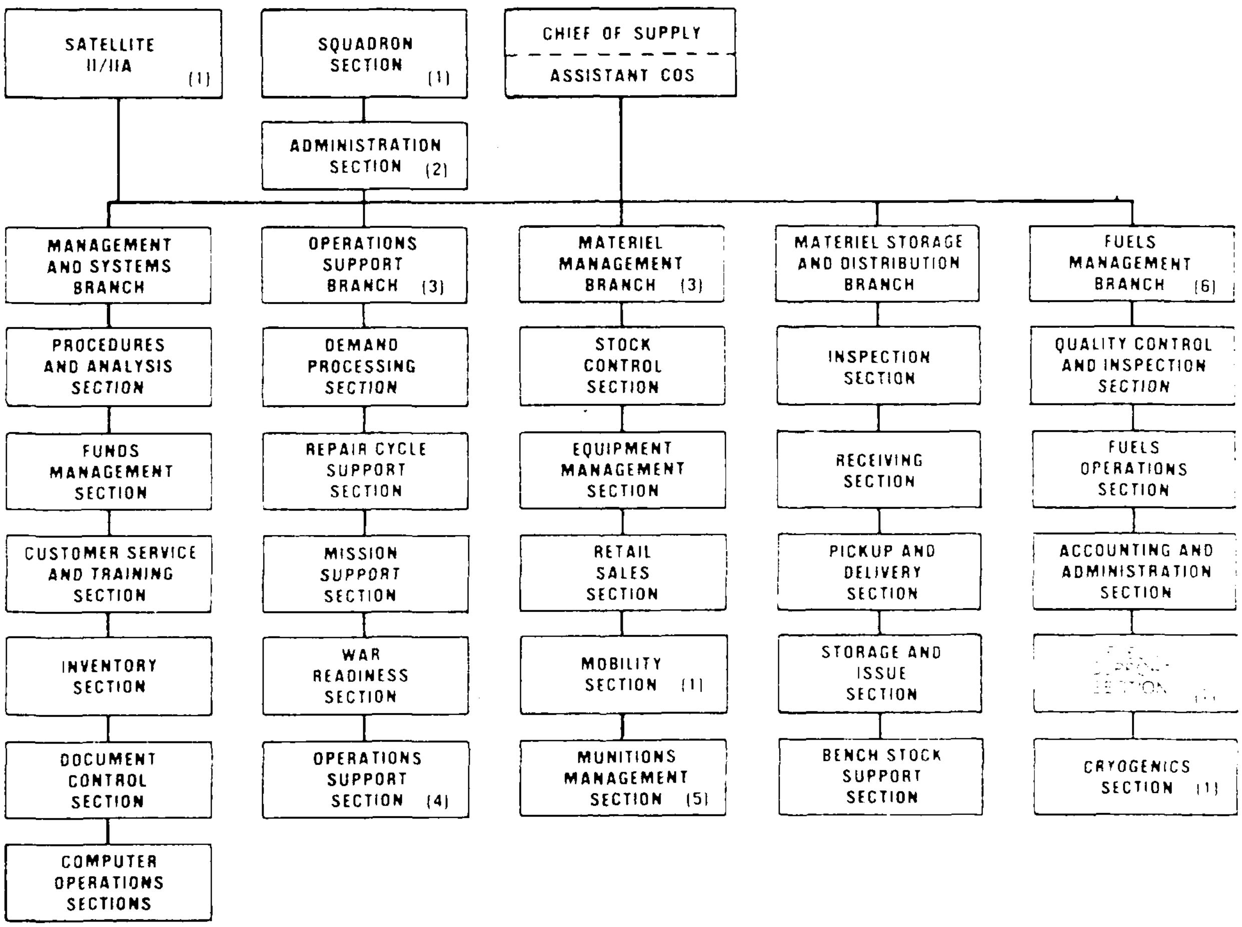

Figure 1

Organizational Structure of Base Supply

The analysis unit is normally tasked by the COS with providing information about how effectively his supply account is being managed. To make this determination, the Analysis Unit gathers data from a variety of sources, including surveillance visit reports, funds management analysis, training reports and the standard computer output provided by the SBSS, particularly the M-32 Monthly Report (AFM 67-1, Ch 2:151). Using a variety of analytical techniques described in the USAF Supply Manual, the unit then synthesizes the data into a form useful to decision makers. The most common method used by the unit to transform data into useful information is trend analysis, which is presented to supply decision makers in a series of "How Goes It?" briefings (Howard, 1983:101). In summary, the Procedures and Analysis Section plays an important part in the ability of the Chief of Supply to make timely and informed decisions. Air Force Manual 67-1, USAF Supply Manual, emphasizes this fact in stating "Supply analysis and (Procedures') surveillance visits are the two most important evaluating activities at the disposal of the COS" (AFM 67-1, Ch 2:151).

Management Reports.

Standard Base Supply System management reports are intended to provide managers with the statistical data necessary for managing an effective supply account (AFM 67-1, Ch 2:135) In all, there are five different types of SBSS reports, classified in terms of how often they are produced, ie, daily, monthly, quarterly, or as required and utility reports.

These reports are normally produced at night, when the SBSS is off line during the "end of day reports mode." A time outside of normal duty hours, when supply activities are at a minimum, is chosen since no transactions can be posted while reports are being generated. Instead, transactions accomplisned during this time are held for posting until the S1100/60 is back online. This process often takes several hours to accomplish, during which time support to customers is severely limited, since personnel cannot access SBSS records (AFLMC Summaries, 1988:88).

Of the more than 80 standard reports produced by the SBSS, the two intended as the primary means by which a supply account is evaluated are the M-32 ("M" for monthly) and D-14 ("D" for daily) Base Supply Management Reports (Howard, 1989). The M-32 is designed "to provide a standard, comprehensive and detailed management product to serve the needs of all Standard Base Supply System Managers,"...and ..."to provide for analysis of the SBSS overall operational effectiveness." (AFM 67-1, Ch 5: 401). The M-32 consists of over ten thousand elements of data divided into twenty-six separate categories. The output of the computer product can exceed over one hundred pages in length.

This report is particularly important to the COS for two reasons. First, a copy of this report is sent to the appropriate MAJCOM, and is the basis on which the supply account is judged and rewarded. Second, several of the data are used by Base Manpower as the criteria by which the organization's manning authorizations are determined (Kenaston, 1989).

The data in the M-32 are an accumulation over the previous month of data found in other standard reports produced on a daily basis. One of these reports is the D-14 Daily Base Supply Management Report, designed to "inform the COS of the effectiveness of the supply account" (AFM 67-1, Ch 5:112). The D-14 represents ten of the twenty-six categories of M-32 data updated by the SBSS program logic, and accounts for almost 8,000 of the 10,000 data elements that comprise the M-32 (AFM 67-1, Ch 5:112). Each data element represents a single variable stored and manipulated by the 1100/60 computer, and is defined on a management report by the intersection of a particular row and column. Those categories common to both reports and the number of individual data elements associated with each category are summarized in Table 1.

TABLE 1

D-14 Daily Report Data Elements

Category	Number of Data Elements
Customer Support Effectiveness	2808
Repair Cycle Asset Control Data	666
Excess Stratification	130
Requisition Summary Supplies/Equipment	144
MICAP Analysis	1076
Due-Out Analysis	1656
Due-Out Cancellation	468
Transaction Summary	480
Retail Outlet Sales/Variance Analysis	81
Supply Performance Measures	402
TOTAL	7911

Copies of the D-14 are sent to the COS and the chiefs of both the Management and Systems Branch and the Operations Support Branch for their review. To be used in conjunction with the M-32, these management reports represent the Standard Base Supply System's solution to meeting the information needs of base supply decision makers.

Decision Support Technology

One of the most exciting developments in computer technology to impact the business world in recent years has been the successful application of what are called decision support systems (DSS). As noted by Sprague, some view this technology as just another in a long line of buzz words that have received undue hype, only to later fall short of expectations and gain disfavor within the business community (Sprague, 1980:21). But most authors on the subject see decision support systems as a viable technology, separate and distinct from electronic data processing (EDP) and management information systems (MIS) with a wide range of applications for the business world (Davis, 1988:12). This section will explore decision support technology, what it is and how it differs from traditional data processing systems. The discussion then turns to the components that make up a typical DSS, and how this technology is being applied to the problems of inventory management. Finally, a brief glimpse into the future of decision support technology is provided.

What are Decision Support Systems?

Over the last twenty years, a number of definitions have been put forth to describe decision support systems. Thus, the concept has evolved over time. One of the earliest definitions put forth by Gorry and Morton describes DSSs as systems designed to support decision making in relatively unstructured problem situations (Gory and Morton, 1971:61). In 1980, the idea was submitted that a decision support system could be defined in terms of its component parts: a data base subsystem, a modeling subsystem and a integrated user interface (Bonczek and others, 1980:342). At the same time, Keen also redefined decision support with the idea that such systems could be described in terms of the process in which they are developed, which he described as adaptive or evolutionary (Keen, 1980:17).

One way to tackle the problem of defining decision support systems is by comparing them to traditional information systems, namely EDP and MIS. Alter, in making a comparison between decision support systems and electronic data processing, notes that whereas EDP is a passive system used by clerks for consistent processing of past data, DSS are active systems used by management for flexible analysis of present and future problems (Alter, 1980:14). Another view differentiates EDP/MIS/DSS in terms of their individual focus: electronic data processing has its focus on data; management information systems have an information focus; and decision support systems are focused on decision making (Sprague, 1980:3,4).

While there exists a wide variety of descriptions for decision support systems, it is helpful to identify a single definition that includes their essential characteristics. One such definition put forth by Sprague and Carlson describe DSS as "interactive computer-based systems that help decision makers utilize data and analysis models to solve unstructured problems" (Sprague and Carlson, 1982:4). Within their definition can be found the three essential DSS components.

Components of a DSS.

Though the terminology varies, the majority of authors agree that there are three basic components of any decision support system (Allen and Emmelhainz, 1984:132). These are a database subsystem, a quantitative modeling subsystem and a user interface that integrates both in a way that allows the user to interact with the DSS. Each of these three components is briefly described in the following discussion.

The database subsystem includes the actual database where data are stored, as well as the facilities to manipulate and upkeep that data (Allen and Emmelhainz, 1984:132). Also important in terms of data maintenance is the data dictionary, which identifies each data element, its purpose, location and other pertinent information (Davis, 1988:85). These data may come from both internal and external sources depending on the needs of the organization. In choosing the data to be included in the database, the developer must limit his choices to a relatively small set of data with which the user can interact

(Sprague, 1980:20). Output from the data base subsystem may become inputs to the second major component of a DSS, the modeling component.

The modeling subsystem permits a manager to make informed decisions about complex problems that would normally be beyond his ability to comprehend (Davis, 1988:111). Large strides have been made in this area over the last twenty years with advancements in quantitative modeling and operations research techniques. This is not to say that all models must involve complex quantitative procedures. Davis defines a spectrum of DSS applications useful in distinguishing the relative capabilities and the intent of different systems (Davis, 1983:13). This spectrum, divided into three bands, ranges from systems with a limited quantitative function such as business graphics, ad-hoc data query and spreadsheet analysis, to those applications which require sophisticated quantitative analysis and complex modeling capabilities such as resource allocations, risk/decision analysis and simulation. However, no matter what the level of sophistication of a DSS's modeling component, the intent should not be to require the user to understand the inner workings of the model (Davis, 1988:16). Rather, the user should be offered a "shell of protection" that allows the non-quantitative user to make quantitative analysis (Davis 1988:111). In order to accomplish this task, the decision support system must include a final component, the user interface.

Crucial to the success of any decision support system is an effective user interface. It is this interface that allows the manager to interact with the DSS. In the past, "the major cause of dissatisfaction among managers wishing to apply decision support has been the absence of truly user-friendly features" (Davis 1988:81). Thus, if a developer expects his decision support system to be used by an organization, the DSS must gain the allegiance of the organization's members by being not only valuable, but simple to use as well (Sprague, 1980:14). This can be accomplished by avoiding technical jargon, and by not relying on lengthy training nor a stack of manuals to "bring the user in line with the needs of the system" (Davis, 1988:93). Helpful in this regard is online assistance in the form of tutor packages and help options.

In the past, attempts have been made to accommodate the potential user's "cognitive style," the systematic way he thinks and solves problems, into the DSS (Mann and others, 1986:2). However, advancements in the technology of both hardware and software have given users the ability to choose from a number of ways to interact with the system (Mann and others 1986:6). Chief among these is the menu tree, a hierarchy of options presented to the user, which can greatly simplify the task of mastering the DSS (Davis, 1988:97). In summary, the designer of the user interface must remember that "the successful DSS must insure that the human side take top priority over all other considerations" (Davis, 1988:93).

DSS in Inventory Management.

Decision support technology is being applied to the problem of inventory management in a variety of ways. The simplest but perhaps most effective examples of this technology are that of ad hoc data base query and business graphics. Positioned on band one of Davis' spectrum of DSS applications, these two tools of the computer age have come to virtually every U.S. industry (Davis, 1988:13). Other, more sophisticated examples of decision support systems in inventory management also exist. Three such applications are described next.

Material/Distribution Requirements Planning: Eli Lilly, the pharmaceutical giant, is finding decision support technology useful in its inventory and production planning (Gordon, 1986:39). The company makes most of its drugs almost from scratch and, perhaps more than any other process industry, the combinations and interdependencies of the various chemicals create a complex system of hierarchies throughout its processing plants. This creates an inventory nightmare, as it has "work-in-process around the world" and various plants depend on one another for operations to continue without interruptions (Gordon, 1986:39).

To deal with the problem, the firm has incorporated a decision support tool that allows managers to make and analyze Material Requirements Planning (MRP) calculations based on the expected availability of materials downstream. Plants are linked via a corporation-wide network of terminals and when a problem arises in one plant, a manager can ascertain what effect the change in his incoming inventory will have on the ability to produce his product. The ability of managers to communicate with other plants, view the status of their inventory, and make appropriate adjustments to their own production schedule has allowed Lilly to reduce the time its work-in-process sits idle by 50% (Gordon, 1986:39).

Forecasting: One of the most important factors in maintaining control of inventory is the ability to accurately forecast end product demand. To help managers accomplish this task, a software package called Logistics*Plus has gained popularity. This system provides "realtime access to data" as well as both reporting features and graphic displays (Fodor, 1987:51). Managers can ask "what if" kinds of questions to assess, for example, the impact that a promotional campaign might have on inventory.

The system does not require the manager to be an expert in forecasting techniques, as it can automatically choose between forecasting models based on the data. On the other hand, managers are able to override the software's choice of a forecasting model. Although costing well into the hundreds of thousands of dollars to bring on line, the makers claim that the system can handle virtually any corporation's forecasting needs (Fodor, 1987:52).

ABC Analysis/EOQ Calculations: Routines have been developed that divide inventory into three classes, based on their annual usage in dollars. Thus a manager can readily determine which items in inventory deserve the most attention, and which can be set on "automatic pilot." Such information allows the manager to make the most of a time constrained workday (King, 1987:6).

Software also exists to assist the manager in determining appropriate order quantities, reorder points and safety stock, based on a specified level of customer service and assumptions of the model. These calculations can be adjusted for each item in inventory if need be, a task that would take considerable time to accomplish manually (King 1987:65).

Decision support systems have been proven to be useful managerial tools in many areas of U.S. industry. And while many applications are currently being used by today's decision makers, several other important new technologies are being applied to the realm of decision support. The next section highlights two of those blossoming technologies, artificial intelligence and expert systems.

The Future of Decision Support.

Advancements in technology often render today's innovations obsolete in a few short years, if not months. An important subfield of computer science setting the pace of software development is that of artificial intelligence (Allen, 1986:3). Artificial intelligence (AI), put simply, is providing computers with the capability to think creatively in a way similar to that of humans (Waterman, 1985:3). This creative thinking, or intelligence, would include an ability to learn from experience and adapt to new situations (Emmelhainz, 1989a).

There is considerable debate, however, as to the current capabilities of artificial intelligence. There are those who would say that AI in its current form has little practical value (Davis, 1988:229). On the other hand, proponents site several useful applications that have been developed for business and industry in the 1980s (Allen 1986:6). Among the most successful software developed to date are those classified into a subfield of artificial intelligence known as expert systems.

Expert systems (ES) are computer programs that attempt to mimic the human expert by drawing on a core of "knowledge" assembled by human experts, and then applying a heuristic approach to solving problems (Allen, 1986:7). The "knowledge" of an expert system in part consists of a series of if-then rules. By applying a number of these rules in a "chain," expert systems are able to achieve a decision making ability that rivals and even exceeds that of human experts (Allen 1986:9; Turban and Watkins, 1985:1).

How then are expert systems related to decision support systems? Their relationship can best be explored by examining some of their differences (Turban and Watkins, 1985:3). For instance, while the objective of a DSS is to assist human decision making, an expert system attempts to mimic and replace human experts; with a DSS, the user asks questions of the machine, while in an expert system the computer queries the user; perhaps most importantly, whereas in the case of a decision support system it is the user who makes the decision, in an ES it is the system itself that determines the best course of action. In light of these differences, it may be best to view expert systems as the expert component of a DSS, rather than decision support systems in and of themselves (Turban and Watkins, 1985:5).

No matter how one places expert systems in the overall context of decision support, most would agree that ES technology will play an increasing role as a tool of the decision maker. Such confidence is based on the fact that the investment in the AI market has increased almost six fold in five years, and is expected to reach a total of over four billion dollars by 1990 (Davis, 1988:229). However, it should be emphasized that the ultimate success of expert systems in the business community depends upon the focus of future research. As with decision support systems, ES research "must be aimed at satisfying the true needs of managers, and not merely for the sake of research itself" (Davis, 1988:230).

Chapter Summary

A review of AFM 67-1, the USAF Supply Manual, was used to determine what are the "true needs" of base supply managers. A study of the literature concerning decision support technology provided insight into how those needs might be met in a microcomputer-based DSS. With the knowledge gained through this literature review, the researcher was able to address the objective of this study, that of transforming daily SBSS data into information useful to supply managers. The methodology used to accomplish this objective is described next.

III. *Methodology*

Overview

The purpose of this chapter is to describe the methodology used in answering the four research questions and accomplishing the research objective presented in Chapter One. This methodology consisted of two distinct phases. Phase I was used to answer the first three questions and involved the systematic development of a decision support system designed to meet the daily information needs of base supply managers. Phase II was used to answer research question four and involved an evaluation of the system based on its ability to meet those information needs as compared to more traditional supply analysis methods. Both of these phases are described in the following discussion.

Phase I System Development

The Modular Approach.

A common problem in the design of information systems, and one which has often lead to a software application's eventual failure, is the inability to deal with complexity (Blokdijk, 1987:21). In effect, systems designers have attempted to "bite off more than they could chew." The result was a system that was too difficult for users to learn, yet just as difficult for designers to modify. To avoid the pitfalls associated with building too complex a management tool, the trend in DSS development is to build separate modules, each module designed to tackle a small but significant area of concern (Hafner, 1986:12). Such a module is referred to as a specific DSS, in that it allows the "decision maker"..."to deal with a specific set of related problems" (Sprague, 1980:12). A specific DSS, linked together with other modules in a hierarchy of interrelated subsystems, provides an overall tool with which management can make decisions (Emmelhainz, 1989b).

The modular, building block approach to overall systems design is that originally proposed by an Air Force Logistics Management Center report entitled "An Improved Management Information System for Chiefs of Supply," and is currently being used by the Center in their efforts to automate various supply functions (Rhodey, 1984:4). Due largely to limitations in the ability to interface with the 1100/60 mainframe computer, microcomputer software development to date has not resulted in any single, integrated, comprehensive decision support system for base supply; however, the building blocks for such a system are being created one module at a time, waiting for when the Standard Systems Center (SSC) is able to develop the software which cements them together.

The modular approach to DSS development provided the underlying strategy in choosing to automate the D-14. Developing a microcomputer-based DSS for daily management analysis represented a relatively limited, and therefore manageable, project. But at the same time, the potential benefits in terms of enhanced managerial decision making to be gained from such a system were considered significant. In addition, this application fits well with the other software projects currently under development by the AFLMC, especially the Supply Management Analysis (SMA) program, designed to automate the monthly analysis of the M-32 report.

DSS Development as an Iterative Process.

As Sprague suggests, the traditional life cycle approach to systems development is inappropriate to the design of decision support systems (Sprague, 1980:10). This is because no one, including those for whom the system is intended, fully knows what future problems and decisions they will face. To deal with the problem of loosely defined user requirements, decision support systems are being designed using what has been described as an adaptive or evolutionary approach (Alavi, 1984:2). In this approach, the designer, working closely with the end users, builds a portion of the overall module a piece at a time. The product is then evaluated, and changes, based on the user's recommendations, are incorporated into the system. This process is repeated in a series of iterations until a viable product emerges that effectively tackles the original problem or need.

As identified by Sprague, each iteration involves, to varying degrees, four steps: analysis, design, construction, and implementation (Sprague, 1980:10). These steps are not discrete, but rather overlap with one another throughout system development. In creating a DSS for daily supply management analysis, an adaptation to this methodology put forth by Davis was used (Davis, 1980:170). His steps involve 1) An Organizational Survey, to "gain a feel" for the scope of the problem and its environment; 2) Requirements Definition, to include the modeling of information needs; 3) Systems Development, or applying the the area of concern to a specific software application; and 4) Implementation, which puts the developed DSS to work work in the organization. These four steps, as they applied to each iteration in the development of an automated D-14 decision support system, are described in the sections that follow. An overview of how these steps proceeded during system development is provided in Figure 2.

First Iteration.

Step One: Organizational Survey.

An organizational survey is conducted by the developer of a DSS to familiarize himself with the organization and those problems that confront it. Not necessarily a formal survey instrument or questionaire, its primary purpose in the first iteration is to determine the appropriateness of DSS technology to the situation and to access the chances for successful implementation (Davis, 1988:171). The developer should seek answers to the following questions: Who will be the actual users of the system? How are decisions made in the organization? What is the scope and complexity of the problem? What hardware and software are appropriate to the situation? What resources will be required to implement a successful system? How user friendly must the system be in order to be accepted into the organization?

