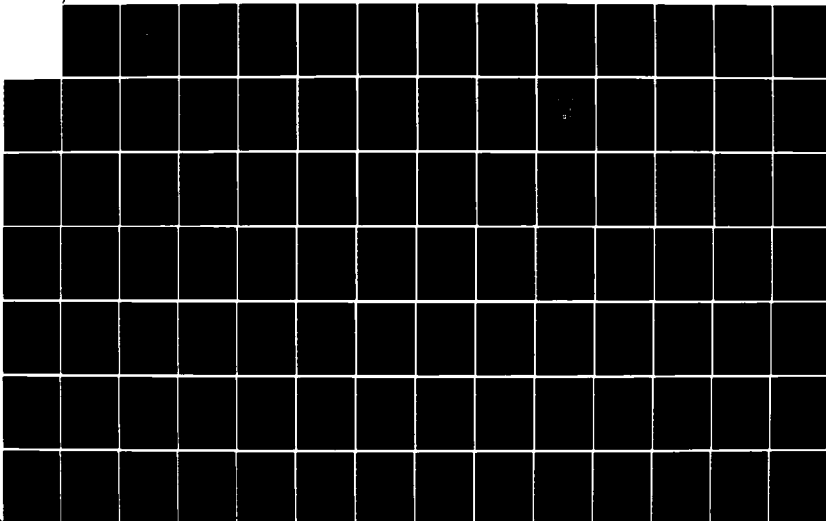AD-A152 218   AUTOMATION OF THE REPORTING AND TRACKING REQUIREMENTS   1/2
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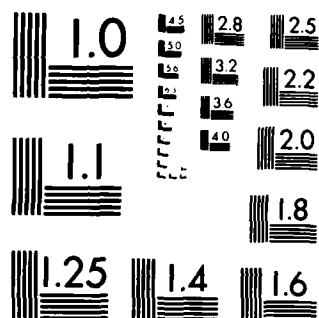   POSTGRADUATE SCHOOL MONTEREY CA   J T ETHERIDGE SEP 84

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NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

AUTOMATION OF THE REPORTING AND TRACKING
REQUIREMENTS OF ARCHITECT-ENGINEERING
TYPE CONTRACTS

by

John T. Etheridge

September 1984

Thesis Advisor: W.R. Talutis

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The Naval Facilities Engineering Command utilizes several automated systems in carrying out its mission. These systems are presently geared toward the Headquarters and major Command levels of management and not toward the field activities and smaller offices. The thesis examines an Architect-Engineer type contracting management procedure and proposes an automated alternative of the contract administration process using micro-

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chapters discuss integration of the proposed system, automated
tools which make the system possible and the interface designs
utilized to make the system user friendly.

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Automation of the
Reporting and Tracking Requirements of
Architect-Engineering Type Contracts

by

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Submitted in partial fulfillment of the
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MASTER OF SCIENCE IN INFORMATION SYSTEMS

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3

ABSTRACT

The Naval Facilities Engineering Command utilizes several automated systems in carrying out its mission. These systems are presently geared toward the Headquarters and major Command levels cf management and not toward the field activities and smaller offices. This thesis examines an Architect-Engineer type contracting management procedure and proposes an automated alternative of the contract administration process using micro-computer technology for field activities. A brief examination is made of the NAVFAC automated systems and of the structure of the NAVFAC contracting organization prior tc the presentation of a proposed A-E Management Information System. The closing chapters discuss integration of the proposed system, automated tools which make the system possible and the interface designs utilized to make the system user friendly.

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A. OVERVIEW

The Naval Facilities Engineering Command has the mission within the Navy of the plant management of naval shore facilities. The support structure for the organization is comprised of upper level program managers, geographically located design divisions, intermediate contracting offices and activity level monitoring staffs. One major management function of NAVFAC contracting is for Architect-Engineering services, maintenance services and construction. This function, as well as the other NAVFAC functions, is supported through an automated management system which has grown from a mechanized accounting system in the late 1940's to a quasi-distributed automated system. To a limited extent, the functional distribution of the system has reached some Engineering Field Divisions and is beginning to reach some field activities. This thesis will explore the possiblity of automating the field activity functions concerned with the Architect-Engineering contract process.

The following is an overview of the thesis chapters:

<u>Chapter II</u>. - Naval Facilities Engineering Command
   The overall mission of the command and in particular
   the contracting aspect are discussed.

<u>Chapter III</u>. - Naval Facilities System (NFS)
   The automated management system is discussed. The
   major components which constitute the NAVFAC informa-
   tion system are described along with a discussion of
   the advantages and benefits of evolving from a file
   oriented structure to a generalized Data Base
   Management System. The Naval Facilities Systems

Office is described and its changing role in the NFS is discussed.

Chapter IV. - The A-E Contracting Process

A brief description os given of the steps required by the contract administration staff to put an A-E contract through the three phases of the A-E contracting life-cycle, pre-negotiation, negotiation, and post-award phases.

Chapter V. - Requirements Determination

The automated support needed by the field activities to adequately use the data collected for the NFS is identified. Tools are described which could be used to build a proposed management information system for the A-E contracting environment.

Chapter VI. - Automation of the Pre-Negotiation Phase

Discussion of a proposed management information system for the A-E contract administration process begins in this chapter and concludes in chapter 8. The Pre-Negotiation steps are discussed in the automated environment. Means and methods of automating the process are investigated. The major concepts involved are the use of databases, report/letter files and application modules to drive the entire contracting administration process.

Chapter VII. - Automation of the Negotiation Phase

A similar approach is taken as described in Chapter 6.

Chapter VIII. - Automation of the Post-Award Phase

A similar approach is taken as described in Chapter 6.

Chapter IX. - End-User Interface

Considerations of the users of the automated systems in terms of the best interface design are discussed. Also discussed are the factors that affect the

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end-user's perception of the system and various
screen design methodologies. Samples of recommended
screen designs are presented.

Chapter X. - System Integration

An overall view of the proposed automated A-E
contracting system is presented along with a review
of the automated tools which comprise the subsystems
of the MIS for the A-E process. The chapter concludes
with a discussion of how the field office could best
utilize an automated system to meet NFS requirements
as well as satisfy local management needs.

Chapter XI. - Conclusions and Recommendations

General conclusions and recommendations for
implementation of the system in the field are
discussed.

B. GOALS AND OBJECTIVES

The objectives of this thesis are threefold. The author
focuses on the management process of the NAVFAC Contracting
Organization and how this process affects the field Public
Works Officer, the Officer In Charge of Construction, and
the Resident Officer In Charge of Construction. This will
satisfy the objective of the author to become acquainted
with the Navy Facilities System Plan [Ref. 1]. Second, a
sample module of a proposed automated tracking and reporting
management system for A-E contracting is presented through
the application of a database management system. This
permits the investigation of the possible uses of a micro-
computer database management system in a field, non-
programming, professional environment. The third objective
is to investigate the possibility of developing a
user-friendly interface between a complex micro-computer

database system and the novice user. If such a interface is
possible, the application of micro-computer based database
management systems can be expanded.

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II. NAVAL FACILITIES ENGINEERING COMMAND

A. NAVFAC CONTRACTING

The Naval Facilities Engineering Command (NAVFACENGCCM) is responsible for and authorized to perform the design, planning, development, procurement, construction, alteration, repair and maintenance at all shore activities cf the Naval Establishment for public works and public utilities [Ref. 2: p.1.3.1]. This responsibility is assigned by the Secretary of the Navy through the Chief of Naval Materiel.

The specific functions performed under this authority are as follows:
   a. Approving the selection and compensation of an architect or engineer;
   b. Approving the selection and fee of a general building contractor;
   c. Consent to the placement of any subcontract for civil works;
   d. Approving any plans or specifications;
   e. Approving of major alterations or increased costs within the estimated cost set forth in a contract for civil works;
   f. Inspection, supervision, and administration cf the terms of subcontract and acceptance of performance;
   g. Monitoring compliance with labor standards requirements;
   h. Ordering or approving changes relating tc civil works;
   i. Cognizance of all matters relating to the acquisition of real property. [Ref. 3]

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In essence, NAVFAC is responsible for any construction related activities from cradle to grave throughout the Naval Shore Establishment. This thesis will primarily focus on the first function mentioned above, Architect-Engineering contracts. These contracting services are utilized by the NAVFAC organization to augment in-house planning and design capability. Architect-Engineering contracts (hereafter referred to as A-E contracts) are used primarily to procure design drawings and specifications for contemplated construction or maintenance and repair projects. A-E contracts can also be utilized as a means: 1) to providing consultation to contract administrators during construction projects; 2) to incorporate specialized review and checking of accuracy of contractor's drawing, material lists, or equipment performance data; 3) to prepare record drawings or update master drawings and plans; and 4) to acquire inspection services for construction work in instances where in-house expertise is non-existent or not available.

B. NAVFAC CONTRACTING ORGANIZATION

The sole "Contracting Officer" within NAVFAC is the Commander, NAVFACENGCOM. All other persons exercising NAVFAC contracting authority act and sign in the stead of the Commander. The NAVFAC Contract Organization is shown below in Figure 2.1.