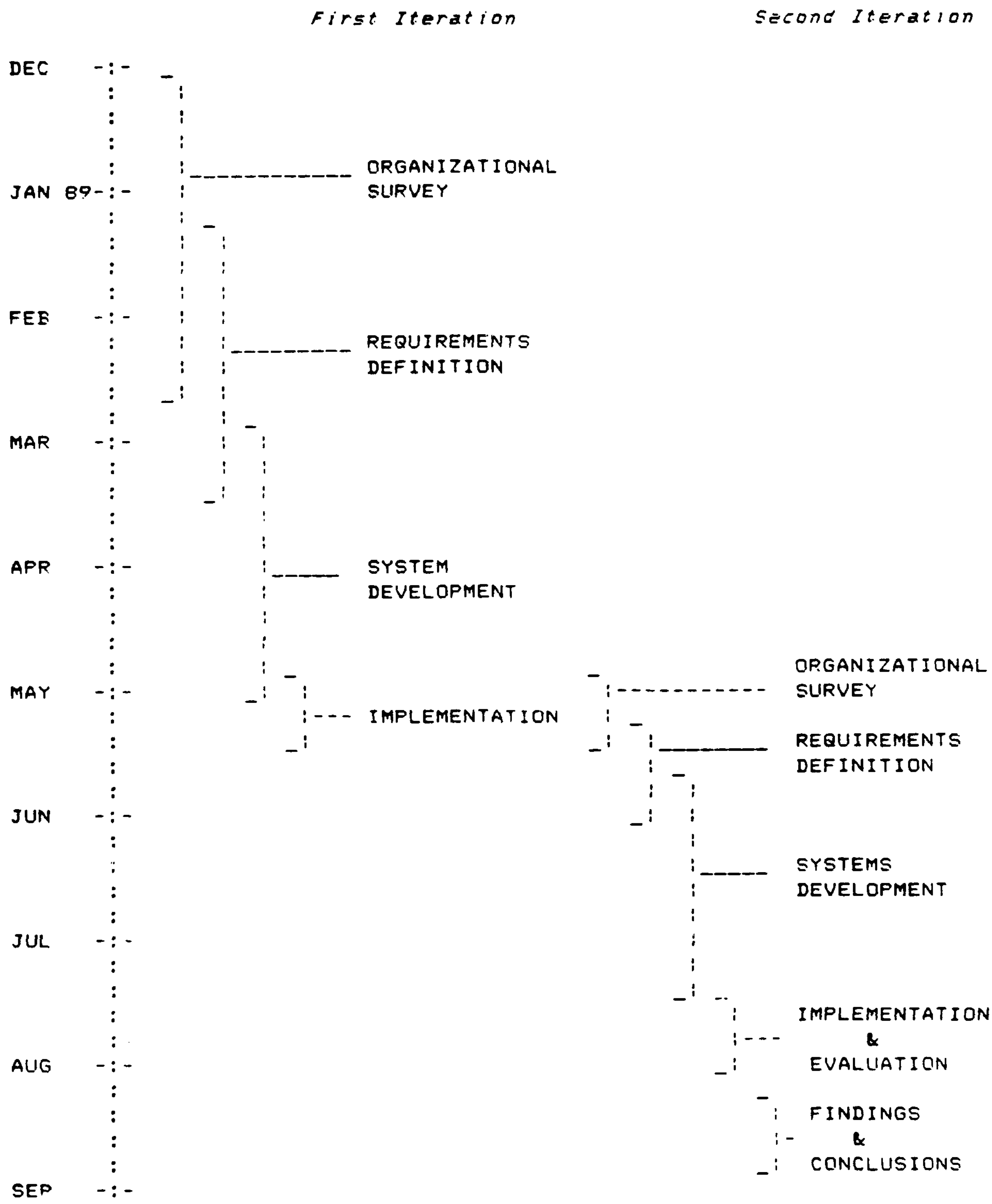

Figure 2

Systems Development Timeline

To answer these questions, a review of applicable literature of the Air Force Standard Base Supply System and decision support system design was accomplished. This review included Air Force Regulations, Manuals and Pamphlets; reports and articles published by the Air Force Logistics Management Center (AFLMC), Air University and Tactical Air Command; previous AFIT thesis research; and journal articles and books concerning decision support system technology.

In addition both telephone and personal interviews were conducted with experienced supply personnel assigned to the AFLMC. These interviews laid the foundation for the direction which the research ultimately proceeded. In fact, it was during a visit to the Center when the need for an automated version of the D-14 was first identified.

STEP TWO: Requirements Definition.

In this step, Davis recommends what he refers to as a "stratified input/output" approach, in which the DSS developer determines how "data is gathered, entered into a storage medium (like a computer), manipulated, and output into a form that can be used by management" (Davis, 1988:173). This complex flow of information is then broken down into manageable components which can be viewed as a hierarchy of information requirements, each level focusing on greater amounts of detail. In using this "divide and conquer" approach, the designer should attempt to answer the following questions: What do the end users consider to be "must have" information? What do they feel is "nice to know" information? What types of "what if" questions arise most often in the organization? How often is the information used? How quickly are answers to questions needed? What level of detail is required? How much value is placed on both the precision and reliability of information generated by the system?

This second step was particularly well suited to the development of a decision support system for daily management of base supply accounts, since the input/output of data is already defined and documented in Standard Base Supply System (SBSS) procedures. Thus, one of the most difficult and time consuming aspects of DSS development had already been dealt with. This allowed the researcher to quickly begin answering the questions proposed by Davis.

Those answers, directly applicable to the first two research questions proposed in chapter one, were obtained in four ways. First, a study was made of the data contained in actual D-14 and M-32 reports obtained from the 2750 ABW Logistics Squadron at Wright Patterson AFB. An understanding of the data elements contained in those reports was made possible by referring to their descriptions in Air Force Manual 67-1, "USAF Supply Manual," Vol II, Part II, Chapter 5. Second, as summarized in Chapter Four, previous research conducted to determine the information needs of base supply managers was reviewed. Third, software already developed by the AFLMC (ie, Supply Management Analysis, Inventory Analysis Program, and Equipment Management Information System) were loaded, run and analyzed to gain a perspective on the Center's software applications. And fourth, interviews were conducted with individuals assigned to the Procedures and Analysis Branch of the 2750 ABW Logistics Squadron and the Springfield, Ohio Air National Guard using guidelines recommended by Emory in *Business Research Methods* (Emory, 1985:160-169). The actual questions used in structuring the interviews can be found in Appendix B.

From these four sources emerged the hierarchy of information needs described by Davis. This hierarchy, with its varying degrees of detail at each level, provided the framework around which a menu driven software application was developed.

STEP THREE: Systems Development.

In this step, the answers to the questions asked in the organizational survey and requirements definition steps are translated into computer code. Though the terminology varies, the majority of authors of DSS technology agree that there are three basic components of any decision support system (Allen and Emmelhainz, 1984:132). These are a data base subsystem, a quantitative modeling subsystem, and a user interface that integrates both in a way that allows the user to interact with the system. It is up to the developer, based on inputs from those for whom the system is intended, to decide how these three components will be brought together in their DSS.

There are three basic alternatives available to the DSS developer to choose from (Davis, 1988:172). First, he may decide to use an "off-the-shelf" DSS software application. This approach is usually the least costly and least time consuming of the three; however, such software is generally intended for more generic problem solving situations. In many cases, a "ready-to-go" package is appropriate, providing its capabilities are designed to meet the organization's information and problem solving needs.

Second, the developer may choose to patch together the three DSS components from separate software packages, such as database management systems, spreadsheets, statistical packages, and simulation environments. This approach can yield excellent results; however, unless the separate components are carefully integrated, the DSS will be unuseable. Although individual components may each operate properly, linking them together with an integrated user interface may produce "weird results" (Davis, 1988:164). Care must be taken up front to choose component software packages that can be mated with the other systems.

Third, the developer may decide to build the total decision support system from scratch. This is by far the most expensive and time consuming approach to software development, and should be considered as a last resort (Davis, 1988:164). Sometimes such an approach is necessary if the ultimate requirements of the desired DSS preclude the use of existing software. However, managers desiring such an approach must realize that it violates the fundamental tenets of a modular design and rapid feedback from end users normally associated with most successful DSS applications.

In applying these three strategies of software development to the task of building a DSS for daily management of base supply accounts, it was decided to go with the second, or patchwork approach. Using an "off-the-shelf" package was considered inappropriate, since these applications are intended for only very general problem solving situations, and usually those associated with the financial needs of corporations. The problems faced by supply managers and the data provided by the 1100/60 mainframe computer in the D-14 daily report are, on the other hand, unique to the SBSS. Likewise, building a DSS from scratch was quickly rejected, since this would involve major reprogramming to the SBSS software, which by regulation can only be accomplished by the Standard Systems Center at Gunter AFB, AL (AFM 67-1, Ch 1:41).

The patchwork approach, however, was deemed extremely appropriate to the automation of the D-14, especially in light of the LMC's current software development efforts. All work to date to automate various supply functions have been accomplished using the DBASE III PLUS Data Management System from Ashton Tate. This software package was chosen over four others based on five criterion in the software selection of the Center's Equipment Management Information System (Bailey, 1988:48). In fact, in order to standardize future software development throughout the Air Force SBSS, the Center has recommended that some version of DBASE III be used as the database management system for any future applications. (Howard, 1989).

Although not specifically recommended by the LMC for Air Force supply applications, it was decided that the QUATTRO Spreadsheet from Borland would be used as the modeling component of this DSS. QUATTRO was chosen because of its excellent graphics capability, as well as its ability to import/export data to and from DBASE III. In fact, QUATTRO was rated superior to ten other spreadsheets by over 1000 respondents of a survey conducted by *Government Computer News* (Danca, 1989:1, 16). Respondents rated QUATTRO number one in the top five attributes they considered most valuable in a spreadsheet. Finally, both DBASE III PLUS and QUATTRO are capable of being programed in ways that allow the user to be guided along and tutored by the application in a series of user friendly, pop-up menus.

As Davis points out, there were risks involved in taking this approach because of the possibility of not being able to combine the two components into a single integrated user interface. However, it was decided that any problems could eventually be overcome and the potential benefits to be gained from the system were worth the risk.

STEP FOUR: Implementation.

Implementation in the usual sense of normal software development is somewhat of a misnomer when applied to decision support technology. In the traditional approach, implementation often meant providing the first draft of a software application as a more or less final version to the entire organization. However, irreparable damage was often done to the user's willingness to accept the system as inevitable problems occurred and users became disenchanted with its potential capabilities. (Davis, 1988:184).

This has become the reasoning behind the iterative, or evolutionary approach to DSS development. In fact, the distinction between a decision support system and traditional management information systems is as much due to the process in which each is developed as it is their differences in capabilities (Keen, 1980:15).

The first iteration of a DSS, which Davis refers to as a prototype version, is therefore used to "test the water early to sound out major problems"..."and minimize the damage to future user acceptance when problems occur" (Davis, 1988:184). In the decision support system of D-14 management this prototyping was done at the supply organizations at Wright Patterson AFB and the Springfield, Ohio Air National Guard.

Second Iteration.

STEP ONE: Organizational Survey.

The second organizational survey was conducted concurrently with the implementation step of the first iteration. The primary intent of the survey at this point was to obtain feedback from supply personnel concerning the software as it existed at that time. While there was still a significant amount of work to be accomplished in terms of programming, enough had been accomplished to give end users a good idea of the system's capabilities. Generally speaking, the feedback was favorable. The ability to automatically scan SBSS output, a feature incorporated into the program, was particularly welcomed.

At the same time, several suggestions were made to improve the decision support system. In the case of the user interface, supply personnel suggested ways to clarify exactly what the system expected when prompting the user for inputs. In addition, in the course of explaining how the application makes it prediction of potential M-32 values, (another capability included in the program) it was discovered that a mistake was made in the prediction algorithm. These modifications were easily incorporated into the programming of the system's software.

In spite of the generally favorable response to the potential benefits that the DSS might provide, there was, however, some skepticism as to whether or not any computer program, no matter how sophisticated or user-friendly, could induce base supply personnel to examine SBSS data on a daily basis. It was simply not something they were normally accustomed to doing because of the time constraints they are under. Their comments underscored the need for speed and simplicity as the primary qualities to be incorporated into a final version of the application. Their comments also provided a significant challenge as the software progressed towards a fully operational decision support system that could be used as an effective base supply management analysis tool.

STEP TWO: Requirements Definition.

Modifications to the data to be incorporated into the software were made in conjunction with the other changes suggested during the second organizational survey. The only major alteration to the database structure was the elimination of two general categories of data that were originally intended to be included into the database subsystem. These two categories, not actually part of the standard D-14 output, were to be "Workload Factors that Determine Manning Authorizations" and "Criteria by Which the USAF Supply Effectiveness Award is Determined."

Although conversations with supply personnel indicated that the addition of these categories would provide a convenient means of reviewing two important areas of general supply concern, there were problems associated with incorporating them into the system's database. Foremost among these was the inability to automatically download/upload such data from the 1100/60 mainframe. Several of the data in both categories are actually formulas made up of other data. This would mean that the time to download the data from the mainframe onto a floppy disk and then upload the disk into the application's database would be significantly increased, if it could be done at all. In fact, some of the formulas are based on data not contained in the D-14 Daily Report, and would therefore require a manual update. Finally, the formulas used to compute data in both categories tend to change over time based on Air Force policy changes. Trying to keep up with these changes Air Force wide that each supply account's software reflected the new policy would be a time consuming process. It was decided that the simplest and safest route to take would be to eliminate these categories of data altogether, especially in light of the comments made about a need for a quickly executing program.

Another suggestion was made to offer end users the capability to choose their own D-14 data elements of interest. Such a capability would significantly increase the system's flexibility, that is its ability to grow and evolve with the organization over time. Flexibility is an important aspect of any decision support system, and one that must be considered to avoid early obsolescence (Davis, 1988:103). There is, however, a tradeoff to flexibility that is also important. This is the overall complexity of the application. Including the ability for supply analysts to modify the structure of the software's database would require a significant increase in the application's overall complexity, as well as an increase in the time required to learn the the system. Based on supply personnel comments about the need for easy to use software, it was decided to continue with a simpler, though less flexible decision support system.

STEP THREE: Systems Development.

Systems development continued using the patchwork approach decided upon during the first iteration. The problem of combining two major software applications into a single integrated package was overcome using the programming language available in MS-DOS, the operating system of the Zenith Z-248. In addition, end user recommendations expressed during the the first two steps of the second iteration were incorporated into the DBASE3+ programming of the decision support system.

STEP FOUR: Implementation.

Davis refers to implementation during the second iteration of systems development as a "pilot operation," in which the system is exposed to the real world (Davis, 1988:185). A pilot operation assumes that major "bugs" have been worked out of the program, and the decision support system is now ready for fine tuning. A successful pilot operation sets the stage for the system's "full scale implementation" (Davis, 1988:185).

This pilot operation was conducted at six Air Force bases in the Eastern United States. The location and Major Command of those bases can be found in Appendix A. Implementation during the second phase was accomplished in conjunction with a formal evaluation of the system by supply personnel assigned to those six organizations. Details of the methodology used in that evaluation are presented in the following section.

PHASE TWO: System Evaluation

This phase, conducted at the end of the second iteration, was used to answer research question four. This question asked, "Would a decision support system, applied to the problem of daily management control, provide a more efficient and effective means of managing a base supply account on a daily basis than is possible under the present system?"

Historically, organizations have not attempted to formally measure the costs versus the benefits of implementing DSS technology (Keen, 1981:2). In addition, they have rarely attempted to measure increases in productivity resulting from a new decision support system. One study found that only six percent of those firms incorporating DSS technology into their organization ever tried to determine its financial impact after becoming operational. (Hogue, 1983:21).

This apparent lack of interest is really based on two inherent characteristics of decision support systems. First, they often provide benefits that are qualitative rather than quantitative. This makes formal measurement impractical. Such benefits are described by users as "the ability to examine more alternatives, the stimulation of new ideas, and improved communication of analysis" (Keen, 1981:2). Second, as noted throughout this chapter, the best decision support systems evolve and grow over time, and so picking a point at which to evaluate the system is difficult.

Nevertheless, this research included an evaluation of the system as it existed at the end of the second iteration. This was considered possible, since, relatively speaking, this DSS was designed to address a more structured problem solving environment. In addition, exposing the application to a number of organizations in a formal test situation set the stage for future iterations which the AFLMC could conduct once the software is turned over to them (Howard, 1989). The purpose of this evaluation was two fold. First, it was used to determine whether or not appropriate SBSS data were identified in the process of answering research question one. Second, it provided the means by which a comparison with traditional supply analysis methods could be made.

The ten major categories of data contained in the D-14 daily report and updated each month in the M-32 are identified in AFM 67-1 Vol II, Part Two, Chapter 5, and consist of the following:

1. Customer Support Effectiveness
2. Repair Cycle Asset Control Data
3. Excess Stratification
4. Requisition Summary Supplies/Equipment
5. MICAP analysis
6. Due-Out Analysis
7. Due-Out Cancellation
8. Transaction Summary
9. Sales Variance Analysis Retail Outlet
10. Supply Performance Measures

Using the D-14 as a guide, base supply decision makers were asked to identify the specific elements of SBSS data which are used by their organization as management indicators in determining the health of their account. Their responses were then compared to the actual data incorporated into the database of the software application as it existed at the end of the second iteration. The ratio of raw data requirements met by this decision support system to that of the organization's total data requirements provided an approximate measure of this study's relative success in identifying those elements of SBSS data that are important to base supply organizations.

To compare the usefulness of this decision support system to that of traditional base supply management analysis methods, personnel assigned to the Procedures and Analysis Section of the various organizations were asked to identify supply analysis tasks that they currently perform or would like to perform on SBSS data. To make the comparison possible, the data that could be chosen were restricted to any four of the 181 data elements incorporated into the software application's database. The analysis on each task was then performed in two ways; on one hand using the more traditional analysis methods, and on the other using the D-14 decision support system. Initially, this methodology proposed that the participants would actually perform the chosen analysis using both methods; however, it soon became apparent during the course of the evaluation that in many cases this would require more time and effort than could realistically be asked of them. In those cases where the time required to complete a particular analysis task using traditional methods was deemed to be excessive, the individual participating in the research was asked only to provide an estimate of the minimum time that would be required to complete such an analysis. A comparison was then made based on both the relative efficiency and effectiveness of the two methods.

Efficiency is defined in Webster's dictionary as "the easy and quick production of desired results" (Webster's revised edition, 1987:99). Similarly, the Standard Encyclopedic Dictionary defines efficiency as "the production of results with a minimum of wasted effort." (Funk & Wagnals, 1975:203). A common definition of efficiency often cited in textbooks is output divided by input. For the purposes of this study, efficiency was measured by the amount of time required by an individual to complete a supply analysis task to their satisfaction. That is to say, the less time it took to perform a particular supply analysis task, the more efficiently that task was performed.

To compare the relative efficiency of both methods of analyzing D-14 data, either the paired difference t-test or the Wilcoxon signed-rank test was used. These statistical tests for analyzing paired data are used when "each measurement in one sample is matched or paired with a particular measurement in the other sample" (Ott, 1988:194). The distinction between the two is in the assumption that the population of differences between the paired data is normally distributed. If this assumption is met, then the more rigorous, parametric paired difference t-test can be used. If normality of population differences cannot be assumed, then the nonparametric Wilcoxon signed-rank test must be used.

In this analysis, the time required for an individual to complete a base supply management analysis task using traditional analysis methods was compared to that individual's time to complete the same task using the decision support system. For the variable under investigation, i.e. task completion time, two separate tests were conducted to determine whether the sample differences could be assumed to have come from a normal distribution, namely the Lilliefor's, and Shapiro-Wilkes tests. This information was used to determine whether or not the paired difference t-test could be applied in the comparisons. The formal test procedures for both statistical tests at the .05 confidence level are summarized here:

Paired Difference t-Test

where ud = difference between mean task completion times
u1 = mean of task completion times using DSS
u2 = mean of completion times using traditional methods

Ho: ud = u1-u2=0 *(No difference between completion times)*
Ha: ud < 0 *(Time to complete task smaller for DSS)*

Test Statistic: t = (d - Do)/(Sd/n)

Reject Region: Reject Ho if t < t crit (alpha = .05)

Wilcoxon Signed Rank Test

where n = # of paired observations with nonzero difference
T+ = Sum of positive ranks; if none, then T+ = 0
T- = Sum of negative ranks; if none, then T- = 0
T = Smaller of T+ and T-, ignoring their signs

Ho: The two populations are identical
Ha: Completion times using DSS smaller than when not

Test Statistic: Since n < 50, T = |T-|

Reject Region: For one tailed test of alpha = .05, n = 9,
reject Ho if T < T crit

In addition to determining the relative efficiency of the D-14 DSS over traditional management analysis methods, an attempt was made to measure its effectiveness as well. While a number of definitions for decision support systems can be found in the literature, they all emphasize, either implicitly or explicitly, that a DSS should aid managers in making more effective decisions (Allen and Emmelhainz, 1984:129). While this may be true, the question of what is meant by "more effective decisions" remains. Effective is defined as "the ability to produce a desired result" or "producing or adapted to produce the proper result" (Webster's Revised Edition, 1987:99; Funk and Wagnals, 1975:202). In the context of base supply managerial decision making, a decision support system might be considered to be a more effective analysis tool if it improves the manager's ability to make useful, relevant and error free decisions. This is how "effective" was defined in the context of this study.

In order to make an objective measurement of what is inherently a subjective and somewhat nebulous concept, a single question, structured in terms of the Likert seven point scale, was asked of the supply personnel who were exposed to the DSS. The question was:

How would you rate the effectiveness of this software as a way to analyze your supply account on a daily basis as compared to more traditional analysis methods? Assume effectiveness to be defined as the ability to make useful, relevant and error free decisions and that your current analysis methods would merit a value of four. Please circle one number.

```
Software                  No difference in                   Software
 is much                    effectiveness                    is much
  less                   between software &                    more
effective               traditional methods                 effective
    +--------+--------+--------+--------+--------+--------+
    1        2        3        4        5        6        7
```

In using the Likert scale to measure relative effectiveness, the mean rating of traditional supply analysis methods is by default assumed to be four (Emory, 1985:255-258). This value was compared to the effectiveness rating given to the D-14 decision support system by applying the same statistical test used in the comparison of relative efficiency. The assumption of normality of population differences was again tested to see whether the more rigorous paired difference t-test could be used over the Wilcoxon signed rank test.

Finally, any evaluation of a decision support system would be incomplete without providing the end users a chance to express their opinions. Supply personnel who participated in the formal evaluation were also asked to critique the DSS. Their critiques, summarized in Appendix C, will provide the basis for future iterations of the system when it is turned over to the Logistics Management Center (Howard, 1989).

Chapter Summary

The preceding discussion described the iterative, four-step methodology used in the systematic development of a decision support system designed to meet the daily information needs of base supply decision makers. This methodology also included a formal evaluation of the DSS as it existed at the end of the second iteration of systems development. The results of this methodology as they apply to the four research questions proposed by this study are presented next in Chapter IV.

IV. *Findings and Discussion*

Overview

The purpose of this chapter is to present the findings of this study as they apply to the four research questions presented in chapter one. By way of review, those questions were:

1. What specific elements of data contained in the D-14 Daily Report are most important in maintaining an effective supply account?

2. What kinds of analysis might be possible and beneficial for base supply managers to perform on data contained in the D-14?

3. Do the problems and decisions faced by base supply managers today lend themselves to microcomputer-based decision support technology?

4. Would a decision support system, applied to the problem of daily management control, provide a more efficient and effective means of managing a base supply account on a daily basis than is possible under the present system?

Answers to the first two research questions resulted in a hierarchy of base supply information needs similar to that described by Davis (Davis, 1988:173). This hierarchy provided the framework around which a menu driven decision support system was developed. This DSS, dubbed the Daily Management Analysis program (DMA), was produced in answer to research question three. Finally, to answer research question four, DMA's performance as a means of analyzing D-14 data was evaluated in comparison to traditional methods. These four research questions and their answers are contained in the discussion that follows.

Research Question One

What specific elements of data contained in the D-14 Daily Report are most important in maintaining an effective supply account?

Summary of Previous Research.

A considerable amount of research has been accomplished in the past addressing this very question. These studies have each resulted in a list of those data elements which were found to be important to base supply decision makers as indicators of how well their accounts are being managed. While making direct comparisons of these studies to one another is difficult because of the specific purpose behind each study, the format in which the results are presented, and the evolving nature of the Standard Base Supply System (SBSS), a common pattern of management indicators important to base supply decision makers does emerge. The following section summarizes these studies in terms of their purpose, scope, methodology and conclusions.

1. *Quantitative Tools for the Logistics Manager* (Kirk, Jenson and Jackson, 1980, ch 1:1-15). Although not a research study per se, this report, compiled by three faculty members of the Air Force Institute of Technology with experience in base supply, provides insight into how supply accounts can be effectively managed. In their analysis, they identified ten categories of "management indicators" supplied by the SBSS in its standard reports, and how each indicator can be used by base supply decision makers in managing their accounts. Their

discussion includes five of the ten categories of data contained in the D-14 Daily Management Report, and describes how the data are calculated, how they are used, and actions that can be taken to reverse an unfavorable trend.

2. *Analysis and Use of Air Force Base Level Supply Management Indicators* (Greer and Moon, 1981). The objective of this research was to develop a handbook for new supply officers that identifies and explains common management indicators and describes how these indicators should be used in the analysis of a supply account (Greer and Moon, 1981:7). Information was gathered from four Air Force Major Commands as well as the data bank of the Air Force Standard Systems Center to determine "common management indicators" (Greer and Moon, 1981:20). Twenty-nine management indicators were identified and grouped among six categories (Greer and Moon, 1981:143-157). Of the twenty-nine management indicators determined to be most important to the four MAJCOMS, at least fifteen are represented by data contained in the D-14 Daily Management Report.

3. *Testing the Representativeness of the Supply Data Bank* (Andrews and Gentner, 1983). The purpose of this project was to determine if the twelve Air Force Bases whose data are stored in the Air Force Supply Data Bank are representative of the supply system as a whole. In order to make this determination, the authors performed "discussions and interviews with personnel knowledgeable in the SBSS" to create a list of "supply test variables with which they could make their analysis" (Andrews

and Gentner, 1983:e-5). These variables, derived from data contained in the monthly M-32 report, were "chosen so that the important base supply characteristics are captured." (Andrews and Gentner, 1983:e-5). In their search for appropriate supply test variables, they identified 78 areas of data which were considered important. Of these 78 subcategories, at least 32 are captured on a daily basis by the D-14.

4. *An Improved Management Information System for Chiefs of Supply* (Rhodey, 1984). This report was among the first to propose a modular, user oriented Management Information System (MIS) for supply decision makers. The data to be used in the MIS proposed by the author is based on the 78 areas of data identified by Andrews and Genter in the report described above. Although no distinct research into the information needs of base supply was performed, this study represents a strong vote of confidence by the experienced supply personnel of the LMC for the conclusions reached in *Testing the Representativeness of the Supply Data Bank*. By further subdivision of the data identified in that report, and by the inclusion of additional data elements recommended by the LMC, a total of 108 subcategories were identified as being important to the Chief of Supply. Of these, no fewer than 45 are included in the D-14 daily report.

5. *Developing a Management Information System for the Chief of Supply* (Stevens, 1985). The objective of this research was "to determine what types of information the COS needs to effectively operate a supply account" (Stevens, 1985:8). To accomplish

this, the author conducted structured telephone interviews with thirty Air Force Chiefs of Supply. His analysis identified a total of 69 areas of data valuable to supply decision makers (Stevens, 1985:27). Of these, 23 are available through the SBSS in the D-14.

6. *Base-Level Supply Analysis Program* (Hargrave and Others, 1985). This project represents an initial attempt by the Air Force Logistics Management Center to automate analysis of the M-32 using the Zenith Z-100 microcomputer. This software is capable of manipulating M-32 data and displaying it both in a tabular format and as a graph, much the same way that DMA is designed to do. However, BLSA has not gained wide spread acceptance throughout the base supply system due to its dependence on the skill of the user in programming in CP/M, the operating system of the Z-100 microcomputer (BLSA Program Report, 1985:5; Bailey, 1989). Nevertheless, this project set the stage for additional efforts in automating SBSS data analysis, as well as identifying a list of 115 key elements of data contained in the M-32 report (Hargrave and others,1985:12-15). Of these, 54 are also found in the D-14.

Summary of Personal Interviews.

In the course of designing a DSS to meet daily base supply information needs, interviews were conducted with 19 experienced supply personnel to gain a deeper understanding of supply management analysis that is possible only through face to face discussion. The individuals who participated in the interviews, their position at their present duty station, and their years of supply experience are contained in Appendix A. The questionaire used to structure the interviews is contained in Appendix B. The following section represents a synthesis of those opinions that were expressed by the majority of supply personnel.

The consensus of views about which data elements are important to base supply managers was generally consistent with the conclusions reached in the studies just described. That is to say, supply personnel were in general agreement with the choices of important management indicators suggested by the studies. In addition, advice was offered as to how the number of data elements incorporated into DMA could be kept to the minimum necessary to meet base supply information requirements. For example, although the D-14 and M-32 are arranged in rows and columns that provide a breakdown of categories into very specific elements, in many cases managers are only interested in row/column totals. In most categories an "overall summary" is provided that combines the values of several sub-categories, and it is this summary which supply analysts review. Other data provide a break down of the service provided by each of the five Air Force Air Logistics Centers (ALC). While these data may be important at the MAJCOM level or higher, they have little relevance to managers of base supply accounts.

The majority of supply analysts agree that information regarding the status of manning authorizations is important to their organization. In particular, the Supply Record Count of the M-32 and the Transaction Summary of the D-14/M-32 are of interest to base supply managers because of their impact on manpower. Also important are those data by which supply accounts are evaluated, although in most cases the criteria vary according to the MAJCOM to which the organization belong.

Perhaps most importantly, interviews with base supply personnel revealed that if their accounts are to be monitored on a daily basis, the overriding consideration is that the task be accomplished as quickly and efficiently as possible. This was an important factor in designing a decision support system for daily supply in terms of the number of data elements to be included in the application. In order for DMA to be an effective tool, data must be extracted from the 1100/60 each day before their values are updated by SBSS program logic. It is estimated that a complete download of all 8000 data elements contained in the D-14 to a floppy disk would require in excess of thirty minutes to complete. It is u likely that any supply analyst could afford that amount of time each day for the task. Thus, it became apparent that in order for this software application to be useful as a base supply management analysis tool, the number of data elements to be included in the database had to be restricted to at most a few hundred.

Finally, an important factor emerged from the discussions that was not readily evident from previous research. This was the importance of the Chief of Supply (COS) as the driving factor behind an organization's information requirements.

A detailed analysis of the supply account is the responsibility of the Procedures and Analysis Section. However, it is the COS who determines what areas of the account will receive special attention. Thus, information requirements vary depending on the background, personality and managerial style of the COS. For instance, a COS with experience at TAC training bases may emphasize MICAP analysis (which indicates whether or not aircraft are grounded due to a lack of parts) even if the mission of his current assignment has little to due with the operational readiness of a major weapon system. Likewise, a COS with a background in Air Force Logistics Command may emphasize repair cycle asset control data throughout his career.

The importance of the Chief of Supply in determining the information requirements of a particular supply organization had a significant impact on the number of data elements included in this software application. The need to satisfy a wide variety of COS information preferences led to a system with more than the 40 to 100 variables mentioned by Sprague, though significantly less than the total number of data elements contained in the D-14 (Sprague, 1980:20). The goal lay in developing a system capable of meeting a wide variety of possible information requests, while ensuring the application did not degenerate into simple data automation (Rhodey, 1984:2). While it is unlikely that any one supply account will analyze all the data possible with DMA, the objective of DMA was for the majority of information needs of most organizations to be satisfied by the selection offered in this Decision Support System.

Hierarchy of Supply Information Needs.

The results of the previous discussion yielded a hierarchy of base supply information needs similar to that described by Davis (Davis, 1988:173). It was around this framework that a menu driven decision support system for the daily and monthly management of a base supply account was developed. Of the almost eight thousand data elements contained in the D-14, this hierarchy represents 181 of them, or roughly 2% of the total. In choosing these particular data as management indicators for base supply, it was the intent of this researcher to follow the advise of Kirk, who recommended:

> The management indicators should be derived from data sources that are readily available, present valid data, be limited to those indicators that are necessary and, of course, be understood and easily communicated. (Kirk and others, 1980, ch 1:1)

These data, divided among the ten general categories described in AFM 67-1 as common to both the D-14 and M-32, are presented here in answer to research question one.

I. Customer Support Effectiveness (12 data elements)

- A. Weapons Maintenance Organizations
    1. Total ALC Stockage Effectiveness by Line Item
    2. Repair Cycle (XD Stockage Effectiveness by Line Item
    3. Repair Cycle (XF) Stockage Effectiveness by Line Item
    4. EOQ Stockage Effectiveness by Line Item
    5. Equipment Stockage Effectiveness by Line Item
    6. Bench Stock Stockage Effectiveness by Line Item
- B. Overall Summary
    1. Total ALC Stockage Effectiveness by Line Item
    2. Repair Cycle (XD) Stockage Effectiveness by Line Item
    3. Repair Cycle (XF) Stockage Effectiveness by Line Item
    4. EOQ Stockage Effectiveness by Line Item
    5. Equipment Stockage Effectiveness by Line Item
    6. Bench Stock Stockage Effectiveness by line Item

II. Repair Cycle Asset Control Data (17 data elements)

- A. Total Units Repaired This Station (RTS)
- B. Total Units Not Repaired This Station (NRTS)
- C. Total Units Condemned (COND)
- D. Average Repair Cycle Time
  - 1. ERRC Code XF
  - 2. ERRC Code XD
- E. Total Units Awaiting Parts (AWP)
  - 1. Repaired This Station (RTS)
    - a. ERRC Code XF
    - b. ERRC Code XD
  - 2. Not Repaired This Station (NRTS)
    - a. ERRC Code XF
    - b. ERRC Code XD
  - 3. Condemned
    - a. ERRC Code XF
    - b. ERRC Code XD
- F. Average Number of Units Awaiting Parts (AWP)
  - 1. Repaired This Station
    - a. ERRC Code XF
    - b. ERRC Code XD
  - 2. Not Repaired This Station
    - a. ERRC Code XF
    - b. ERRC Code XD
  - 3. Condemned
    - a. ERRC Code XF
    - b. ERRC Code XD

III. Excess Stratification (19 data elements)

- A. Overall Total
  - 1. Line Items
  - 2. Units
  - 3. Dollar Value
- B. Total ERRC Code XD
  - 1. Line Items
  - 2. Dollar Value
- C. Total ERRC Code XF
  - 1. Line Items
  - 2. Dollar Value
- D. Total ERRC Code XB
  - 1. Line Items
  - 2. Dollar Value
- E. Total ERRC Code ND/NF
  - 1. Line Items
  - 2. Dollar Value
- F. Releveling Frequency
  - 1. Number of Times Completed
  - 2. Julian Date of Last Completion
- G. Followup Frequency
  - 1. Number of Times Completed
  - 2. Julian Date of Last Completion

H. File Status
   1. Number I/R
   2. Number I/R Completed
   3. Percent Completed
   4. Julian "As Of" Date

IV. Requisition Summary (15 data elements)

A. Total Number Priority Group I
   1. Supplies
   2. Equipment
   3. Overall

B. Total Number Priority Group II
   1. Supplies
   2. Equipment
   3. Overall

C. Total Number Priority Group III
   1. Supplies
   2. Equipment
   3. Overall

D. Total Number of All Three Priority Groups
   1. Supplies
   2. Equipment
   3. Overall

E. Total Dollar Value of All Three Priority Groups
   1. Supplies
   2. Equipment
   3. Overall

V. MICAP Analysis (27 data elements)

A. Cause Code Analysis
   1. Total Number by Cause Code (Overall Summary)
      a. Code A (No Stock Level - No Demand)
      b. Code B (No Stock Level - With Demand)
      c. Code C (IM/SM Prohibits Level)
      d. Code D (Base Decision - No Level)
      e. Code F (Full Stock - Zero Balance)
      f. Code G (Full Stock - Assets AWP)
      g. Code H (Full Stock - RQN > STD)
      h. Code J (Full Stock - RQN < STD)
      i. Code K (Full Stock - No Due In)
      j. Code P (Command Unique)
      k. Code R (Full Stock - Inaccessible)
      l. Code S (Full Stock - G/H)
      m. Code T (Full Stock G/S)
      n. Code X (Full Stock G/K)
      o. Code Z (Initial Shortage)
   2. Total Number MICAPS, All Cause Codes (Overall Summary)

B. Delete Code Analysis
   1. Total Number by Delete Code (Overall Summary)
      a. Code 0 (Cancellation)
      b. Code 1 (Received ALC/Other SVCS)

c. Code 2 (Received DLA)
d. Code 3 (Received JLS)
e. Code 4 (Canned to Preclude)
f. Code 5 (Received Local Purchase)
g. Code 6 (Received Base Assets)
h. Code 7 (WRM Asset Used)
i. Code 8 (Canned to Satisfy)
j. Code 9 (Report Error)

2. Total Number MICAPS, All Delete Codes (Overall)

VI. Due Out Analysis (20 data elements)

A. Total Number of Due Outs (by Organization)
1. Maintenance
2. Communication
3. Civil Engineering
4. Transportation
5. Other

B. Total Number of Due Outs by Cause Code (Overall Summary)
1. Code A (No Stock Level - No Demand)
2. Code B (No Stock Level - With Demands)
3. Code C (IM/SM Prohibits Level)
4. Code D (Base Decision - No Level)
5. Code F (Full Stock - Zero Balance)
6. Code G (Full St ck - Assets AWP)
7. Code H (Full Stock - RQN > STD)
8. Code J (Full Stock - RQN < STD)
9. Code K (Full Stock - No Due In)
10. Code R (Full Stock - Inaccessible)
11. Code S (Full Stock G/H)
12. Code T (Full Stock G/J)
13. Code X (Full Stock G/K)
14. Code Z (Initial Shortage)

C. Total Number of Due Outs (Overall Summary)

VII. Due Out Cancellation Summary (17 data elements)

A. Total Dollar Value All Organizations
1. Supplies
   a. General Support Division
   b. System Support Division
   c. Non Stock Fund
   d. Total Supplies
2. Equipment
   a. General Support Division
   b. Non Stock Fund
   c. Total Equipment
3. Overall Summary
   a. General Support Division
      1) Obligated Funds
      2) Unobligated Funds
      3) Total General Support Division

b. System Support Division
1) Obligated Funds
2) Unobligated Funds
3) Total System Support Division

c. Non Stock Fund
1) Firm
2) Memo
3) Total Non Stock Fund

B. Total Dollar Value all Organizations/Divisions/Items

VIII. Transaction Summary (25 data elements)

A. Total Transactions by Type Transaction
1. Total A&F Transactions
2. Total Conditions Change
3. Total DRMO
4. Total Due Out
5. Total Due Out Release
6. Total File Changes
7. Total Inventory Adjustments
8. Total Issues
9. Total Kill
10. Total MSK
11. Total Receipts
12. Total Reverse Post
13. Total Shipments
14. Total SPR
15. Total Supply Point
16. Total Turn-In
17. Total Warehouse Location Change
18. Total WRM
19. Total WRSK

B. Total Transactions by Account
1. B/E Account
2. K Account
3. P Account

C. Total Transactions by Item Type
1. Supplies
2. Equipment

D. Total Number of Transactions All Types/Accounts/Items

IX. Retail Outlet Sales Variance Analysis (12 data elements)

A. ISU
1. Total Line Items
2. Total Units
3. Total Dollar Value

B. DUO
1. Total Line Items
2. Total Units
3. Total Dollar Value

C. DOR
1. Total Line Items

2. Total Units
3. Total Dollar Value

D. TIN
1. Total Line Items
2. Total Units
3. Total Dollar Value

X. Supply Performance Measures (17 data elements)

A. Gross/Net Availability
1. Net Availability
a. Operational RPC
b. Operational EOQ (less BSS)
c. Operational EOQ (BSS)
d. Total Operational Organizations
e. Support RPC
f. Support EOQ (Less BSS)
g. Support EOQ (BSS)
h. Total Support Organization
i. Total All Organizations

B. Reason for Non-Availability
1. Total Number Non-Available by Cause Code
a. Non-Stock Cause Code A
b. Non-Stock Cause Code B,C,D
c. Full Stock Cause Code F, G, R
d. < Full Stock Cause Code H,J,K
2. Total Number Nonavailable by Item Type
a. Repair Cycle - XD
b. Repair Cycle - XF
c. EOQ
3. Total Number All Cause Codes/Item Types

Appropriateness of Chosen Data.

In an effort to assess the relative success of this research in identifying the correct data to include in the application's database, the program developed during the course of this research was evaluated by supply personnel at six Air Force Bases in the Eastern United States. As part of the evaluation, supply personnel were asked to identify which D-14 data their organization used in analyzing their supply account. Their choices were compared to the selection of data provided by this DSS. The ratio of raw data requirements met by this application to that of the organization's total data requirements provided an approximate measure of this study's success in identifying those elements of SBSS data that are important to base supply organizations. The results of that comparison for each supply account included in the evaluation are presented in Table 2.

Table 2

D-14 Data Elements Satisfied by DSS

SUPPLY ORGANIZATION EVALUATED	TOTAL NUMBER OF D-14/M-32 DATA REQUIRED BY ORG	NUMBER OF DATA SATISFIED BY DSS DATABASE	PERCENT OF DATA REQUIREMENTS SATISFIED BY DSS
2750 ABW/DMS	25	21	84%
178 TFG/LGS	14	10	71%
121 TFW/COS	46	32	70%
3800 ABW/LGS	17	12	71%
375 Supply Sq	15	11	73%
3210 Supply Sq	32	21	66%
TOTAL	149	107	71.8%

Thus, among the six supply organizations participating in this evaluation, DMA was able to meet approximately 72% of their raw data requirements. How the database of this decision support system can be modified to better meet base supply needs is addressed in Chapter five.

Research Question Two

What kinds of analysis might be possible and beneficial for base supply managers to perform on data contained in the D-14?

Summary of Personal Interviews.

Structured interviews with supply personnel provided insight into how the data contained in SBSS management reports are analyzed. As suggested by the Air Force Supply Manual, this analysis is primarily concerned with determining how the account had performed over the past month as indicated by the M-32 (AFM 67-1, Vol II, Part 2, ch 2). By comparing this information to that of previous months, problem areas can be identified, and action taken to rectify adverse trends. The analysis is usually presented to the Chief of Supply in a series of charts developed for the monthly "How Goes It?" briefing. Figure 3 provides an example of a typical chart used by the 2750 ABW Logistics Squadron in its briefings to the COS (2750 Base Supply "How goes it?" Feb 1989).

It is in the "How goes it?" briefing that the COS is normally first made aware of any problems or unusual fluctuations in his account. Branch chiefs and/or the Procedures and Analysis section are usually aware of such deviations and have an explanation readily available. A "hiccup" in a particular area of the supply account is normally attributable to some single occurrence such as fiscal year-end spending or a change in the number of customers being supported by the account.