The primary players in the contracting chain are the Commander NAVFAC, Engineering Field Divisions (EFD), Officers-In-Charge-of-Construction (OICC), and the Resident Officers-In-Charge-of-Construction. As can be seen in Figure 2.1, the Commander NAVFAC sits at the head of the organization where all final contracting decisions reside.

```
+-----------------+
|  CDR   NAVFAC   |
+-----------------+
         |
    +---------+
    |   EFD   |
    +---------+
    |  OICC   |
    +---------+
         |
    +-------------------------+
    |                         |
+---------+             +---------+
| AOICC   |             | ROICC   |
+---------+             +---------+
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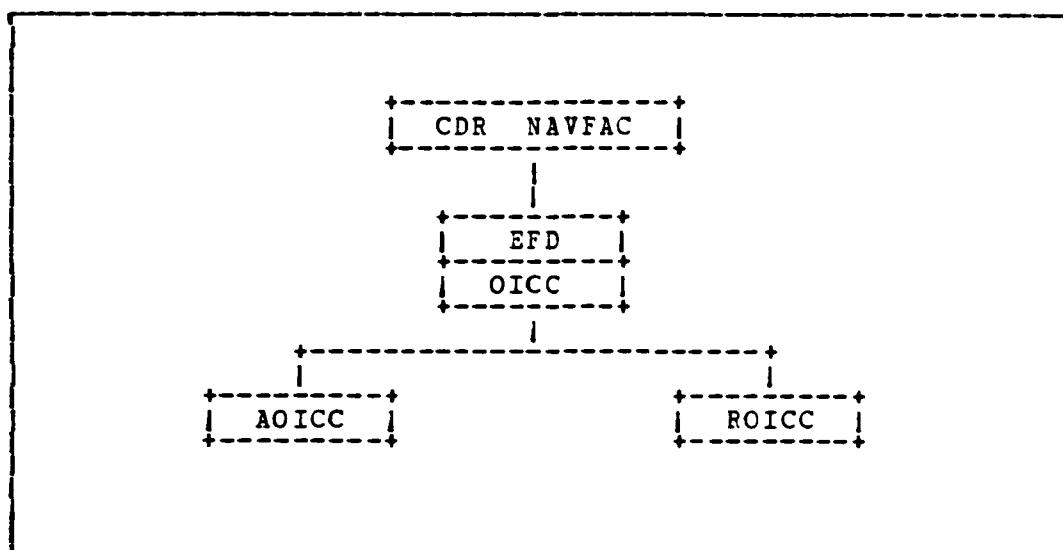
Figure 2.1   NAVFAC Contract Organization.

1. Engineering Field Divisions

The EFDs are organizationally patterned after
Headquarters, NAVFAC. A major department of the EFD is the
Acquisition Department. Four divisions under the supervision
of the Acquisition Department Director concern themselves
with the acquisition process: 1) Acquisition Project
Management Division; 2) Contract Division; 3) Design
Division; and the 4) Construction Division.

a. Acquisition Division

The Acquisition Project Management Division
performs many general acquisition management functions. Its
major mission is to monitor and coordinate the execution of
construction contracts. In this role, the EFD serves activ-
ities which are located in a NAVFAC designated geographical
area. responsibility. To meet this program management func-
tion, the EFD develops listings of prospective A-E

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contractors, makes selections of contractors for specific design contracts and negotiates contract fees. Once contracts are awarded, the staff coordinates and reviews contract design and construction matters. Any proposed changes in the scope of contracts are reviewed by this office.

b. Contract Division

The Contract Division is concerned with the legal contractual matters and the contract administration process. This division provides the field OICC and ROICC with interpretations of contracts, policy guidance and recommendations on claims. Basically, the Contract Division acts as a consultant to field contracting offices on more difficult contractual matters.

c. Design Division

The Design Division is a "government-owned Architect and Engineering organization" so to speak. It performs the same design functions that most commercial A-E firms provide. Approximately 25% of the Design Division's effort is strict engineering design with the remaining 75% directed toward engineering contracts management and consulting. The Design Division reviews A-E contracted designs to ensure maximum utilization of design criteria for economical design cost and quality construction. For field activities they review all field designs and provide technical consultation on design matters.

d. Construction Contract Management and Administration Division

The Construction Contract Management and Administration Division manages construction execution to achieve timely, quality construction. This division receives support from the three other divisions mentioned above.

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2. Naval Shore Activities