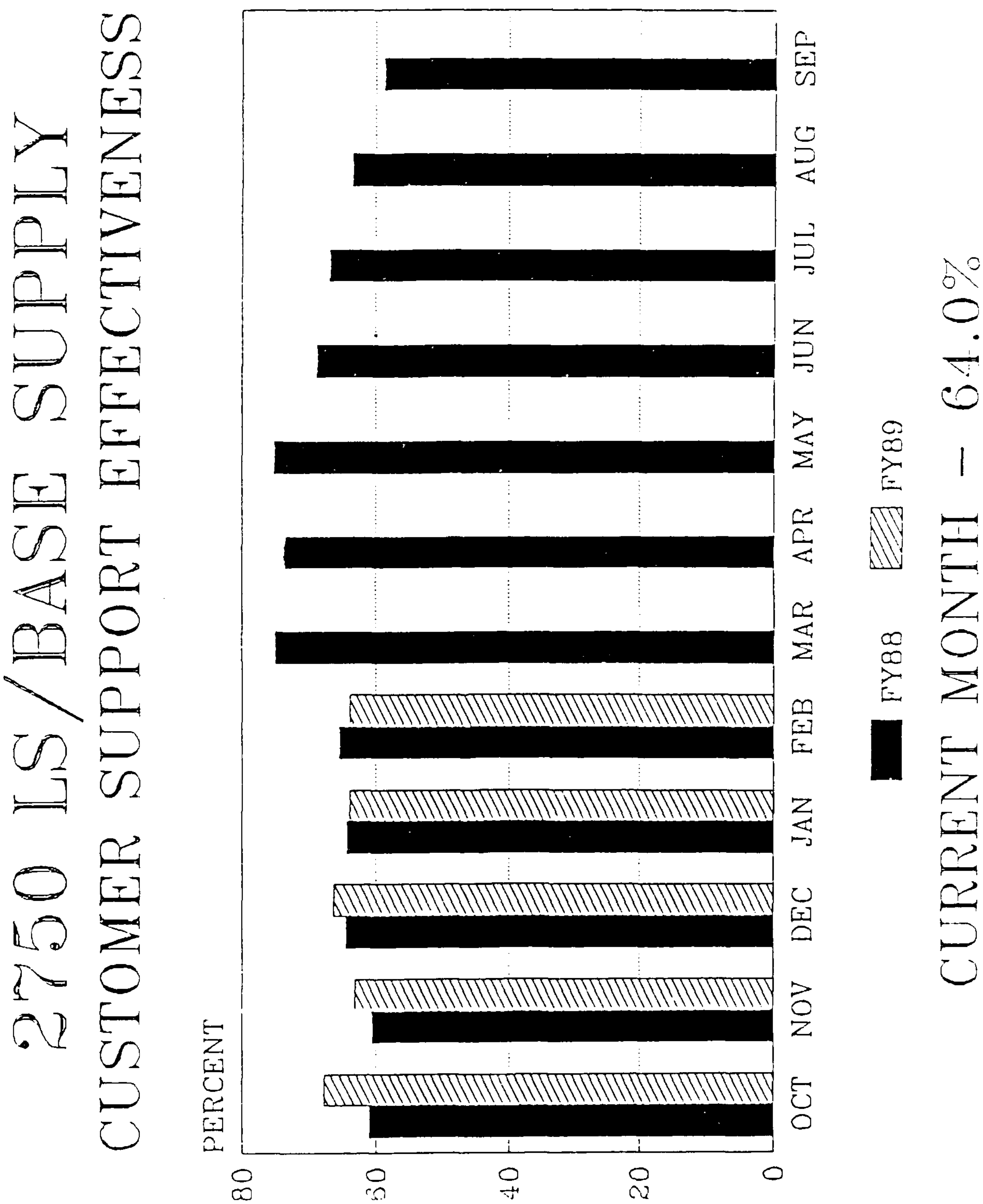

Figure 3

Typical Base Supply "How Goes It?" Chart

On those occasions where, for no apparent reason, a management indicator failed to perform as well as expected, there is little the supply organization can do to trace the cause. In spite of the potential for doing so, few analysts monitor the account on a daily basis. In many instances the D-14, although made available each day by the 1100/60 software, is not even printed. Those organizations that do print the D-14 often do so only for selected categories of data. What is done with the printout depends on the organization; however, as an indication of the value placed on the daily report by some organizations, in one instance the researcher recovered a particular day's D-14 output from the COS's garbage can.

The lack of emphasis placed on analyzing the daily report is attributable to the time and effort it would take to do so by organizations already faced with limited manpower. This problem is particularly acute in smaller accounts, such as those found in the Air National Guard, where the Procedures and Analysis Section is often made up of a single individual. As merely filing reports can take up to an hour each day, such organizations are barely able to file SBSS output, much less perform any in depth-analysis.

Therefore the overriding consideration is that any analysis of the data contained in the D-14 must be simple and virtually instantaneous. Preferably, any software application should allow the supply analyst to portray the data graphically, since this is the method by which SBSS information is normally conveyed to the COS (Hargrave, 1985:3). This graphics capability should not require the analyst to develop the details of the chart, but only choose the particular data of interest. In addition, because a significant portion of a supply analyst's time is spent determining where problems in the account have developed, an especially useful function of any software application would be in the ability to automatically scan the data for areas where predetermined parameters have been exceeded. These parameters would act as flags which, when raised, would bring to management's attention those areas in need of corrective action. Similarly, supply organizations would benefit from the ability to automatically identify any unfavorable trends that have developed during the month. Such capabilities would provide base supply with the potential for exception reporting similar to that proposed in the LMC Report "An Improved Management Information System for the Chief of Supply" (Rhodey, 1984:2).

In contrast, there are certain types of analysis from which most supply organizations would derive little benefit. In particular, complex Operations Research (OR) techniques such as linear programming, network models and simulation would be of little value to base supply. In fact, such capabilities might work against the successful implementation of DMA by complicating what needs to be a very straight forward and easily understood decision support system. This is not to say that OR techniques will never be useful in the supply world. As more supply personnel (including the COS) are exposed to these quantitative tools, their application to and use by base supply will increase. However, at the present time, the better strategy for improving supply management at the base level rests in helping analysts make better use of current methods, rather than trying to introduce totally new methods.

In this regard, the microcomputer has proven to be a useful tool for analyzing supply accounts. This statement should be qualified by noting that the value of the microcomputer depends upon which software application is used in the analysis. In the case of the Logistics Management Center's (LMC's) Inventory Analysis Program (IAP), supply personnel speak of marked improvements in productivity, reducing the amount of time it takes to analyze monthly adjustments to inventory by as much as 75 percent. On the other hand, supply personnel are routinely provided with software from a variety of sources other than the LMC that are intended to make their jobs more productive. Much of this software is described as less than user-friendly, and at times comes with a user manual exceeding one hundred pages in length. Such applications actually work against the increased use of computers in base supply by both intimidating and frustrating those supply personnel who desire to use computers in their analysis.

The problems encountered by supply personnel in their attempts to include the computer as a management analysis tool point out an important consideration in developing and implementing a decision support system for use by base level supply. As noted by Sprague, the system can only gain the support of its intended users by being easy to use (Sprague, 1980:14). Realizing this, the designer of a DSS must remember that "the human side takes top priority over all other considerations (Davis, 1988:93). It was the intent of this researcher to apply this advice to the design of a decision support system for daily base supply management analysis.

In summary, base supply decision makers need a quick, convenient, and simple means to analyze the daily data provided in the D-14. Any analysis method should enable the user to portray the data graphically, the method most familiar to the COS. Finally, and perhaps most importantly, managers need a way to effectively sort through the thousands of data elements produced by the SBSS everyday. A decision support system, designed with these considerations in mind, is described next.

Research Question Three

Do the problems and decisions faced by base supply managers today lend themselves to microcomputer-based decision support technology?

To answer research question three, this study included the systematic development and implementation of a decision support system designed to meet the daily information requirements of base level supply organizations. The resulting software application, dubbed the Daily Management Analysis Program (DMA), was based on the findings of the previous two research questions. The following discussion provides a detailed description of DMA in terms of the three basic components that make up any decision support system: a database subsystem, a quantitative modeling subsystem, and a user interface (Allen and Emmelhainz, 1984:132). The actual DBASE3+ code and QUATTRO MACROs used to program this DSS are found in Appendices E and F respectively.

Database Subsystem.

The data used by DMA consist of the 181 data elements identified in research question one as important to maintaining an effective supply account. These data, updated on a daily basis by the SBSS software, are common to both the D-14 and M-32. In a process referred to as data extraction, each data element is individually identified by the 1100/60 mainframe, and downloaded into a microcomputer from where it can then be stored onto a floppy disk for later use by DMA (Emmelhainz, 1989c). At the start of a DMA session, the user is queried whether or not he wishes to load such a floppy disk into the database subsystem of DMA.

The complete DMA database consists of a total of twenty DBASE3+ database files. These twenty files are broken down into two distinct "catalogs" of ten data base files each (Pratt, 1988:238). The ten files common to each catalog represent the ten categories of data contained in the D-14, ie Customer Support Effectiveness, Repair Cycle Asset Control Data, Excess Stratification, etc. The two catalogs are based on the time frame of the data the user wishes to examine. DMA allows the user to either analyze the current month's data or the previous month's data on a daily basis. The general structure of DMA's database is represented pictorially in Figure 4. The data base dictionary of DMA is located in Appendix D.

The logic behind maintaining only two month's worth of daily data in DMA and separating those daily databases into a current month catalog and previous month catalog is as follows: Either a supply analyst will wish to examine data from the previous month in order to determine why the M-32 indicated a particular area of the supply account failed to perform satisfactorily, or he will wish to examine data from the current month to determine if a similar discrepancy is likely to occur in the upcoming M-32. If a supply analyst has failed to examine the daily trends of his account after two months have elapsed, it is doubtful the analysis would ever be accomplished.

The exact structure of an individual database file is depicted in Figure 5. This particular file represents the Customer Support Effectiveness (CSE) database file. Each field (column) of the file represents one of the specific data elements identified by this study as important to supply organizations in the daily management of their accounts. Each record (row) of the file represents a particular day of the month. These records are ordered by sorting them according to the field "DAY" using the DBASE3+ command "INDEX ON." This insures a particular month's data are sequenced from one to thirty-one when being examined by supply personnel, no matter how the data were originally entered into the database.

The opening screens of DMA query the user for both the current date and the date of the data to be loaded or examined.

CURRENT MONTH CATALOG

CSE.DBF	RCAC.DBF	RS.DBF	DOCS.DBF	MA.DBF
TS.DBF	SVA.DBF	ES.DBF	DOA.DBF	SPM.DBF

PREVIOUS MONTH CATALOG

CSE.DBF	RCAC.DBF	RS.DBF	DOCS.DBF	MA.DBF
TS.DBF	SVA.DBF	ES.DBF	DOA.DBF	SPM.DBF

Figure 4

General Structure of DMA Database

MONTH	DAY	CSE WMOALC	CSE WMO XD	.....	CSE OS BS
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	::				
	::				
	::				
	::				
	31				

Figure 5

Customer Support Effectiveness D tabase Structure

This allows the DMA program logic to determine whether the data should be treated as "current month" or "previous month" data, so that the proper catalog file can be used. It is at this time also that data more than two months old are deleted from the system to insure records (days) from different months are not analyzed at the same time. These actions occur without the user having to perform any file manipulation.

Modeling Subsystem.

Because of its excellent graphics capability, the QUATTRO spreadsheet from Borland was used as the modeling component of DMA. QUATTRO graphics provided the vehicle by which SBSS data are automatically translated into a form which supply managers are accustomed to dealing with. Creating charts that display trend analysis, traditionally a time consuming process, is accomplished in a matter of seconds by QUATTRO.

The modeling portion of DMA is activated when the user chooses "GRAPH" from the menu of data analysis options. The sequence of events that occurs next is as follows. (1) Once a particular data element is chosen, a new data base file is created containing only the field associated with that element. (2) The program then automatically exits DBASE3+ and loads QUATTRO. (3) Once QUATTRO is loaded, a spreadsheet file containing the MACROs which run the graphics is automatically retrieved. (4) The first MACRO to run locates the new database file that had just been created by the user in selecting an element of data to examine. (5) The data in this file is then portrayed graphically until the user presses [RETURN], at which time programming control is returned to DBASE. This process requires as little as ten seconds to accomplish once the user selects the data element of interest.

A particularly challenging aspect of deciding to use QUATTRO to perform the graphing function was that of integrating two major software applications into a single package. As Davis warns, linking together individual software components into a patchwork system may produce "weird" results (Davis 1988:164). The major obstacle to overcome in combining two large software packages was the limited RAM (Random Access Memory) storage capacity of the Zenith Z-248 microcomputer used by the Air Force as its standard desktop computer. The Z-248 has a maximum RAM capacity of 512 kilobytes (K). Both DBASE3+ and QUATTRO each require in exceess of 350 K of RAM space, or about 70% of the storage capacity of the Z-248. Consequently, either program fits into the Z-248's available RAM, but not both at the same time.

In order to overcome this limitation, it was necessary to create a batch file (named DMA.bat) using the programming language available in MS-DOS, the operating system of the Z 248. The actual program code used to link the two applications together is found in Appendix G. The program executes the following logic: First, transparent from the user's point of view, DBASE3+ is loaded. The individual is then free to work with the menu driven DMA program as much as desired. If the user chooses EXIT from the list of main menu options, he is simply bade farewell by DMA and returned to the system level C:prompt. If instead GRAPH is chosen, a new database file (called graph.dbf) is automatically created by DBASE which contains the data to be graphed by QUATTRO. Upon exiting DBASE, DMA.bat searches for this new data base file. Finding graph.dbf is the cue to the MS-DOS program logic that QUATTRO is to be loaded rather than returning to the C: prompt. What occurs once QUATTRO is loaded has already been described.

A problem occurs once the graphics task is complete and the user wishes to return to the database component of DMA. Because DBASE3+ was completely dumped from RAM to make room for QUATTRO, there would normally be no way for the software to distinguish whether or not the user was returning from the graphics function or if this was the first time DMA had been loaded that session. This would mean that every time a new graph was created and examined, the user, upon returning to DBASE, would be presented with the opening screens that logically should only be seen the first time through. While this would not necessarily invalidate DMA as a useful supply management analysis tool, it would no doubt become annoying to one making frequent use of DMA's graphics capability.

Fortunately, the DBASE3+ language provided a means around this potentially annoying feature. Just prior to exiting DBASE3+, a value is assigned to a memory variable labeled "m begin." A value of "T" is assigned to m begin if the user wishes to EXIT DMA for good, while a value of "F" is assigned if the user plans only to GRAPH and then immediately return to DMA.

Normally the values assigned to memory variables are lost when DBASE3+ is dumped from the computer's RAM. However, it is possible to store these values to a floppy or hard disk using the DBASE3+ command "SAVE," which retains them even if the computer is shut off. The very first thing DMA does upon loading is to execute the command "RESTORE", which retrieves the file containing the memory variable values. The value of m begin is then determined and the opening screens are either displayed or bypassed depending on the situation.

In addition to using QUATTRO to model D-14 data graphically, DMA provides another modeling capability. If for some unexplainable reason the M-32 did not perform as well as expected in a particular area, a supply analyst may wish to determine whether or not the upcoming M-32 is likely to contain the same weak performance. By choosing PREDICT from the list of main menu options, the user is supplied with DMA's best estimate of what the end of the month M-32 value will be for that data element based on the values that have been loaded into the system at the time the prediction is made. This capability does not require QUATTRO in order to perform the calculations, and in fact is best accomplished using the computational capabilities available in DBASE.

The algorithm used to calculate an M-32 estimate depends on which data element is chosen. This is because daily D-14 values are updated and accumulated by the SBSS software in one of two ways. For an area such as Customer Support Effectiveness, where values are expressed as a percent, DMA simply takes the average of those values to project the probable end of month percentage. In other areas of the M-32, values represent an accumulation of daily data. In such cases, DMA adds to the most recent D-14 data a percentage based on the number of days that have elapsed since the month began. For example, a prediction made at mid-month would double the latest daily values. Together, these two simple algorithms provide an easy means to estimate what the M-32 might look like.

User Interface.

The Daily Management Analysis Program is designed so that the user is guided through the system in a series of menu driven options. The majority of programs that run the menu system take the user through the hierarchy of information needs identified in research question one until the precise data element of interest is selected. Other menu options allow the user to choose the way in which data are to be examined. Options exist throughout the application to call up various help menus, return to the main menu, or exit the system. The following discussion describes the user interface of the Daily Management Analysis program as it is presented to an individual operating the system.

The opening screens introduce the user to DMA and provide general information about how the system can be used as a base supply management analysis tool. Next, DMA asks the user whether new data are to be loaded into the DMA database, or if data already present in DMA are to be examined. Then, the user is queried for the current date, and the date of the data he wishes to load/examine. The answers to these questions determine which catalog of databases DMA will operate from.

If the analyst has indicated that data are to be examined, a menu is preseted that offers the various options as to how the data can be analyzed using DMA (Figure 6). Two of these options, GRAPH and PREDICT, have already been described as they represent the modeling capabilities of DMA. If "LIST" is chosen, DMA returns the value of the selected data element for each day (record) contained in the database. If records exist for which there are no data, as would likely occur sometime during the month, those days are displayed as zeros in the listing. LIST provides a simple way for a supply analyst to determine what the exact values of any given data were over the course of a month without having to track them manually.

In choosing FLAG, a supply decision maker is offered a long sought capability. This is the ability to set parameters that will raise flags to notify management anytime the parameters are exceeded during the course of the month. DMA allows the decision maker to set an upper and lower limit for each of the 181 data elements contained in the DMA database. These parameters are stored permanently in their own database file so that the user is only required to set a flag for a particular value once. Associated with FLAG is the SCAN function. Once the desired upper and lower limits are set using FLAG, DMA can then SCAN an entire area of the D-14 such as Customer Support Effectiveness, at one time. The program scans the entire

How would you like to examine the data?

```
 __________
:          :
:  LIST    :
:  GRAPH   :
:  FLAG    :
:  SCAN    :
:  PREDICT :
:          :
:  HELP    :
:  EXIT    :
:__________:
```

Press [l] for LIST, [g] for GRAPH, etc.

Figure 6

Options of How to Examine DMA Data

month's worth of data for each data element and compares the daily values to the FLAGs that were previously set. If an upper or lower limit for a particular data element was exceeded on any day during the month, DMA notifies the user by listing the title of the data on the screen. In addition, the user is then afforded the opportunity to review any flags contained in the FLAG database. Together, the FLAG and SCAN options offer the supply analyst the means to quickly survey up to two month's D-14 data to determine if a problem has developed in a particular area.

To summarize, research question three asked whether decision support technology is applicable to the needs of base supply decision makers. The DSS developed during the course of this study is presented as an affirmative answer to that question. The question of whether or not DMA provides supply managers with a better method of analyzing their accounts is answered next.

Research Question Four

Would a decision support system, applied to the problem of daily management control, provide a more efficient and effective means of managing a base supply account on a daily basis than is possible under the present system?

To answer research question four, DMA was evaluated by supply personnel at six Air Force bases. This evaluation was conducted according to the methodolgy presented in chapter three. The purpose was two fold. First, to determine the relative success of the study in identifying the correct data to include in DMA's database. The results of that part of the evaluation were summarized earlier in this chapter under the section covering Research Question One. Second, the evaluation provided the means by which the relative efficiency and effectiveness of DMA could be compared to that of traditional supply analysis methods. The following section summarizes the results of this portion of the evaluation.

Relative Efficiency of DMA

To compare the efficiency of DMA to that of traditional supply analysis methods, supply personnel were asked to identify analysis tasks they currently perform or would like to perform on D-14 data supplied by the SBSS. The actual/estimated time to complete those tasks were used as a measure of the method's efficiency. Table 3 summarizes the supply analysis tasks that were selected and the times required to complete those tasks using DMA and traditional methods.

The population of differences between task completion times was tested for normality using the Lilliefors and Shapiro-Wilkes tests. Under the Lilliefors test, the maximum deviation between the actual and expected cumulative frequency distributions was calculated to be .3363, which acted as the test statistic. Since this value is greater than the critical D value of .271 (n = 9, alpha = .05), it can be concluded that the population of differences could not be normally distributed. Similarly, the Shapiro-Wilkes test resulted in a p-value of less than .01, strong evidence against the assumption of normality.

TABLE 3

Comparison of Task Completion Times

SUPPLY ANALYSIS TASK PERFORMED OR DESIRED	ESTIMATED TIME TO COMPLETE TASK USING TRADITIONAL ANALYSIS METHODS	TIME REQUIRED TO COMPLETE SAME TASK USING DMA	DIFFERENCE (TRAD-DMA)
Graph MICAP Data	60 min+	2 min	58 min
Graph Requisitions	60 min+	2 min	58 min
Calculate $ Value of Requisitions	60 min+	3 min	57 min
Predict upcoming Stockage Effectiveness	120 min+	1 min	119 min
Determine Reverse Post Rates	40 min	10 min	30 min
Track Stockage Effectiveness	2 min	3 min	1 min
Determine areas in Need of Attention Prior to End of Month	60 min	4 min	54 min
Graph Total Number of Due Outs	60 min	3 min	57 min
Predict Stockage Effectiveness	60 min	3 min	57 min

Since an analysis of the population of differences revealed that it was unlikely that such a sample could have come from a normal distribution, only the Wilcoxon signed rank test could be applied to any comparison of relative efficiency. When the number of observations is less than 50, the test statistic for the Wilcoxon signed rank test is equal to the lessor of either the sum of positive ranks (in this case equal to 44), or the sum of the absolute values of negative ranks (equal to -1). Thus, a value of 1 was compared to the critical value of 8 for a one sided test (where n = 9; p = .05). Since the calculated T value of 1 was less than the critical value of 8, the null hypothesis can be rejected and the conclusion reached that task completion times are less for DMA. Therefore, it can also be concluded that DMA provides a more efficient method of analyzing base supply accounts on a daily basis than traditional methods.

Relative Effectiveness of DMA

The relative effectiveness of DMA was calculated using a single question formatted as a seven point Likert scale and assigning a mean effectiveness rating of four to traditional supply analysis methods. The results are presented in Table 4.

Table 4

Comparison of Effectiveness Ratings

EFFECTIVENESS RATING TRADITIONAL METHODS	EFFECTIVENESS RATING APPLIED TO DMA	DIFFERENCE (DMA-TRAD)
4	6	+2
4	6	+2
4	7	+3
4	6	+2
4	5	+1
4	6	+2
4	4	0
4	4	0
4	2	-2
4	3	-1
4	6	+2
4	6	+2
4	5	+1
4	6	+2
4	6	+2

Again, an analysis of the population of differences revealed that such a sample in all likelihood could not have been drawn from a normal distribution; therefore only the Wilcoxon signed rank test was applied to the comparison of effectiveness. The test statistic in this case, again determined by the absolute value of the sum of negative ranks, was equal to 10. This value was compared to the Wilcoxon signed rank critical value of 21 (where n, the number of nonzero differences = 13, and p = .05). Since the value of the test statistic (equal to 10) is less than the critical value of 21, the null hypothesis can be rejected and the conclusion drawn that the mean effectiveness rating of DMA is greater than that of traditional methods. When broken down by Air Force base, personnel at four of the six bases were unanimously in favor of DMA, one base was neutral towards it, and one base was split evenly in half over their opinion of the system as compared to traditional methods.