Each Naval Shore Activity Commanding Officer has on his staff a Civil Engineer Corps officer who is responsible for the facility management of the station. This officer will be either the Public Works Officer (PWO) or a Staff Civil Engineer (SCE) who in turn will interface with the station PWO. This officer and possibly his staff will ensure the NAVFAC mission is carried out as described above. The EFD, OICC, and ROICC support the PWO/SCE. The PWO/SCE navigates projects through these offices requesting the services required to properly manage the maintenance, repair, alteration and construction of local Naval Shore assets.

3. Officer In Charge of Construction

The OICC receives designs and contract specifications from the EFDs and the PWO to be awarded as construction contracts. The OICC maintains lists of prospective contractors as well as issues Request for Proposals and Invitations for Bids. Contractors are screened by the OICC staff to determine if they qualify to bid on Navy construction contracts. This OICC office awards the construction contracts, issues change orders to existing contracts and approves performance payments. The official contract files are maintained by the OICC.

4. Resident Officer In Charge of Construction

The ROICC administers the construction contracts awarded by the OICC often physically located at the EFD. The ROICC is also functionally responsible to the local Naval Shore activity to ensure the contractor provides the best quality construction permitted under the contract. The ROICC works directly with the contractor in the daily execution of

the contracts. This interface includes inspections of work; review of material submittals; approval of payment requests, schedules, estimates, shop drawings, etc; and the review and surveillance of the contractor's Quality Control system.

These four organizations, from EFDs down to the ROICC, constitute the contracting family of NAVFAC. The focus in this thesis is on those elements of the ROICC and Naval Shore Activities which are concerned with contracted A-E design efforts. These are the organizations who would benefit the most from the micro-computer based management system proposed herein.

III. BACKGROUND

A. NAVAL FACILITIES SYSTEM

1. System Overview

NAVFAC has a single Automated Data Processing System called the Naval Facilities System (NFS). The automated data processing plan for the command is published annually in the NAVFAC P-424, the Naval Facilities System Plan [Ref. 1]. This plan provides the short and long range ADP corporate planning for NAVFAC. The intent of the plan is to optimize the information technology currently available and integrate existing management systems to permit the managers of programs to more effectively meet their missions. The plan is coordinated with and developed in conjunction with the Command Management Plan, the NAVFAC command budget and the Navy ADP budget.

The NFS is an accumulation of 15 interfacing Automated Information Systems (AISs). These systems are utilized in determining the requirements, making the acquisitions and monitoring the utilization of real property, utilities, and all forms of civil engineering support. Figure 3.1 shows the relationship between the Requirements, Acquisition, and Utilization of Real Property, Utilities, and Civil Engineering Support. Naval Force Planning determines base loading, some required human resources and the mobilization plans. The mobilization plans generate a requirement for Civil Engineer Support which further places a need for human resources which in turn further increases base loading. The requirements for real property and utilities are determined once these needs are identified.