While the previous discussion indicates that DMA can provide base supply decision makers with a more efficient and effective means of analyzing their accounts, it should be noted that discussions with supply personnel revealed that a wide variety of daily tasks exists for which DMA is not equipped to handle. In the majority of such cases, the job requires data from areas of the Standard Base Supply System other than the D-14, such as Not Mission Capable (NMC) rates or information concerning delinquent documents. In addition, while the desired data may be included into DMA's database, in many cases analysts need to combine two or more pieces of raw data in order for them to be meaningful. For instance, while supply organizations need to know the total number of reverse posts and the total number of transactions, both of which are included in DMA'S database, a more meaningful piece of information would be the two data elements presented together as a fraction. Providing such a capability would be a worthwhile goal in the next iteration of systems development.

This chapter has presented the findings of this study in terms of the four research questions proposed in chapter one. A summary of those findings, the conclusions reached as a result of this study, and recommendations for both DMA's implementation as well as suggestions for future research are presented next in Chapter V.

V. Summary, Conclusions and Recommendations

Summary and Conclusions

The purpose of this research was to transform the data currently provided by the Standard Base Supply System in the D-14 daily report into information that is more useful to base supply decision makers by applying principles of decision support technology. In order to accomplish this task, the answers to four specific research questions were sought. A study of previous research as well as structured interviews with experienced supply personnel produced a list of 181 elements of data determined to be important to base supply decision makers in managing an effective account. These data, divided among the ten general categories of the D-14 daily report, represent approximately two percent of the almost eight thousand data provided by the D-14.

Next, a four-step, iterative process recommended by authors of decision support technology was used to develop a menu driven software application. The resulting decision support system, programmed in DBASE III PLUS code and dubbed the Daily Management Analysis Program (DMA), provides a number of capabilities that the research indicated would be useful to supply personnel in analyzing their accounts. Among these is the ability to set an upper and lower limit for each of the 181 data elements identified in the study. When the DMA database is scanned, the user is notified of any D-14 data for which the limits have been exceeded at sometime during the month. In addition, by using the graphics capability found in the QUATTRO spreadsheet, supply analysts can automatically graph up to two months worth of D-14 data. Finally, DMA also provides the capability to predict what the values of the upcoming M-32 monthly report will be based on the daily data that have been uploaded into DMA's database.

This study also included a systematic evaluation of the Daily Management Analysis Program as it existed at the end of the second iteration of systems development. This evaluation was used to determine the researcher's success in identifying proper D-14 data to include in the database subsystem of DMA, and to determine the relative usefulness of DMA as a daily supply management analysis tool when compared to traditional methods. The evaluation was conducted with supply personnel at six Air Force Bases in the Eastern United States representing five major commands. The ratio of raw D-14 data requirements met by DMA to that of the organizations' total data requirements indicated that DMA was able to satisfy approximately 72% of the supply organizations' total daily data needs.

An evaluation of the relative usefulness of DMA compared to traditional analysis methods examined both its efficiency and effectiveness. Using the Wilcoxon signed rank test to compare the mean time to accomplish various supply analysis tasks, it was determined that a statistically significant reduction in task completion times could be achieved using DMA rather than traditional methods. In addition, supply personnel, asked to rate the relative effectiveness of DMA in terms of the Likert seven point scale, indicated that is was significantly more effective than traditional methods as well.

In addition to assessing the worth of DMA as a daily base supply management analysis tool, the evaluation set the stage for future iterations of systems development. These iterations are to be accomplished by the Air Force Logistics Management Center at Gunter AFB, when DMA is turned over to them for further testing and ultimate implementation throughout the Air Force.

The objective of this research, as originally proposed in Chapter I, was to determine whether the data currently provided by the Standard Base Supply System (SBSS) in the D-14 Daily Report could be transformed into information that is more useful to supply managers. Through the systematic development of a decision support system designed around inputs from experienced base supply personnel, a more efficient and effective micro-computer based method of analyzing SBSS data was devised. Perhaps most importantly, supply analysts will be afforded the opportunity to perform the kinds of analysis tasks that until now have not been feasible due to the time constraints they are faced with. It is therefore this researcher's belief that the research objective has been met in the Daily Management Analysis program.

Implementation Considerations

While the evaluation of DMA by base supply personnel indicated that the program could be useful to them in analyzing their accounts, it will be necessary for the system to undergo at least one more iteration of systems development. A relatively simple change would consist of a modification to DMA's database, to incorporate increased detail in such areas as customer support effectiveness, WRSK transactions, and issues, while deleting areas such as net availability measures and variance analysis. A slightly more complicated change to DMA would be to combine several data elements into the formulas that supply organizations use in evaluating their accounts. For example, the number of priority requisitions and the number of total requisitions (both of which are included in DMA's data base) could be combined to provide the percent of priority requisitions to the total, a management indicator which although routinely used by supply accounts, is not provided directly by the SBSS and must therefore be calculated manually.

While DMA is very easy to use, it may be beneficial, at least initially, to load and demonstrate the program to various supply organizations. This is partly due to the general reluctance of supply personnel to experiment with any new software. DMA is especially intimidating on the surface, as it consists of six "floppy disks" and requires the user's to create a subdirectory in their hard drive as a place to store DMA. While the entire process of loading DMA can take as little as five minutes, to those with less computer experience it can appear as an imposing task.

DMA should require virtually no training in order for it to be mastered by most supply personnel, regardless of their computer expertise. Based on experience gained during the systems evaluation, approximately twenty minutes is all that is required to demonstrate the basic capabilities of the program.

An important task that must be accomplished prior to full scale implementation of DMA is that of securing a licensing agreement with the Borland Corporation, makers of QUATTRO, to use their software. While the Air Force has secured the right from Ashton Tate to operate DBASE III PLUS throughout the Air Force, a similar arrangement does not yet exist with Borland to use QUATTRO.

As noted in Chapter I, in order for DMA to be welcomed as a useful supply management analysis tool, it must include the capability for an automatic download of appropriate data from the 1100/60 mainframe to the microcomputer used to operate the program. This ability does not require extensive SBSS reprogramming, and in fact has been accomplished for other applications developed by the Air Force Logistics Management Center. DMA's successful implementation throughout the Air Force depends upon the AFLMC providing such a capability.

A final consideration affecting the implementation of DMA or any other microcomputer-based management analysis tool involves the general apprehension of base supply personnel toward change. While this characteristic is not unique to the supply world, base supply decision makers must realize that increases in technology will provide new tools and techniques with which to manage their organizations. These tools may involve analyzing the accounts in ways which have not been possible in the past. Future instruction in the management of base supply should emphasize the use of such tools and a willingness to use them.

Recommendations for Further Research

In addition to DMA and the other software applications developed by the Air Force Logistics Management Center, there remains a number of areas identified during interviews with supply personnel as additional opportunities for automation of SBSS data. These include automation of the M-04, which provides data on bench stock levels. Also of interest to supply managers is information regarding Non Mission Capable Supply (NMCS) rates, War Readiness Spares Kits (WRSK), mobility equipment, funds management, and delinquent documents. Future research in any one of these areas should prove worthwhile.

Epilogue

This research has demonstrated how decision support technology can be applied to the decision making needs facing today's base supply managers. As suggested in the previous section, supply organizations face a wide variety of information requirements. Each of these areas represents an opportunity to use the modular approach to create an individual specific decision support system. With the development of the software to cement them together, these modules can one day become the building blocks for an overall decision support system for base supply management analysis.

Appendix A: *Supply Personnel Participating in Research*

NAME AND RANK	DUTY TITLE IN SUPPLY	SUPPLY EXPERIENCE
AFLMC/LGS, Gunter AFB, AL (AFLC) *		
Maj Patrick Howard	Division Chief	12 years
Capt Jeff Bailey	Division Chief	7 years
MSgt Marti Martinez	Systems Specialist	24 years
2750 ABW/DMS, Wright-Patterson AFB, OH (AFLC)		
Maj Joseph L. Reuwer	Chief of Supply	20 years
Mr. Wayne Kirkpatrick	Chief Procedures Branch	28 years
Mr. Donald Steltz	Supply Systems Analyst	30 years
Mr. Mike Sutton	Supply Systems Analyst	17 years
Mrs. Sandy Wright	Supply Systems Analyst	3 years
121 TFW/COS, Rickenbacker ANG, OH (ANG)		
CMSgt Norm Baldinger	Supply Systems Analyst	36 years
Mr. Summerfield Burley	Customer Support Rep	23 years
178 TFG, Springfield ANG, OH (ANG)		
1Lt Teresa Shoffstall	Management Systems Officer	3 years
CMSgt Boyd McCarty	Systems Analyst	35 years
HQ MAC/LGSMR & 375 Supply Sq, Scott AFB MO (MAC)		
MSgt Bob Dunigan	Supply Systems Analyst	24 years
SSgt Lawrence Carter	NCOIC Analysis Unit	5 years
Mr. Arther J. Greca	Management Systems Officer	20 years
Mrs. Cheryl Bingaman	Supply Systems Analyst	15 years
3800 ABW/LGSPP, Maxwell AFB AL, (AU)		
Mr. Joseph A. Joyave	Supply Technicion	10 years
3210 Supply Squadron, Eglin AFB, FL (AFSC)		
Mr. Barry McCullough	Systems Analyst	16 years
Mr. Leo D. Paddie	Systems Analyst	27 years

* Members of AFLMC did not participate in formal evaluation

Appendix B: *Personal Interview Questionaire*

Is the M-32 useful in managing your supply account? Why or why not?

What do you consider to be the strengths of the M-32? What do you consider its weaknesses?

A typical M-32 Report contains over 10,000 distinct elements of data. In analyzing the M-32, what specific data elements are you most concerned with?

How do you presently manipulate the data contained in the M-32 to transform it into useful information?

Who are the primary users of this information? How is this information presented to them? What level of detail is required in your presentation of M-32 data?

How often are you tasked by users to provide information contained in the M-32? How much time does a response to requests for information normally take?

What other kinds of analysis would be useful to perform on the M-32, but are not normally accomplished due to the time and effort that would be involved?

In your previous experience as supply analysts, have your information needs remained relatively stable from assignment to assignment, or do the needs vary depending on location and/or desires of the Chief of Supply?

Certain data contained in the M-32 provide the basis by which supply accounts are judged and evaluated. Are you familar with these data elements? Are they important to your organization's management?

Other data contained in the M-32 provide the basis by which a supply organization's manpower are determined. Are you familar with these data elements? Are they important to your organization's management? Do you think supply accounts in general would benefit from such information?

The Air Force Logistics Management Center has developed several software applications to aid in the analysis of an organization's supply account. You may be familar with two of them, SMA and IAP. Do you find these PC based tools to be useful in analyzing your accounts? How do you use them, if at all? Are there any major faults with these software applications? How could they be improved?

What is your opinion of the D-14 as a management tool for analyzing SBSS data on a daily basis?

Appendix C: *Supply Personnel Critique of DMA*

The r c ection portion of the program is great! Would like to see .igures on graphs and not just totals.

Application of this software would help supply's analysis unit track indicators valuable to the Chief of Supply. I would recommend more flexibility in the selection of indicators or an option in the software so supply accounts might choose what to look at.

Software would be useful on a daily basis. Could be improved to include more detail or have the capability to build this detail into the program's selection. We would use it as is because it has the ability to point out areas that may need attention.

Graph part can be of great use for supply summary and report to inform COS about the account. Would like to see the customer effectiveness broke down into percent on specific line items.

Eliminate graph portion. Add figures that drive percentages.

Excellent program. Should be mandatory output from D002A in place of D-14s.

It would be interesting to see the end product on this program. I'm for anything that would make the job easier. However, since the D-14 is a daily product, I'm not sure that the computer time used to furnish this data then load it in an office computer would be worth it. Now for instant calculation of data to show a trend or to perform an analysis this would be useful.

If I had a problem with my account that needed investigation, I would rather use resources currently supplied by SBSS. Program to inflexible for in depth analysis.

Effective from tenth of month to the 25th. Good way to look at data in midstream, avoids decision making on old data. Can be used.

Be able to download the D-14 from the mainframe onto floppy rather than manual input. Be able to select certain time frames by days or weeks. Have capability to produce and print standard reports. Need more user time for further evaluation. A definitely useful program.

Product eliminates bulky listings. Helps eliminates manual data transactions. Especially liked Flag/Predict options. Would like to see expansion of program to include some additional areas such as financial data.

Appendix D: *Daily Management Analysis Data Dictionary*

The DMA data dictionary consists of 181 D-14 data elements divided among twenty DBASE III PLUS database files. The twenty files are divided among two catalogs of ten files each, to represent the current month's data and the previous month's data. Thus, a database file in one catalog has a corresponding file in the other catalog. All fields are numeric, varying in size from two to ten numeric characters.

Customer Support Effectiveness Databases: CSE EVN.DBF and CSE ODD.DBF

COMMON NAME	FIELD NAME
Month of the Year	Month
Day of the Month	Day
Weapons MX Orgs ALC Stockage Effectiveness	CSE WMOALC
Weapons MX Orgs Repair Cycle (XD) Effectiveness	CSE WMO XD
Weapons MX Orgs Repair Cycle (XF) Effectiveness	CSE WMO XF
Weapons MX Orgs EOQ Stockage Effectiveness	CSE W EOQ
Weapons MX Orgs Equipment Stockage Effectiveness	CSE WMO E
Weapons MX Orgs Bench Stock Stockage Effectiveness	CSE WMO BS
Overall Summary ALC Stockage Effectiveness	CSE OS ALC
Overall Summary Repair Cycle (XD) Effectiveness	CSE OS XD
Overall Summary Repair Cycle (XF) Effectiveness	CSE OS XF
Overall Summary EOQ Stockage Effectiveness	CSE OS EOQ
Overall Summary Equipment Stockage Effectiveness	CSE OS E
Overall Summary Bench Stock Stockage Effectiveness	CSE OS BS

Repair Cycle Asset Control Data Databases: RCAC EVN.DBF and RCAC ODD.DBF

COMMON NAME	FIELD NAME
Month of the Year	Month
Day of the Month	Day
Total Units Repaired This Station (RTS)	RC T RTS
Total Units Not Repaired This Station (NRTS)	RC T NRTS
Total Units Condemned (COND)	RC T C
Average Repair Cycle Time ERRC Code XF	RC ARCT XF
Average Repair Cycle Time ERRC Code XD	RC ARCT XD
Total Units Awaiting Parts (RTS) ERRC Code XF	RC TAP R F
Total Units Awaiting Parts (RTS) ERRC Code XD	RC TAP R D
Total Units Awaiting Parts (NRTS) ERRC Code XF	RC TAP N F
Total Units Awaiting Parts (NRTS) ERRC Code XD	RC TAP N D
Total Units Awaiting Parts (COND) ERRC Code XF	RC TAP C F
Total Units Awaiting Parts (COND) ERRC Code XD	RC TAP C D
Average No. Units Awaiting Parts (RTS) ERRC Code XF	RC AAP R F
Average No. Units Awaiting Parts (RTS) ERRC Code XD	RC AAP R D
Average No. Units Awaiting Parts (NRTS) ERRC Code XF	RC AAP N F

Average No. Units Awaiting Parts (NRTS) ERRC Code XD	RC AAP N D
Average No. Units Awaiting Parts (COND) ERRC Code XF	RC AAP C F
Average No. Units Awaiting Parts (COND) ERRC Code XD	RC AAP C D

Excess Stratification Databases:
ES EVN.DBF and ES ODD.DBF

COMMON NAME	FIELD NAME
Month of the Year	MONTH
Day of the Month	DAY
Overall Total, Line Items	ES OT LI
Overall Total, Units	ES OT U
Overall Total, Dollar Value	ES OT DV
Total ERRC Code XD, Line Items	ES XD LI
Total ERRC Code XD, Dollar Value	ES XD DV
Total ERRC Code XF, Line Items	ES XF LI
Total ERRC Code XF, Dollar Value	ES XF DV
Total ERRC Code XB, Line Items	ES XB LI
Total ERRC Code XB, Dollar Value	ES XB DV
Total ERRC Code ND/NF Line Items	ES NDNF LI
Total ERRC Code ND/NF Dollar Value	ES NDNF DV
Releveling Frequency, Number of Times Completed	ES RF NTC
Releveling Frequency, Julian Date of Last Completion	ES RF JDLC
Followup Frequency, Number of Times Completed	ES FF NTC
Followup Frequency, Julian Date of Last Completion	ES FF JDLC
File Status, Number I/R	ES FS NIR
File Status, Number I/R Completed	ES FS NIRC
Percent Completed	ES FS PC
Julian As Of Date	ES FS JAOD

Requisition Summary Databases:
RS EVN.DBF and RS ODD DBF

COMMON NAME	FIELD NAME
Month of the Year	MONTH
Day of the Month	DAY
Total Number Priority Group I (Supplies)	RS TNPG1 S
Total Number Priority Group I (Equipment)	RS TPNG1 E
Total Number Priority Group I (Overall)	RS TPNG1 O
Total Number Priority Group II (Supplies)	RS TPNG2 S
Total Number Priority Group II (Equipment)	RS TPNG2 E
Total Number Priority Group II (Overall)	RS TPNG2 O
Total Number Priority Group III (Supplies)	RS TPNG3 S
Total Number Priority Group III (Equipment)	RS TPNG3 E
Total Number Priority Group III (Overall)	RS TPNG3 O
Total Number All Three Priority Groups (Supplies)	RS TNAPG S
Total Number All Three Priority Groups (Equipment)	RS TNAPG E
Total Number All Three Priority Groups (Overall)	RS TNAPG O

Total Dollar Value of All Three Groups (Supplies)	RS TNAPG S
Total Dollar Value of All Three Groups (Equipment)	RS TNAPG E
Total Dollar Value of All Three Groups (Overall)	RS TNAPG O

MICAP Analysis Databases:
MA EVN.DBF and MA ODD.DBF

COMMON NAME	FIELD NAME
Month of the Year	Month
Day of the Month	Day
Overall Summary, Total Number MICAPS Cause Code A	MA CC TN A
Overall Summary, Total Number MICAPS Cause Code B	MA CC TN B
Overall Summary, Total Number MICAPS Cause Code C	MA CC TN C
Overall Summary, Total Number MICAPS Cause Code D	MA CC TN D
Overall Summary, Total Number MICAPS Cause Code F	MA CC TN F
Overall Summary, Total Number MICAPS Cause Code G	MA CC TN G
Overall Summary, Total Number MICAPS Cause Code H	MA CC TN H
Overall Summary, Total Number MICAPS Cause Code J	MA CC TN J
Overall Summary, Total Number MICAPS Cause Code K	MA CC TN K
Overall Summary, Total Number MICAPS Cause Code P	MA CC TN P
Overall Summary, Total Number MICAPS Cause Code R	MA CC TN R
Overall Summary, Total Number MICAPS Cause Code S	MA CC TN S
Overall Summary, Total Number MICAPS Cause Code T	MA CC TN T
Overall Summary, Total Number MICAPC Cause Code X	MA CC TN X
Overall Summary, Total Number MICAPS Cause Code Z	MA CC TN Z
Overall Summary, Total Number MICAPS All Cause Codes	MA CC TACC
Overall Summary, Total Number MICAPS Delete Code 0	MA DC TN 0
Overall Summary, Total Number MICAPS Delete Code 1	MA DC TN 1
Overall Summary, Total Number MICAPS Delete Code 2	MA DC TN 2
Overall Summary, Total Number MICAPS Delete Code 3	MA DC TN 3
Overall Summary, Total Number MICAPS Delete Code 4	MA DC TN 4
Overall Summary, Total Number MICAPS Delete Code 5	MA DC TN 5
Overall Summary, Total Number MICAPS Delete Code 6	MA DC TN 6
Overall Summary, Total Number MICAPS Delete Code 7	MA DC TN 7
Overall Summary, Total Number MICAPS Delete Code 8	MA DC TN 8
Overall Summary, Total Number MICAPS Delete Code 9	MA DC TN 9
Overall Summary, Total Number MICAPS All Delete Codes	MA DC TADC

Due Out Analysis Databases:
DOA EVN.DBF and DOA ODD.DBF

COMMON NAME	FIELD NAME
Month of the Year	MONTH
Day of the Month	DAY
Total Number of Due Outs, Maintenance Organizations	DOA TNO M
Total Number of Due Outs, Communication	DOA TNO C
Total Number of Due Outs, Civil Engineering	DOA TNO CE
Total Number of Due Outs, Transportation	DOA TNO T
Total Number of Due Outs, Other Organizations	DOA TNO O

Overall Summary, Total No. of Due Outs, Cause Code A	DOA TNCC A
Overall Summary, Total No. of Due Outs, Cause Code B	DOA TNCC B
Overall Summary, Total No. of Due Outs, Cause Code C	DOA TNCC C
Overall Summary, Total No. of Due Outs, Cause Code D	DOA TNCC D
Overall Summary, Total No. of Due Outs, Cause Code F	DOA TNCC F
Overall Summary, Total No. of Due Outs, Cause Code G	DOA TNCC G
Overall Summary, Total No. of Due Outs, Cause Code H	DOA TNCC H
Overall Summary, Total No. of Due Outs, Cause Code J	DOA TNCC J
Overall Summary, Total No. of Due Outs, Cause Code K	DOA TNCC K
Overall Summary, Total No. of Due Outs, Cause Code R	DOA TNCC R
Overall Summary, Total No. of Due Outs, Cause Code S	DOA TNCC S
Overall Summary, Total No. of Due Outs, Cause Code T	DOA TNCC T
Overall Summary, Total No. of Due Outs, Cause Code X	DOA TNCC X
Overall Summary, Total No. of Due Outs, Cause Code Z	DOA TNCC Z
Overall Summary, Total Number of Due Outs	DOA TN OS

Due Out Cancellation Summary Databases:
DOCS EVN.DBF and DOCS ODD.DBF

COMMON NAME	FIELD NAME
Month of the Year	MONTH
Day of the Month	DAY
Dollar Value All Orgs, Supplies, General Support Div	DC V S GSD
Dollar Value All Orgs, Supplies, System Support Div	DC V S SSD
Dollar Value All Orgs, Supplies, Non Stock Fund	DC V S NSF
Dollar Value All Orgs, Total Supplies	DC V S TS
Dollar Value All Orgs, Equipment, Gen Support Div	DC V E GSD
Dollar Value All Orgs, Equipment, Non Stock Fund	DC V E NSF
Dollar Value All Orgs, Total Equipment	DC V E TE
Overall Dollar Value, (GSD), Obligated Funds	DC V GSD O
Overall Dollar Value, (GSD), Unobligated Funds	DC V GSD U
Overall Total Dollar Value, General Support Division	DC V GSD T
Overall Dollar Value, (SSD), Obligated Funds	DC V SSD O
Overall Dollar Value, (SSD), Unobligated Funds	DC V SSD U
Overall Total Dollar Value, System Support Division	DC V SSD T
Overall Total Dollar Value, Non Stock Fund, Firm	DC V NSF F
Overall Total Dollar Value, Non Stock Fund, Memo	DC V NSF M
Overall Total Dollar Value, Total Non Stock Fund	DC V NSF T
Total Dollar Value All Organizations/Divisions/Items	DC V TDVA

Transaction Summary Databases:
TS EVN.DBF and TS ODD.DBF

COMMON NAME	FIELD NAME
Month of the Year	MONTH
Day of the Month	DAY
Total A&F Transactions	TS TT AF
Total Conditions Change	TS TT CC

Total DRMO Transactions	TS TT DRMO
Total Due Out	TS TT DO
Total Due Out Release	TS TT DOR
Total File Changes	TS TT FC
Total Inventory Adjustments	TS TT IA
Total Issues	TS TT I
Total Kill	TS TT K
Total MSK	TS TT MSK
Total Receipts	TS TT R
Total Reverse Post	TS TT RP
Total Shipments	TS TT S
Total SPR	TS TT SPR
Total Supply Point	TS TT SP
Total Turn-in	TS TT TI
Total Warehouse Location Change	TS TT WLC
Total WRM	TS TT WRM
Total WRSK	TS TT WRSK
Total BE/Account Transactions	TS TA BE
Total K Account Transactions	TS TA K
Total P Account Transactions	TS TA P
Total Transactions (Supply Items)	TS TIT S
Total Transactions (Equipment Items)	TS TIT E
Total Number of Transactions All Types/Accounts/Items	TS TNTATAI

Retail Outlet Sales Varience Analysis Databases:
SVA EVN.DBF and SVA ODD.DBF

COMMON NAME	FIELD NAME
Month of the Year	MONTH
Day of the Month	DAY
Total Line Items (ISU)	SVA ISU TI
Total Units (ISU)	SVA ISU TU
Total Dollar Value (ISU)	SVA ISU DV
Total Line Items (DUO)	SVA DUO TI
Total Units (DUO)	SVA DUO TU
Total Dollar Value (DUO)	SVA DUO DV
Total Line Items (DOR)	SVA DOR TI
Total Units (DOR)	SVA DOR TU
Total Dollar Value (DOR)	SVA DOR DV
Total Line Items (TIN)	SVA TIN TI
Total Units (TIN)	SVA TIN TU
Total Dollar Value (TIN)	SVA TIN DV

```
*************************************************************
* Program..: INTRO.prg
* Notes....: This program first examines whether the user is
*    returning to dbase from quattro (where the graphics is
*    done), or if he is starting up DMA for the first time
*    this session.  If the user is just starting DMA, a welcome
*    screen is presented.
*************************************************************

* Change environment by setting talk and bell off
* And determine the value of m_begin
SET TALK OFF
SET BELL OFF
RESTORE FROM variable.mem

DO CASE
  *The user is starting up DMA for the first time
  CASE m_begin = 1
    *Release the values stored in the memory variables
    RELEASE ALL
    CLEAR
  *Give me a D !!
    @  2,10 to  4,22 DOUBLE
    @ 18,10 to 20,22 DOUBLE
    @  2,10 to 20,13 DOUBLE
    @  4,22 to 18,25 DOUBLE
  *Give me an M !!
    @  2,30 to  4,36 DOUBLE
    @  4,36 to  6,39 DOUBLE
    @  6,39 to  8,42 DOUBLE
    @  4,42 to  6,45 DOUBLE
    @  2,45 to  4,51 DOUBLE
    @  2,48 to 20,51 DOUBLE
    @  2,30 to 20,33 DOUBLE
  *Give me an A !!
    @  8,59 to 10,68 DOUBLE
    @  6,56 to 20,59 DOUBLE
    @  4,59 to  6,62 DOUBLE
    @  2,62 to  4,65 DOUBLE
    @  4,65 to  6,68 DOUBLE
    @  6,68 to 20,71 DOUBLE
  *WhatsThatSpell ?!!
    @ 21,1 SAY " "
    @ 22,40 SAY "....for Daily Management Analysis"
    WAIT
```

```
  *The user is returning from the graphics function of DMA
  *so he will want to go straight to the main menu
  CASE m_begin = 2
    *Release all the values stored in memory variables
    *except m_cat, which determines what catalog (current
    *or previous) of database files the user was interested in
    RELEASE ALL EXCEPT m_cat
    DO MAIN
ENDCASE

*****************************************************************
*  PROGRAM: WELCOME
*  PURPOSE: This program presents the user with a welcome screen
*    describing DMA and providing some tips on how to use it as
*    a daily base supply analysis tool.
*****************************************************************

m_skip = ' '
CLEAR

@ 2,4 TO 4,71 DOUBLE
@ 3,6 SAY 'WELCOME TO DMA, YOUR DAILY SUPPLY MANAGEMENT ANALYSIS
ASSISTANT!'

@ 6,2 SAY ' THIS PROGRAM IS DESIGNED TO ALLOW YOU TO QUICKLY
ANALYZE UP TO TWO MONTHS'
@ 7,1 SAY 'WORTH OF D-14 DATA.  BY TAKING FIVE MINUTES EACH DAY
TO AUTOMATICALLY'
@ 8,1 SAY 'DOWNLOAD DATA FROM THE SBSS 1100/60, YOU WILL BE ABLE
TO EXAMINE DAILY'
@ 9,1 SAY 'TRENDS ON ANY OF OVER 180 VARIABLES OF D-14 DATA IN A
MATTER OF SECONDS. THIS'
@ 10,1 SAY 'INFORMATION CAN BE PRESENTED BOTH GRAPHICALLY AND IN
TABULAR FORMAT.  IN'
@ 11,1 SAY 'ADDITION, YOU CAN SET FLAGS FOR EACH DATA ELEMENT,
 WHICH WILL NOTIFY YOU ANY'
@ 12,1 SAY 'TIME THE UPPER AND LOWER BOUNDS YOU PLACE ON IT ARE
EXCEEDED.  FINALLY,'
@ 13,1 SAY 'DMA CAN BE USED TO ESTIMATE WHAT THE VALUE OF THE
M-32 IS LIKELY TO'
@ 14,1 SAY 'BE FOR ANY GIVEN PIECE OF DATA.'

? m_skip
WAIT
CLEAR

@ 4,2 SAY '  YOU WILL BE PROVIDED A MENU THAT OFFERS THE OPTIONS
JUST DESCRIBED.  ONCE'
@ 5,1 SAY 'YOU SELECT THE WAY IN WHICH YOU WOULD LIKE TO EXAMINE
```

```
THE DATA, DMA WILL'
@ 6,1 SAY 'PROVIDE YOU WITH A SERIES OF MENU OPTIONS DESIGNED TO
ALLOW YOU TO SELECT'
@ 7,1 SAY 'THE PARTICULAR DATA ELEMENT YOU ARE INTERESTED IN.
ONCE THE EXACT D-14'
@ 8,1 SAY 'VARIABLE IS IDENTIFIED, DMA AUTOMATICALLY PROVIDES YOU
WITH THE DESIRED'
@ 9,1 SAY 'INFORMATION.'

@ 11,2 SAY '  IF ALL THIS SOUNDS CONFUSING, JUST GO AHEAD AND
START USING DMA.'
@ 12,1 SAY 'YOU WILL QUICKLY CATCH ON.  HELP OPTIONS WITH SLIGHT
MORE DETAIL ARE'
@ 13,1 SAY 'PROVIDED ALONG THE WAY IF YOU NEED THEM. IF YOU HAVE
@ 14,1 SAY 'SUGGESTIONS ABOUT DMA, CALL THE SUPPLY BRANCH OF THE
AIR FORCE LOGISTICS'
@ 15,1 SAY 'MANAGEMENT CENTER (AFLMC) AT AV 446-6041 OR CONTACT
CAPT MARK LESAGE AT'
@ 16,1 SAY 'AV 579-6206, HURLBERT FIELD.'
? m_skip
WAIT

******************************************************************
* Program..: TODAY
* Notes....: This program determines the current day, month,
*    and year in order that the proper catalog of files is
*    put in use.
******************************************************************

m_again = 'y'
m_skip = ' '
DO WHILE m_again = 'y'
CLEAR

@ 1, 20 TO 3, 48
@ 9, 28 TO 12,40 DOUBLE
@ 2, 22 SAY [PLEASE ENTER TOAYS'S DATE]
@ 5, 20 SAY [PRESS RETURN AFTER EACH ENTRY]
@ 7, 1  SAY [FOR EXAMPLE, 27 FEB 90 WOULD BE ENTERED AS 27
{RETURN} 02{RETURN} 90{RETURN}]
@ 10, 30 SAY [dd/mm/yy]
 STORE 27 TO day
 STORE 02 TO month
 STORE 90 TO year
SET CONFIRM ON
@ 11, 30 GET day     PICTURE '99' RANGE 1, 31
@ 11, 33 GET month   PICTURE '99' RANGE 1, 12
@ 11, 36 GET year    PICTURE '99' RANGE 89, 99
READ
SET CONFIRM OFF
```

```
DO CASE
 CASE month=1 .OR. month=3 .OR. month=5 .OR. month=7 .OR.
month = 9 .OR. month=11
   m_mon = 'odd'
 CASE month=2 .OR. month=4 .OR. month=6 .OR. month=8 .OR.
month=10 .OR. month=12
   m_mon = 'evn'
ENDCASE

DO CASE
  CASE month = 1
   thismonth = ' JANUARY'
  CASE month = 2
   thismonth = ' FEBRUARY'
  CASE month = 3
   thismonth = ' MARCH'
  CASE month = 4
   thismonth = ' APRIL'
  CASE month = 5
   thismonth = ' MAY'
  CASE month = 6
   thismonth = ' JUNE'
  CASE month = 7
   thismonth = ' JULY'
  CASE month = 8
   thismonth = ' AUGUST'
  CASE month = 9
   thismonth = ' SEPTEMBER'
  CASE month = 10
   thismonth = ' OCTOBER'
  CASE month = 11
   thismonth = ' NOVEMBER'
  CASE month = 12
   thismonth = ' DECEMBER'
ENDCASE

DO CASE
  CASE year = 89
   thisyear = ', 1989'
  CASE year = 90
   thisyear = ', 1990'
  CASE year = 91
   thisyear = ', 1991'
  CASE year = 92
   thisyear = ', 1992'
  CASE year = 93
   thisyear = ', 1993'
  CASE year = 94
   thisyear = ', 1994'
```

```
  CASE year = 95
   thisyear = ', 1995'
  CASE year = 96
   thisyear = ', 1996'
  CASE year = 97
   thisyear = ', 1997'
  CASE year = 98
   thisyear = ', 1998'
  CASE year = 99
   thisyear = ', 1999'
ENDCASE

@ 15,2 SAY 'PLEASE VERIFY TODAY'S DATE IS:'
?? m_skip
?? day
?? thismonth
?? thisyear
? m_skip
@ 17,2 SAY 'PRESS [y] IF DATE IS CORRECT, PRESS [n] IF IT IS
INCORRECT'
@ 19,2 SAY 'NOTE: DATA MORE THAN TWO MONTHS OLD WILL BE DROPPED
FROM DMA'
DO WHILE .T.
 choise = '?'
 @ 17, 65 GET choise PICTURE 'X'
  READ
  DO CASE
   CASE choise = 'y'
     m_again = 'n'
    EXIT
   CASE choise = 'n'
     EXIT
  ENDCASE
ENDDO
ENDDO


******************************************************************
* PROGRAM: LOADEXAM
* PURPOSE: This program creates a menu that allows the
*    user to choose either to Load new data into the DMA
*    database, or Examine data already stored in the database
******************************************************************

CLEAR
PUBLIC m_cat

*Loop as long as user desires another action
DO WHILE .T.
```

```
*Clear screen and display menu
CLEAR
@ 2,2 SAY 'Indicate your choice by entering in the first
letter of your desired option.'
@ 6,2 SAY 'Would you like to load new data into DMA or
examine data already there'
@  8,10 SAY 'LOAD'
@  9,10 SAY 'EXAMINE'
@ 11,10 SAY 'HELP'
@ 14,10 SAY 'Press [l] for LOAD, [e] for EXAMINE, or [h]

*Place a double lined box around menu
@ 7,8 TO 12,18 DOUBLE

*Initialize choise. Get and read the value for choise
choise = '?'
@ 6, 73 GET choise PICTURE 'X'
READ
CLEAR

*Take appropriate action based on choise
IF choise = 'l'
**************************************************************
* PROGRAM: LOADDATA
* PURPOSE: This program queries the user to determine the
*    specific day and month for which the data to be loaded
*    applies. It then requests the uses to insert the data
*    disk into the A drive so the contents of the floppy can
*    be loaded into the appropriate areas of DMA's database.
**************************************************************

CLEAR
*Set memory variables
 m_skip = ' '
 m_then = 'Then'

  CLEAR
  * Determine day and month to which the data applies
  @  5, 4 SAY 'Enter day and month of data you wish to load.
Press {RETURN} for both'
  @  7, 5 SAY '(For example, 16 May 90 would be entered as
16{RETURN}  05{RETURN}'


  @ 10,30 Say [dd/mm]

  STORE 16 TO selectday
  STORE 05 TO selectmonth
  SET CONFIRM ON
```

```
  SET CONFIRM ON
  @ 11,30 GET selectday PICTURE '99' RANGE 1, 31
  @ 11,33 GET selectmonth PICTURE '99' RANGE 1, 12
  READ
  SET CONFIRM OFF

  DO CASE
   CASE selectmonth = 1
     m_month = ' JANUARY'
   CASE selectmonth = 2
     m_month = ' FEBRUARY'
   CASE selectmonth = 3
     m_month = ' MARCH'
   CASE selectmonth = 4
     m_month = ' APRIL'
   CASE selectmonth = 5
     m_month = ' MAY'
   CASE selectmonth = 6
     m_month = ' JUNE'
   CASE selectmonth = 7
     m_month = ' JULY'
   CASE selectmonth = 8
     m_month = ' AUGUST'
   CASE selectmonth = 9
     m_month = ' SEPTEMBER'
   CASE selectmonth = 10
     m_month = ' OCTOBER'
   CASE selectmonth = 11
     m_month = ' NOVEMBER'
   CASE selectmonth = 12
     m_month = ' DECEMBER'
  ENDCASE

CLEAR
@ 2,1 SAY 'INSERT FLOPPY DISK CONTAINING DATA FOR:'
  ?? m_skip
  ?? selectday
  ?? m_month
   ? m_skip
   ? m_then
  WAIT

******LOADING PROGRAM GOES HERE********

  @ 12,2 SAY 'DMA is loading your data. Please Standby.....'

  m_loop = 1
  DO WHILE m_loop < 900
   m_loop = m_loop + 1
  ENDDO
```

```
  @ 14,2 SAY 'Loading is complete.'
  m_loop = 1
  DO WHILE m_loop < 250
   m_loop =m_loop + 1
  ENDDO
  LOOP
 ENDIF

 IF choise = 'e'
m_answer = 'wrong'
  DO WHILE m_answer = 'wrong'
   @ 9,10 SAY 'EXAMINE'
   @ 7,8 TO 12,18 DOUBLE
   @ 14,2 SAY 'DO YOU WISH TO EXAMINE PREVIOUS MONTH'S DATA
(M-32 ALREADY OUT) '
   @ 15,2 SAY 'OR CURRENT MONTH'S DATA (FOR WHICH THE M-32
HAS NOT BEEN PRINTED'
   @ 17,2 SAY 'PRESS [p] FOR PREVIOUS MONTH OR [c] FOR
CURRENT MONTH'
   m_select = '?'
   @ 17,65 GET m_select PICTURE 'X'
   READ
   DO CASE
    CASE m_select = 'p'
     m_answer = 'ok'
     IF m_mon = 'odd'
      m_cat = 'evn'
     ENDIF
     IF m_mon = 'evn'
      m_cat = 'odd'
     ENDIF
    CASE m_select = 'c'
     m_answer = 'ok'
     IF m_mon = 'odd'
      m_cat = 'odd'
     ENDIF
     IF m_mon = 'evn'
      m_cat='evn'
     ENDIF
   ENDCASE
   *Provide Menu of choises of how to examine data
  ENDDO
  EXIT
 ENDIF

 IF choise = 'h'
  m_skip = ' '
  *Provide help for this area
  CLEAR
```

```
        @ 2,1 SAY ' By pressing (1), you can automatically
upload data into DMA that have'
        @ 3,1 SAY 'previously been extracted from the SBSS
1100/60 by a standard extraction'
        @ 4,1 SAY 'routine.  You will be asked to identify the
day and month for which'
        @ 5,1 SAY 'the data apply so that DMA can put them in
their proper place in DMA's'
        @ 6,1 SAY 'database.  DMA holds up to two months worth
of D-14 data.  This allows'
        @ 7,1 SAY 'you to examine last months data to determine
why the M-32 perfomed as it'
        @ 8,1 SAY 'did, or the current months data to get an
idea of what the upcoming'
        @ 9,1 SAY 'M-32 will look like.  At the begining of the
third month, data more'
        @ 10,1 SAY 'than 62 days old will be automatically
dropped from the system'
        @ 11,1 SAY 'to ensure old data does not get mixed up with
the new.  Although'
        @ 12,1 SAY 'loading data on a daily basis may seem like
a painful process, it'
        @ 13,1 SAY 'will come quick and easy after you have done
it for a while.  The'
        @ 14,1 SAY 'more often you input the data, the more
useful DMA will be'
        @ 15,1 SAY 'as a supply management analysis tool.  We
think you will find'
        @ 16,1 SAY 'that it is worth the effort.'

 ? m_skip
 WAIT
 CLEAR
        @ 2,1 SAY '  By pressing (e), you will be provided a menu
of options designed to'
        @ 3,1 SAY 'allow you to examine a full months worth of
D-14 data in a number of ways.'
        @ 4,1 SAY 'You can either examine daily data from the
previous month (for which the'
        @ 5,1 SAY 'M-32 has already been printed), or you can
examine the current month's'
        @ 6,1 SAY 'data (which still awaits the M-32).  Examining
last month's data can help'
        @ 7,1 SAY 'you determine why an area of the M-32
performed the way it did.'
        @ 8,1 SAY 'Examining the current month's data can help
you determine if the same'
        @ 9,1 SAY 'problems are likely to appear on the upcoming
M-32.'
        @ 11,1 SAY 'You can learn the details of how the data can
be examined using DMA by'
```

```
  ? m_skip
  WAIT
  LOOP
 ENDIF
ENDDO
 CLEAR
 @ 11, 17 SAY 'PLEASE STANDBY WHILE DMA RETRIEVES YOUR DATA'
DO MAIN
```

```
SET PROCEDURE TO MENU
****************************************************************
* Program..: DESIRE.prg
* Notes....: This program creates a menu that allows the
*    user to choose in what way we wants to examine the
*    data contained in the DMA database
****************************************************************

 m_loop = 'y'
 DO WHILE m_loop = 'y'
* Create Public Memory Variables
PUBLIC M_DESIRE
PUBLIC M_ELEMENT
PUBLIC M_TITLE
PUBLIC M_FLAG
PUBLIC M_AREA

* Loop as long as user desires another action.  If user
DO WHILE .T.

   * Clear screen and display menu
    CLEAR

    @  2,2   SAY [How would you like to examine the data]
    @   9,10 SAY [LIST]
    @  10,10 SAY [GRAPH]
    @  11,10 SAY [FLAG]
    @  12,10 SAY [SCAN]
    @  13,10 SAY [PREDICT]
    @  15,10 SAY [EXIT]
    @  16,10 SAY [HELP]

    @ 8,8 TO 17,18 DOUBLE

    * Initialize m_desire. Get and read the value for
    *   m_desire then clear screen
    m_desire = '?'
    @ 2, 42 GET m_desire PICTURE 'X'
    READ
    CLEAR

    * Take appropriate action based on value of selectnum

    IF m_desire = 'e'
         * Exit program and return to DOS prompt
         CLEAR
         @ 5, 17 SAY 'THANKYOU FOR USING DMA. COME BACK SOON!'
         STORE 1 TO m_be in
         ERASE variable.mem
         SAVE TO variable.mem
         QUIT
     ENDIF
```

```
    IF m_desire = 'l'
        *Set desire to list
        EXIT
    ENDIF

    IF m_desire = 'g'
        * Set desire to graph
        EXIT
    ENDIF

    IF m_desire = 'f'
        * set desire to flag
        EXIT
    ENDIF

    IF m_desire = 's'
        * Set desire to scan
        EXIT
    ENDIF

    IF m_desire = 'p'
        * Set desire to predict
        EXIT
    ENDIF

    IF m_desire = 'h'
        * Run help screen
        CLEAR
        TEXT
LIST (l): Returns the D-14 data of the item of interest for each
    day of the month. This allows you to automatically review a
    month's worth of D-14 data for a particular item without having
    to shuffle through pages of SBSS output.

GRAPH (g): Creates a bar chart that graphically portrays
    the D-14 data accumulated for each day of the month. This may
    help you gain a feel for how the M-32 evolved.

FLAG (f): Allows you to set upper and lower limits for each of
    the 181 D-14 data elements contained in DMA'S database. Once the
    limits have been set, they are permentantly stored by DMA and
    may be recalled anytime. Works in conjunction with SCAN.

SCAN (s): Once an upper and lower limit have been set using the FLAG
    function, DMA will SCAN a chosen area of the D-14 database, say
    for instance Customer Support Effectivess, for any days in which
    the limits have been violated. Those data are then listed.

PREDICT (p): Provides DMA's best estimate of what the value of the
    M-32 will be for a given piece of data based on what has been
    uploaded from the 1100/60 at the time the prediction is made.
```

```
        ENDTEXT
      WAIT
      LOOP
    ENDIF
  ENDIF
ENDDO

**********************************************************
* Program : AREA
* Purpose : This program creates a menu that allows the
*    user to choose which area of the D-14 or M-32 he
*    wishes to examine
**********************************************************

DO WHILE .T.

 * Display main menu
 CLEAR
 @ 2,2 SAY 'Indicate your choice by entering the appropriate
number'
 @ 6,2 SAY 'Which area of supply management are you interested
in?'
 @  8,9 SAY '01.  CUSTOMER SUPPORT EFFECTIVENESS'
 @  9,9 SAY '02.  REPAIR CYCLE ASSET CONTROL DATA'
 @ 10,9 SAY '03.  EXCESS STRATIFICATION'
 @ 11,9 SAY '04.  REQUISITION SUMMARY'
 @ 12,9 SAY '05.  MICAP ANALYSIS'
 @ 13,9 SAY '06.  DUE OUT ANALYSIS'
 @ 14,9 SAY '07.  DUE OUT CANCELLATION SUMMARY'
 @ 15,9 SAY '08.  TRANSACTION SUMMARY'
 @ 16,9 SAY '09.  RETAIL OUTLET SALES VARIENCE'
 @ 17,9 SAY '10.  SUPPLY PERFORMANCE MEASURES'
 @ 19,9 SAY '11.  RETURN TO MAIN MENU'

 @ 7,8 TO 20,45 DOUBLE

*Initialize, get and read value of choise
choise = 11
 @ 6,57 GET choise PICTURE '99' RANGE 1,11
 READ
 CLEAR

*Take action based on choise
IF choise = 1
 m_area = 'cse'
 DO CASE
  CASE m_desire = 'f'
     *Open FLAG CSE database
     USE FLAG_CSE
     SET FIELDS TO ALL
     *Display the customer support effctiveness menu
```

```
      DO CSE
      EXIT
   CASE m_desire = 's'
    DO SCAN_CSE
     EXIT
   OTHERWISE
      *Open appropriate (current or previous) catalog
      DO CASE
       CASE m_cat = 'evn'
        USE EVN_CSE
       CASE m_cat = 'odd'
        USE ODD_CSE
       ENDCASE
      *Display customer support effectiveness menu
      DO CSE
      EXIT
  ENDCASE
 ENDIF

 IF choise = 2
  m_area = 'rcac'
  DO CASE
   CASE m_desire='f'
    USE FLAG_RC
    SET FIELDS TO ALL
    DO RCAC
    EXIT
   CASE m_desire = 's'
    DO SCAN_RC
    EXIT
   OTHERWISE
     DO CASE
      CASE m_cat = 'evn'
       USE EVN_RCAC
      CASE m_cat = 'odd'
       USE ODD_RCAC
      ENDCASE
      DO RCAC
      EXIT
  ENDCASE
 ENDIF

 IF choise=3
  m_area = 'es'
  DO CASE
   CASE m_desire='f'
    USE FLAG_ES
    SET FIELDS TO ALL
    DO ES
    EXIT
```

```
   CASE m_desire='s'
    DO SCAN_ES
    EXIT
   OTHERWISE
     DO CASE
      CASE m_cat='evn'
       USE EVN_ES
      CASE m_cat='odd'
       USE ODD_ES
     ENDCASE
     DO ES
    EXIT
  ENDCASE
ENDIF

IF choise=4
  m_area = 'rs'
  DO CASE
   CASE m_desire='f'
    USE FLAG_RS
    SET FIELDS TO ALL
    DO RS
     EXIT
   CASE m_desire='s'
    DO SCAN_RS
    EXIT
   OTHERWISE
    DO CASE
     CASE m_cat='evn'
      USE EVN_RS
     CASE m_cat='odd'
      USE ODD_RS
    ENDCASE
     DO RS
     EXIT
  ENDCASE
ENDIF

IF choise=5
  m_area = 'ma'
  DO CASE
   CASE m_desire='f'
    USE FLAG_MA
    SET FIELDS TO ALL
    DO MA
     EXIT
   CASE m_desire='s'
    DO SCAN_MA
    EXIT
```

```
   OTHERWISE
    DO CASE
     CASE m_cat='evn'
      USE EVN_MA
     CASE m_cat='odd'
      USE ODD_MA
     ENDCASE
      DO MA
     EXIT
  ENDCASE
ENDIF

IF choise=6
 m_area = 'doa'
 DO CASE
  CASE m_desire='f'
   USE FLAG_DOA
   SET FIELDS TO ALL
   DO DOA
   EXIT
  CASE m_desire='s'
   DO SCAN_DOA
   EXIT
  OTHERWISE
   DO CASE
    CASE m_cat='evn'
     USE EVN_DOA
    CASE m_cat='odd'
     USE ODD_DOA
   ENDCASE
    DO DOA
    EXIT
 ENDCASE
ENDIF

IF choise=7
 m_area = 'docs'
 DO CASE
  CASE m_desire='f'
   USE FLAGDOCS
   SET FIELDS TO ALL
   DO DOCS
   EXIT
  CASE m_desire='s'
   DO SCANDOCS
   EXIT
  OTHERWISE
   DO CASE
    CASE m_cat='evn'
     USE EVN_DOCS
```

```
    CASE m_cat='odd'
     USE ODD_DOCS
   ENDCASE
    DO DOCS
    EXIT
 ENDCASE
ENDIF

IF choise=8
 m_area = 'ts'
 DO CASE
  CASE m_desire='f'
   USE FLAG_TS
   SET FIELDS TO ALL
   DO TS
   EXIT
  CASE m_desire='s'
   DO SCAN_TS
   EXIT
  OTHERWISE
   DO CASE
    CASE m_cat='evn'
     USE EVN_TS
    CASE m_cat='odd'
     USE ODD_TS
   ENDCASE
   DO TS
   EXIT
 ENDCASE
ENDIF

IF choise=9
 m_area = 'sva'
 DO CASE
  CASE m_desire='f'
   USE FLAG_SVA
   SET FIELDS TO ALL
   DO SVA
   EXIT
  CASE m_desire='s'
   DO SCAN_SVA
   EXIT
  OTHERWISE
   DO CASE
    CASE m_cat='evn'
     USE EVN_SVA
    CASE m_cat='odd'
     USE ODD_SVA
   ENDCASE
```

```
    DO SVA
    EXIT
  ENDCASE
 ENDIF

 IF choise=10
 *m_area = 'spm'
 *DO CASE
 * CASE m_desire='f'
 *  USE FLAG_SPM
 *  SET FIELDS TO ALL
    *Display SPM menu
 *  DO SPM
 *  EXIT
 * CASE m_desire='s'
 *  DO SCAN_SPM
 *  EXIT
 * OTHERWISE
 *  DO CASE
 *   CASE m_cat='evn'
 *    USE EVN_SPM
 *   CASE m_cat='odd'
 *    USE ODD_SPM
 *   ENDCASE
 *  DO SPM
 *  EXIT
 *ENDCASE
                    LOOP
 ENDIF

 IF choise=11
  *Return to Main Menu by EXITing to Procedure file
   m_return = 'yes'
   DO GO_BACK
   EXIT
 ENDIF

 ENDDO
 LOOP
 ENDDO
```

```
PROCEDURE GO_BACK
******************************************************************
*Program.: GO_BACK
*Purpose.: This program merely provides a way to return to the main
*    menu from the program MAIN.prg by examining the value of the
*    memory variable m_return.  If m_return = 'yes', the user is
*    taken right back to the main menu.
*******************************************************************

DO CASE
  CASE m_return = 'yes'
   *Return to the main menu
   RETURN
END CASE


PROCEDURE CSE
******************************************************************
* Program..: CSE_MENU                                            *
* Notes....: This program creates a menu that allows the         *
*    user to choose which area of Customer Support               *
*    Effectiveness he wishes to examine.                         *
******************************************************************

* Loop until user makes a choise
DO WHILE .T.

   * Clear screen and display menu
    CLEAR

    @ 6,2 SAY 'Which area of Customer Support Effectiveness are
you interested?'

    @  8,10 SAY '1.  WEAPONS MAINTENANCE ORGANIZATIONS'
    @  9,10 SAY '2.  OVERALL SUMMARY'
    @ 11,10 SAY '3.  RETURN TO MAIN MENU'

    * Place a double lined box around menu
    @ 7,8 TO 12,47 DOUBLE

    * Initialize, get and read the value for choise
    choise = 3
    @ 6,67 GET choise PICTURE '9' RANGE 1,3
    READ
    CLEAR

    * Take appropriate action based on choise
     IF choise = 1
         * Run CSE_WMO Menu
         EXIT
     ENDIF
```

```
     IF choise = 2
         * Run CSE_Overall Summary Menu
         EXIT
     ENDIF

     IF choise = 3
        * Return to Base Menu of Choises
        RETURN
     ENDIF
ENDDO

DO CASE
  CASE choise = 1
**************************************************************
* Program: CSE_WMO
* PURPOSE: This program creates a menu that allows the
*    user to choose which specific data element of Customer
*    Support Effectiveness he wishes to examine then executes
*    the program to accomplish the desired action
**************************************************************

* Tell DMA how this type of data is accumulated by the SBSS
m_type = 'avg'

* Loop until user makes a choise
DO WHILE .T.

 *Display menu
 CLEAR
 @ 6,2 SAY 'Which particular data are you interested?'

 @  8,3  SAY '1.  TOTAL ALC STOCKAGE EFFECTIVENESS BY LINE
ITEM'
 @  9,3  SAY '2.  REPAIR CYCLE (XD) STOCKAGE EFFECTIVENESS BY
LINE ITEM'
 @ 10,3  SAY '3.  REPAIR CYCLE (XF) STOCKAGE EFFECTIVENESS BY
LINE ITEM'
 @ 11,3  SAY '4.  EOQ STOCKAGE EFFECTIVENESS BY LINE ITEM'
 @ 12,3  SAY '5.  EQUIPMENT STOCKAGE EFFECTIVENESS BY LINE
ITEM'
 @ 13,3  SAY '6.  BENCH STOCK STOCKAGE EFFECTIVENESS BY LINE
ITEM'
 @ 15,3  SAY '7.  RETURN TO MAIN MENU'

 @ 7,2 TO 16,61 DOUBLE

 *Initialize,get and read the value for choise
 choise = 7
 @ 6,47 GET choise PICTURE '9' RANGE 1, 7
 READ
 CLEAR
```

```
 * Take appropriate action based on choise
 DO CASE
  CASE choise = 1
   *Work with this particular data
    m_element = 'CSE_WMOALC'
    m_title = 'WEAPON MX ORGANIZATIONS TOTAL ALC STOCKAGE
EFFECTIVENESS BY LINE ITEM'
    DO CASE
     CASE m_desire = 'f'
      LOCATE FOR element = m_element
      *Let user specify flags
     EXIT
     OTHERWISE
      SET FIELDS TO RECORD, CSE_WMOALC
      *The prediction model needs to know the field *, so
      n=4
      *Execute program for desired action
     EXIT
    ENDCASE

  CASE choise=2
   *Work With this particular data
   m_element='CSE_WMO_XD'
   m_title='WEAPONS MX ORGS REPAIR CYCLE (XD) STOCKAGE
EFFECTIVENESS BY LINE ITEM'
   DO CASE
    CASE m_desire='f'
     LOCATE FOR element= m_element
      *Let user specify flags
     EXIT
    OTHERWISE
     SET FIELDS TO RECORD, CSE_WMO_XD
     n=5
     EXIT
   ENDCASE

  CASE choise = 3
  *Work with this particular data
  m_element = 'CSE_WMO_XF'
  m_title='WEAPONS MX ORGS REPAIR CYCLE (XF) STOCKAGE
EFFECTIVENESS BY LINE ITEM'
  DO CASE
   CASE m_desire='f'
    LOCATE FOR element= m_element
     EXIT
   OTHERWISE
    SET FIELDS TO RECORD, CSE_WMO_XF
    n=6
    EXIT
  ENDCASE
```

```
  CASE choise = 4
  *Work with this particular data
  m_element = 'CSE_W_EOQ'
  m_title='WEAPONS MX ORGANIZATIONS EOQ STOCKAGE EFFECTIVENESS
LINE ITEM'
  DO CASE
   CASE m_desire='f'
    LOCATE FOR element= m_element
    EXIT
   OTHERWISE
    SET FIELDS TO RECORD, CSE_W_EOQ
    n=7
    EXIT
  ENDCASE

  CASE choise = 5
  *Work with this particular data
   m_element = 'CSE_WMO_E'
   m_title='WEAPONS MX ORGANIZATIONS EQUIPMENT STOCKAGE
EFFECTIVENESS BY LINE ITEM'
   DO CASE
    CASE m_desire='f'
    LOCATE FOR element= m_element
    EXIT
   OTHERWISE
    SET FIELDS TO RECORD, CSE_WMO_E
    n=8
    EXIT
  ENDCASE

  CASE choise = 6
   *Work with this particular data
   m_element = 'CSE_WMO_BS'
   m_title='WEAPONS MX ORGS BENCH STOCK STOCKAGE EFFECTIVENESS
LINE ITEM'
   DO CASE
    CASE m_desire='f'
     LOCATE FOR element= m_element
    EXIT
    OTHERWISE
     SET FIELDS TO DAY, CSE_WMO_BS
     n=9
    EXIT
  ENDCASE

  CASE choise = 7
   *Return to main menu
        RETURN
 ENDCASE
ENDDO
```

```
CASE choise = 2
****************************************************************
* Program: CSE_OS
* PURPOSE: This program creates a menu that allows the
*     user to choose which specific data element of Customer
*     Support Effectiveness he wishes to examine then executes
*     the program to accomplish the desired action
****************************************************************

* Tell DMA how this type of data is accumulated by the SBSS
m_type = 'avg'

* Loop until user makes a choise
DO WHILE .T.

 *Display menu
 CLEAR
 @ 6,2 SAY 'Which particular data are you interested?'

 @  8,3  SAY '1.  TOTAL ALC STOCKAGE EFFECTIVENESS BY LINE
ITEM'
 @  9,3  SAY '2.  REPAIR CYCLE (XD) STOCKAGE EFFECTIVENESS BY
LINE ITEM'
 @ 10,3  SAY '3.  REPAIR CYCLE (XF) STOCKAGE EFFECTIVENESS BY
LINE ITEM'
 @ 11,3  SAY '4.  EOQ STOCKAGE EFFECTIVENESS BY LINE ITEM'
 @ 12,3  SAY '5.  EQUIPMENT STOCKAGE EFFECTIVENESS BY LINE
ITEM'
 @ 13,3  SAY '6.  BENCH STOCK STOCKAGE EFFECTIVENESS BY LINE
ITEM'
 @ 15,3  SAY '7.  RETURN TO MAIN MENU'

 @ 7,2 TO 16,61 DOUBLE

 *Initialize,get and read the value for choise
 choise = 7
 @ 6,47 GET choise PICTURE '9' RANGE 1, 7
 READ
 CLEAR

 * Take appropriate action based on choise
 DO CASE
  CASE choise = 1
   *Work with this particular data
    m_element = 'CSE_OS_ALC'
    m_title = 'OVERALL SUMMARY TOTAL ALC STOCKAGE
EFFECTIVENESS BY LINE ITEM'
    DO CASE
     CASE m_desire = 'f'
      LOCATE FOR element = m_element
    EXIT
```

```
      *Let user specify flags
     OTHERWISE
      SET FIELDS TO RECORD, CSE_OS_ALC
      *The prediction model needs to know the field #, so
      n=10
      *Execute program for desired action
     EXIT
    ENDCASE

  CASE choise=2
   *Work With this particular data
   m_element='CSE_OS_XD'
   m_title='OVERALL SUMMARY REPAIR CYCLE (XD) STOCKAGE
EFFECTIVENESS BY LINE ITEM'
   DO CASE
    CASE m_desire='f'
     LOCATE FOR element= m_element
      *Let user specify flags
     EXIT
    OTHERWISE
     SET FIELDS TO RECORD, CSE_OS_XD
     n=11
    EXIT
   ENDCASE

  CASE choise = 3
  *Work with this particular data
  m_element = 'CSE_OS_XF'
  m_title='OVERALL SUMMARY REPAIR CYCLE (XF) STOCKAGE
EFFECTIVENESS BY LINE ITEM'
  DO CASE
   CASE m_desire='f'
    LOCATE FOR element= m_element
    EXIT
   OTHERWISE
    SET FIELDS TO RECORD, CSE_OS_XF
    n=12
    EXIT
  ENDCASE

  CASE choise = 4
  *Work with this particular data
  m_element = 'CSE_OS_EOQ'
  m_title='OVERALL SUMMARY EOQ STOCKAGE EFFECTIVENESS BY
LINE ITEM'
  DO CASE
   CASE m_desire='f'
    LOCATE FOR element= m_element
    EXIT
   OTHERWISE
```

```
    SET FIELDS TO RECORD, CSE_OS_EOQ
    n=13
    EXIT
  ENDCASE

  CASE choise = 5
  *Work with this particular data
   m_element = 'CSE_OS_E'
   m_title='OVERALL SUMMARY EQUIPMENT STOCKAGE
EFFECTIVENESS BY LINE ITEM'
   DO CASE
    CASE m_desire='f'
    LOCATE FOR element= m_element
    EXIT
   OTHERWISE
    SET FIELDS TO RECORD, CSE_OS_E
    n=14
    EXIT
  ENDCASE

  CASE choise = 6
   *Work with this particular data
   m_element = 'CSE_OS_BS'
   m_title='OVERALL SUMMARY BENCH STOCK STOCKAGE EFFECTIVENESS
LINE ITEM'
   DO CASE
    CASE m_desire='f'
     LOCATE FOR element= m_element
    EXIT
    OTHERWISE
     SET FIELDS TO DAY, CSE_OS_BS
     n=15
    EXIT
  ENDCASE

  CASE choise = 7
   *Return to main menu
    RETURN
 ENDCASE
ENDDO
ENDCASE

**************************************************************
* Program..: EXECUTE
* Notes....: This program executes the desired action based
*    on the user's responces to the various menu optons.
**************************************************************

* Select the chosen fields to work with
SET FIELDS ON
m_skip = ' '
```

```
DO CASE
  CASE m_desire = 'l'
    *List the data which the user has indicated
    ? m_title
    @ 2,1 SAY 'DAY'
    SET HEADING OFF
    DISPLAY ALL OFF
    SET FIELDS TO
    ? m_skip
    WAIT

  CASE m_desire = 'g'
    *Graph the data which the user has indicated
    LOCATE FOR RECORD = 1
    SET SAFETY OFF
    COPY TO GRAPH.dbf
    USE GRAPH.dbf
    SET SAFETY ON
    CLEAR
* Assign value to a saved memory variable saying user will graph
* so when user returns to DBASE he will not see welcome screens
    PUBLIC m_begin
    m_begin = 2
    ERASE variable.mem
    SAVE TO variable.mem
    SET FIELDS TO
    QUIT

  CASE m_desire = 'f'
    *Allow user to set flags for selected data element
    CLEAR
    SET FORMAT TO FLAG_CSE.fmt
    SET CONFIRM ON
    EDIT FOR element = m_element
    CLOSE DATABASES
    CLOSE FORMAT
    SET CONFIRM OFF

  CASE m_desire = 'p'
    *Make a prediction of what M-32 will look like
    CLEAR
    m_skip = ' '
    m_field = FIELD(n)
    m_sum = 0
    m_count = 0
    m_zerodays = 0
    @ 2,1 SAY 'Please standby while DMA makes its prediction'
    m_day = 1
    DO WHILE m_day < 32
      LOCATE FOR RECORD = m_day
```

```
      IF &m_field <> 0
        m_sum = m_sum + &m_field
        m_count = m_count + 1
      ELSE
        m_zerodays = m_zerodays + 1
      ENDIF
      m_day = m_day + 1
    ENDDO
     DO CASE
      CASE m_type = 'avg'
        m_predict = m_sum/m_count
      CASE m_type = 'zro'
        m_predict = m_sum * (30 - m_zerodays)/ m_count
      CASE m_type = 'cum'
        m_factor  = 30/(m_count + m_zerodays)
        m_predict = &m_field * m_factor
     ENDCASE
  @ 7,1 SAY 'BASED ON THE DATA INPUTTED SO FAR THIS MONTH, DMA
PREDICTS THE M-32 VALUE FOR'
  ? m_skip
  ? m_title
  ? m_skip
  @ 11,1 SAY 'WILL BE:'
  ?? m_predict
  ? m_skip
  SET FIELDS TO
  WAIT
  CLEAR
  DO WHILE .T.
   @ 3,4 SAY 'WOULD YOU LIKE AN EXPLANATION OF HOW DMA MADE ITS
PREDICTION (y or n)'
   choise = '?'
   @ 3,75  GET choise PICTURE 'X'
   READ
     DO CASE
      CASE choise = 'y'
 *Prediction Help goes here
   CLEAR
   *Position cursor at line 2
   @ 2,1 SAY ' '
   TEXT
          The way in which DMA makes its prediction depends upon
     the way in which the data are accumulated by the SBSS.  In some
     areas of the D-14, the data represent only the transactions that
     have occurred that day.  In such cases, DMA sums the daily data
     and multiples the sum by an amount which approximates the number
     of days remaining in the month at the time the prediction is
     made.  In other areas of the D-14, the data are accumulated
     automatically by the SBSS.  In such cases, there is no need for
     DMA to sum the daily values.  In all cases, it is assumed that
     data which are missing or equal to zero represent days for which
```

```
      data has not been downloaded or days of minimal supply
      and are therefore ignored in the calculations.  Finally,
      assumed that there are thirty days in a month.
    ENDTEXT
    ? m_skip
    WAIT
       CASE choise = 'n'
        @ 8,4 SAY 'IN THAT CASE, LET'S RETURN TO THE MAIN MENU'
        m_loop = 1
        DO WHILE m_loop < 70
        m_loop = m_loop + 1
        ENDDO
      ENDCASE
   ENDCASE
RETURN
```

NOTE: The program continues in a similar fashion for the remaining nine areas of the D-14, i.e., Excess Stratification, MICAP Analysis, ect. The actual coding is not included here for the sake of space.

```
PROCEDURE SCAN_CSE
*****************************************************************
* Program.:  SCAN_CSE
* Purpose :  This program scans the CSE file to determine if
*    any preset flags have been violated.
*****************************************************************
CLEAR
*initialize memory variables
  m_record = 1
  m_scan   = 0
  m_day    = 1
  n        = 3
  m_field  = FIELD(n)
  title1   = 'WEAPONS MX ORGANIZATIONS, TOTAL ALC
STOCKAGE EFFECTIVENESS BY LINE ITEM'
  title2   = 'WEAPONS MX ORGANIZATIONS, REPAIR CYCLE (XD)
STOCKAGE EFFECTIVENESS BY LINE ITEM'
  title3   = 'WEAPONS MX ORGANIZATIONS, REPAIR CYCLE (XF)
STOCKAGE EFFECTIVENESS BY LINE ITEM'
  title4   = 'WEAPONS MX ORGANIZATIONS, EOQ STOCKAGE
EFFECTIVENESS BY LINE ITEM'
  title5   = 'WEAPONS MX ORGANIZATIONS, EQUIPMENT STOCKAGE
EFFECTIVENESS BY LINE ITEM'
  title6   = 'WEAPONS MX ORGANIZATIONS, BENCH STOCK STOCKAGE
EFFECTIVENESS BY LINE ITEM'
  title7   = 'OVERALL SUMMARY, TOTAL ALC STOCKAGE EFFECTIVENESS
BY LINE ITEM'
  title8   = 'OVERALL SUMMARY, REPAIR CYCLE (XD) STOCKAGE
EFFECTIVENESS BY LINE ITEM'
  title9   = 'OVERALL SUMMARY, REPAIR CYCLE (XF) STOCKAGE
EFFECTIVENESS BY LINE ITEM'
  title10  = 'OVERALL SUMMARY, EOQ STOCKAGE EFFECTIVENESS BY
ITEM'
  title11  = 'OVERALL SUMMARY, EQUIPMENT STOCKAGE EFFECTIVENESS
BY LINE ITEM'
  title12  = 'OVERALL SUMMARY, BENCH STOCK STOCKAGE EFFECTIVE
BY LINE ITEM'
  m_skip   = ' '

  SET STATUS ON
  @ 1,13 TO 6,61 DOUBLE
  @ 2,15 SAY 'THE FLAGS YOU SET FOR THE FOLLOWING AREAS OF'
  @ 3,15 SAY 'CUSTOMER SUPPORT EFFECTIVENESS WERE VIOLATED'
  @ 4,15 SAY 'ON AT LEAST ONE DAY DURING THE PAST MONTH:'
  @ 5,15 SAY '(Scan takes a minute. Please wait for prompt)'
  @ 7,1  SAY ' '

  CLOSE DATABASES
  DO WHILE m_record < 13
    CLOSE DATABASES
    SELECT 2
```

```
USE FLAG_CSE
  LOCATE FOR RECORD = m_record
  STORE maximum TO m_max
  STORE minimum TO m_min
  m_record = m_record+1
   CLOSE DATABASES
   SELECT 1
IF m_cat = 'evn'
   USE EVN_CSE INDEX I_RECORD
ELSE
   USE ODD_CSE INDEX I_RECORD
ENDIF
   n = n+1
   m_field = FIELD(n)
   m_day = 1
   DO WHILE m_day < 32
    SEEK m_day
    IF &m_field > m_max .OR. &m_field < m_min .AND. &m_field
     DO CASE
      CASE m_field = 'CSE_WMOALC'
       ? title1
      CASE m_field = 'CSE_WMO_XD'
       ? title2
      CASE m_field = 'CSE_WMO_XF'
       ? title3
      CASE m_field = 'CSE_W_EOQ'
       ? title4
      CASE m_field = 'CSE_WMO_E'
       ? title5
      CASE m_field = 'CSE_WMO_BS'
       ? title6
      CASE m_field = 'CSE_OS_ALC'
       ? title7
      CASE m_field = 'CSE_OS_XD'
       ? title8
      CASE m_field = 'CSE_OS_XF'
       ? title9
      CASE m_field = 'CSE_OS_EOQ'
       ? title10
      CASE m_field = 'CSE_OS_E'
       ? title11
      CASE m_field = 'CSE_OS_BS'
       ? title12
     ENDCASE
     m_day = 32
    ELSE
     m_day = m_day + 1
    ENDIF
  ENDDO
ENDDO
? m_skip
```

```
  WAIT
  CLEAR

*****************************************************************
* Program.:  REV__CSE                                           *
* Purpose :  This program reviews the FLAG_CSE database and     *
*     provides the user with the values that have been preset as *
*     flags for each record
*****************************************************************
*initialize memory variables
  m_skip   = ' '
  m_record = 1
  m_upper  = 'The value chosen as the ceiling ='
  m_lower  = 'The value chosen as the floor   ='
  title1   = 'WEAPONS MX ORGANIZATIONS, TOTAL ALC
STOCKAGE EFFECTIVENESS BY LINE ITEM'
  title2   = 'WEAPONS MX ORGANIZATIONS, REPAIR CYCLE (XD)
STOCKAGE EFFECTIVENESS BY LINE ITEM'
  title3   = 'WEAPONS MX ORGANIZATIONS, REPAIR CYCLE (XF)
STOCKAGE EFFECTIVENESS BY LINE ITEM'
  title4   = 'WEAPONS MX ORGANIZATIONS, EOQ STOCKAGE
EFFECTIVENESS BY LINE ITEM'
  title5   = 'WEAPONS MX ORGANIZATIONS, EQUIPMENT STOCKAGE
EFFECTIVENESS BY LINE ITEM'
  title6   = 'WEAPONS MX ORGANIZATIONS, BENCH STOCK STOCKAGE
EFFECTIVENESS BY LINE ITEM'
  title7   = 'OVERALL SUMMARY, TOTAL ALC STOCKAGE EFFECTIVENESS
BY LINE ITEM'
  title8   = 'OVERALL SUMMARY, REPAIR CYCLE (XD) STOCKAGE
EFFECTIVENESS BY LINE ITEM'
  title9   = 'OVERALL SUMMARY, REPAIR CYCLE (XF) STOCKAGE
EFFECTIVENESS BY LINE ITEM'
  title10  = 'OVERALL SUMMARY, EOQ STOCKAGE EFFECTIVENESS BY LINE
ITEM'
  title11  = 'OVERALL SUMMARY, EQUIPMENT STOCKAGE EFFECTIVENESS
BY LINE ITEM'
  title12  = 'OVERALL SUMMARY, BENCH STOCK STOCKAGE EFFECTIVENESS
BY LINE ITEM'

CLEAR
DO WHILE .T.
  @ 1,10 SAY 'WOULD YOU LIKE TO REVIEW THE VALUES THAT HAVE BEEN
PRESET AS'
  @ 2,10 SAY 'FLAGS FOR THE AREA OF CUSTOMER SUPPORT EFFECTIVENESS
  choise = '?'
  @ 2,72 get choise PICTURE 'X'
  READ
    DO CASE
     CASE choise = 'y'
     CLOSE DATABASES
     m_record = 1
```

```
        SELECT 2
        USE FLAG_CSE
        DO WHILE m_record < 13
          LOCATE FOR RECORD = m_record
          STORE element TO m_name
          STORE maximum TO m_max
          STORE minimum TO m_min
            DO CASE
              CASE m_name = 'CSE_WMOALC'
                ? title1
              CASE m_name = 'CSE_WMO_XD'
                ? title2
              CASE m_name = 'CSE_WMO_XF'
                ? title3
              CASE m_name = 'CSE_W_EOQ'
                ? title4
              CASE m_name = 'CSE_WMO_E'
                ? title5
              CASE m_name = 'CSE_WMO_BS'
                WAIT
                ? title6
              CASE m_name = 'CSE_OS_ALC'
                ? title7
              CASE m_name = 'CSE_OS_XD'
                ? title8
              CASE m_name = 'CSE_OS_XF'
                ? title9
              CASE m_name = 'CSE_OS_EOQ'
                ? title10
              CASE m_name = 'CSE_OS_E'
                WAIT
                ? title11
              CASE m_name = 'CSE_OS_BS'
                ? title12
            ENDCASE
          ?  m_upper
          ?? m_max
          ?  m_lower
          ?? m_min
          ?  m_skip
          m_record = m_record + 1
        ENDDO
        CASE choise = 'n'
          CLOSE DATABASES
         RETURN
      ENDCASE
      ? m_skip
      WAIT
      SET STATUS OFF
      CLEAR
     ENDDO
  ENDDO
  RETURN
```

```
PROCEDURE SCAN_ES
*****************************************************************
* Program.:   SCAN_ES
* Purpose.:   This program scans the ES file to determine if     *
*     any preset flags have been violated.                      *
*****************************************************************
CLEAR
*initialize memory variables
  m_record = 1
  m_scan   = 0
  m_day    = 1
  n        = 3
  m_field  = FIELD(n)
   title1='EXCESS STRATIFICATION, OVERALL TOTAL LINE ITEMS'
   title2='EXCESS STRATIFICATION, OVERALL TOTAL UNITS'
   title3='EXCESS STRATIFICATION, OVERALL TOTAL DOLLAR VALUE'
   title4='EXCESS STRATIFICATION, ERRC CODE XD: TOTAL LINE ITEMS'
   title5='EXCESS STRATIFICATION, ERRC CODE XD: TOTAL DOLLAR VALUE'
   title6='EXCESS STRATIFICATION, ERRC CODE XF: TOTAL LINE ITEMS'
   title7='EXCESS STRATIFICATION, ERRC CODE XF: TOTAL DOLLAR VALUE'
   title8='EXCESS STRATIFICATION, ERRC CODE XB: TOTAL LINE ITEMS'
   title9='EXCESS STRATIFICATION, ERRC CODE XB: TOTAL DOLLAR VALUE'
   title10='EXCESS STRATIFICATION, ERRC CODE ND/NF: TOTAL LINE ITEMS
   title11='EXCESS STRATIFICATION, ERRC CODE ND/NF: TOTAL DOLLAR
   title12='RELEVELING FREQUENCY: NUMBER OF TIMES COMPLETED'
   title13='RELEVELING FREQUENCY: JULIAN DATE OF LAST COMPLETION'
   title14='FOLLOWUP FREQUENCY: NUMBER OF TIMES COMPLETED'
   title15='FOLLOWUP FREQUENCY: JULIAN DATE OF LAST COMPLETION'
   title16='FILE STATUS: NUMBER I/R'
   title17='FILE STATUS: NUMBER I/R COMPLETED'
   title18='FILE STATUS: PERCENT COMPLETED'
   title19='FILE STATUS: JULIAN AS OF DATE'
   m_skip = ' '

  SET STATUS ON
  @ 1,13 TO 6,61 DOUBLE
  @ 2,15 SAY 'THE FLAGS YOU SET FOR THE FOLLOWING AREAS OF'
  @ 3,15 SAY '    EXCESS STRATIFICATION WERE VIOLATED'
  @ 4,15 SAY 'ON AT LEAST ONE DAY DURING THE PAST MONTH:'
  @ 5,15 SAY '(Scan takes a minute. Please wait for prompt)'
  @ 7,1  SAY ' '

  CLOSE DATABASES
  DO WHILE m_record < 20
    CLOSE DATABASES
    SELECT 2
    USE FLAG_ES
      LOCATE FOR RECORD = m_record
      STORE maximum TO m_max
      STORE minimum TO m_min
      m_record = m_record+1
```

```
   CLOSE DATABASES
   SELECT 1
IF m_cat = 'evn'
   USE EVN_ES INDEX I_RECORD
ELSE
   USE ODD_ES INDEX I_RECORD
ENDIF
   n = n+1
   m_field = FIELD(n)
   m_day = 1
   DO WHILE m_day < 32
    SEEK m_day
    IF &m_field > m_max .OR. &m_field < m_min .AND. &m_field
     DO CASE
      CASE m_field = 'ES_OT_LI'
       ? title1
      CASE m_field = 'ES_OT_U'
       ? title2
      CASE m_field = 'ES_OT_DV'
       ? title3
      CASE m_field = 'ES_XD_LI'
       ? title4
      CASE m_field = 'ES_XD_DV'
       ? title5
      CASE m_field = 'ES_XF_LI'
       ? title6
      CASE m_field = 'ES_XF_DV'
       ? title7
      CASE m_field = 'ES_XB_LI'
       ? title8
      CASE m_field = 'ES_XB_DV'
       ? title9
      CASE m_field = 'ES_NDNF_LI'
       ? title10
      CASE m_field = 'ES_NDNF_DV'
       ? title11
      CASE m_field = 'ES_RF_NTC'
       ? title12
      CASE m_field = 'ES_RF_JDLC'
       ? title13
      CASE m_field = 'ES_FF_NTC'
       ? title14
      CASE m_field = 'ES_FF_JDLC'
       ? title15
      CASE m_field = 'ES_FS_NIR'
       ? title16
      CASE m_field = 'ES_FS_NIRC'
       ? title17
      CASE m_field = 'ES_FS_PC'
       ? title18
```

```
          CASE m_field = 'ES_FS_JAOD'
           ? title19
          ENDCASE
          m_day = 32
         ELSE
          m_day = m_day + 1
         ENDIF
       ENDDO
     ENDDO
  ? m_skip
  WAIT
  CLEAR

****************************************************************
* Program.:  REV_ES
* Purpose :  This program reviews the FlAG_ES database and
*    provides the user with the values that have been preset as *
*    flags for each record
****************************************************************
*initialize memory variables
  m_skip    = ' '
  m_record = 1
  m_upper   = 'The value chosen as the ceiling ='
  m_lower   = 'The value chosen as the floor   ='
   title1='EXCESS STRATIFICATION, OVERALL TOTAL LINE ITEMS'
   title2='EXCESS STRATIFICATION, OVERALL TOTAL UNITS'
   title3='EXCESS STRATIFICATION, OVERALL TOTAL DOLLAR VALUE'
   title4='EXCESS STRATIFICATION, ERRC CODE XD: TOTAL LINE ITEMS'
   title5='EXCESS STRATIFICATION, ERRC CODE XD: TOTAL DOLLAR VALUE'
   title6='EXCESS STRATIFICATION, ERRC CODE XF: TOTAL LINE ITEMS'
   title7='EXCESS STRATIFICATION, ERRC CODE XF: TOTAL DOLLAR VALUE'
   title8='EXCESS STRATIFICATION, ERRC CODE XB: TOTAL LINE ITEMS'
   title9='EXCESS STRATIFICATION, ERRC CODE XB: TOTAL DOLLAR VALUE'
   title10='EXCESS STRATIFICATION, ERRC CODE ND/NF: TOTAL LINE ITEMS
   title11='EXCESS STRATIFICATION, ERRC CODE ND/NF: TOTA  DOLLAR VAL
   title12='RELEVELING FREQUENCY: NUMBER OF TIMES COMPLETED'
   title13='RELEVELING FREQUENCY: JULIAN DATE OF LAST COMPLETION'
   title14='FOLLOWUP FREQUENCY: NUMBER OF TIMES COMPLETED'
   title15='FOLLOWUP FREQUENCY: JULIAN DATE OF LAST COMPLETION'
   title16='FILE STATUS: NUMBER I/R'
   title17='FILE STATUS: NUMBER I/R COMPLETED'
   title18='FILE STATUS: PERCENT COMPLETED'
   title19='FILE STATUS: JULIAN AS OF DATE'

CLEAR
DO WHILE .T.
  @ 1,10 SAY 'WOULD YOU LIKE TO REVIEW THE VALUES THAT HAVE BEEN
PRESET AS'
  @ 2,10 SAY 'FLAGS FOR THE AREA OF EXCESS STRATIFICATION (y or n)'
  choise = '?'
  @ 2,64 GET choise PICTURE 'X'
```

```
READ
  DO CASE
   CASE choise = 'y'
   CLOSE DATABASES
   m_record = 1
   SELECT 2
   USE FLAG_ES
   DO WHILE m_record < 20
     LOCATE FOR RECORD = m_record
     STORE element TO m_name
     STORE maximum TO m_max
     STORE minimum TO m_min
       DO CASE
        CASE m_name = 'ES_OT_LI'
         ? title1
        CASE m_name = 'ES_OT_U'
         ? title2
        CASE m_name = 'ES_OT_DV'
         ? title3
        CASE m_name = 'ES_XD_LI'
         ? title4
        CASE m_name = 'ES_XD_DV'
         ? title5
        CASE m_name = 'ES_XF_LI'
          WAIT
         ? title6
        CASE m_name = 'ES_XF_DV'
         ? title7
        CASE m_name = 'ES_XB_LI'
         ? title8
        CASE m_name = 'ES_XB_DV'
         ? title9
        CASE m_name = 'ES_NDNF_LI'
         ? title10
        CASE m_name = 'ES_NDNF_DV'
           WAIT
         ? title11
        CASE m_name = 'ES_RF_NTC'
         ? title12
        CASE m_name = 'ES_RF_JDLC'
         ? title13
        CASE m_name = 'ES_FF_NTC'
         ? title14
        CASE m_name = 'ES_FF_JDLC'
         ? title15
        CASE m_name = 'ES_FS_NIR'
          WAIT
         ? title16
        CASE m_name = 'ES_FS_NIRC'
         ? title17
```

```
          CASE m_name = 'ES_FS_PC'
           ? title18
          CASE m_name = 'ES_FS_JAOD'
           ? title19
         ENDCASE
      ?  m_upper
      ?? m_max
      ?  m_lower
      ?? m_min
      ?  m_skip
      m_record = m_record + 1
    ENDDO
    CASE choise = 'n'
     CLOSE DATABASES
     RETURN
   ENDCASE
   ? m_skip
   WAIT
   SET STATUS OFF
   CLEAR
  ENDDO
ENDDO
RETURN
```

NOTE: The programming continues in a similar fashion for the remaining eight areas of the D-14 for the scan and review_scan portions of DMA. The are not included here for the sake of space.

Appendix F: *QUATTRO MACROS Used to Operate Graphics*

MACRO	FUNCTION	QUATTRO CODE
STARTUP	Sets up spreadsheet for retrieval of selected data	{AA56}
GETGRAPH	Retrieves GRAPH.dbf	{PANELOFF}{WINDOWSOFF} {goto}a1~ {/ File,CopyFile}C:GRAPH.DBF {TITLE}{PANELON}{WINDOWSON}
GRAPHIT	Graphs the data contained in GRAPH.dbf, then displays the graph until user wishes to return to main menu	{PANELOFF}{WINDOWSOFF} {/ Graph,View}~ {goto}aa2~{clear} C:DMA/autoload.wkq~ {down}~{goto}z20~ {PANELON}{WINDOWSON} {/ Basics,Quit}~
TITLE	Identifies which title to use then copies it to the proper cell	{PANELOFF}{WINDOWSOFF} {IF b1="CSE_WMOALC"}{TITLE1} {IF b1="CSE_WMO_XD"}{TITLE2} . . . {IF b1="FM_R_TNC"}{TITLE181}
TITLE1	Copies proper title to cell d1	{goto}d4~ {/ Block,Copy}{down}~d1 {GRAPHIT}
TITLE2	Copies proper title to cell d1	{goto}d7~ {/ Block,Copy}{down}~d1 {GRAPHIT} . . .
TITLE181	Copies proper title to cell d1	{goto}d547~ {/ Block,Copy}{down}~d1 {GRAPHIT}

Appendix G: *MS-DOS Program Logic Used to Integrate DBASE III PLUS and QUATTRO Into Single Package*

```
:HELLO
DELETE GRAPH.DBF
ECHO OFF
DBASE
IF NOT EXIST GRAPH.DBF GOTO BYE
QUATTRO
IF EXIST GRAPH.DBF GOTO HELLO
:BYE
```

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VITA

Captain Mark LeSage [redacted] then attended the Pennsylvania State University. He graduated with Honors from Penn State in 1980, from which he received a Bachelor of Science degree in Administrative Management. He was commissioned into the United States Air Force through ROTC at that time as well.

He entered rotary wing undergraduate pilot training at Fort Rucker, Alabama, receiving his wings in July of 1981. After transitioning into the H-53 "Supper Jolly Green Giant," he was assigned to the 601 Tactical Air Support Squadron at Sembach Air Base, FRG. In addition to his duties as Aircraft Commander, Captain LeSage served as Life Support Officer and Chief of Current Operations.

His next assignment brought him to the 6514 Test Squadron at Hill AFB, Utah, where he flew the HH-53 in support of the unit's mission of Air Launch Cruise Missile Mid-Air Retrieval. While stationed at Hill, Captain LeSage also served as Cruise Missile On-Scene-Commander, Flight Safety Officer, and Remotely Piloted Vehicle (RPV) operator during the testing of the Over-the-Horizon Backscatter Radar. During his tour at Hill he received an MBA from the University of Phoenix at Salt Lake City.

He was assigned to his present duties at the School of Systems and Logistics, Air Force Institute of Technology in May of 1988.

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The Air Force Standard Base Supply System (SBSS) produces a number of standard management reports to provide the statistical data necessary for managing an effective supply account. One of these reports, the D-14, is meant to provide base supply decision makers with the information they need to manage their accounts on a daily basis. However, because of the volume of data contained in this report, its ability to provide useful information is suspect. The objective of this research was to transform the data currently provided by the SBSS in the D-14 daily report into information that is more useful to supply managers by applying the principles of decision support technology.

The researcher applied a four-step, iterative methodology to the systematic development of a decision support system (DSS) designed to meet daily base supply information needs. In the process, 181 specific elements of D-14 data, identified as important to managing effective supply accounts, were included into the database subsystem of the DSS. The resulting software, dubbed the Daily Management Analysis program (DMA), allows a supply analyst to automatically analyze up to two months worth of these data. In addition, managers can quickly scan the data loaded into DMA's database for areas of the D-14 in which preset upper and lower limits have been exceeded. DMA was evaluated by supply personnel at six Air Force bases and was determined to be both an efficient and effective means of managing supply accounts on a daily basis. A copy of the DMA program is kept on file with the Air Force Institute of Technology.