NAVY FACILITIES SYSTEM
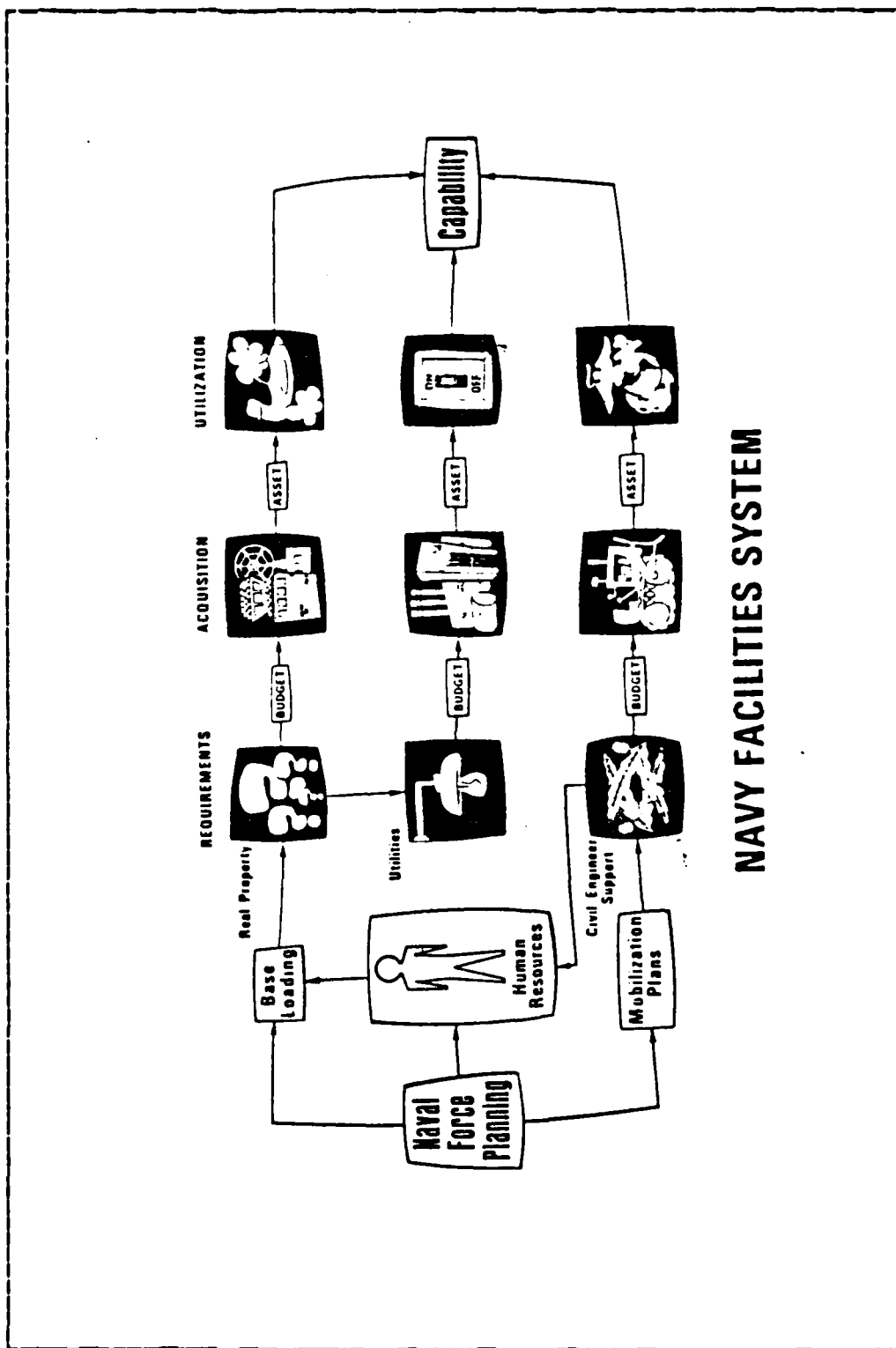
Figure 3.1 Navy Facilities System.

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Acquisition of real property, utility systems and equipment are budgeted for and then carried out. The combined utilization of the real property, utilities and equipment produce the desired capability espoused by the Naval Force Planning. Four AISs are of importance to this thesis. These AISs are Management Information Systems (MIS) for use by NAVFAC Headquarters, the Engineering Field Divisions (EFD), the Construction Battalion Centers (CBC), and the Public Works Centers (PWC). The other 11 AISs are functional as Navy-wide applications in environmental protection; in shore facilities planning and real estate; in military construction programming; in support of the Naval Construction Force; in construction, automotive, and special equipment; in base engineering support, energy conservation, engineering research, family housing, base operating support; and in occupational safety and health/deficiency abatement.

2. Data Base Management System

The accumulation and management of the data required to support the 15 AISs presents a management challenge. Since the mid-70's the thrust in supporting these AISs has been to adapt a generalized Data Base Management System (DBMS) approach. Conversion to a DBMS from a conventional file oriented systems is a time consuming process. This approach continues today to replace the existing file oriented system of the NFS where a particular application has to have it's own data file. A database management system is a software tool that is designed to manage and maintain an organization's database resource. The DBMS itself is not tied to any particular set of files. [Ref. 4: p.333]

a. Benefits of the DBMS

The conversion to a DBMS has many long term benefits. Data captured in the database becomes application

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independent. The data structure of the data in the database remains the same no matter what the application, causing some standardization of application development since all applications must access the same structured data. However, this does not limit the applications since applications can build different views of the data simply by accessing and merging the data to suit the application needs. For example, one program could be written to track contracts in separate geographic areas. The program could produce reports based on just one region or it could combine or extract data from the database to produce a NAVFAC-wide report.

Existing software is able to provide logical as well as physical data independence, enhancing the data storage economies. Redundant data need not be stored for several applications. The evolution of the database can proceed without the spiralling cost of maintenance for application programs. There no longer needs to be updates to application programs due to data changes. With DBMS comes utility programs to assist the Data Base Administrators (DBA) to act as controllers and custodians of the data to ensure integrity of the data and enforce the proper structure. (The centralized database system currently in use will be discussed later in this chapter.) Along with integrity comes the requirement to protect the data through proper security measures. The data for the most part is unclassified administrative data for military purposes, yet it is in a sense administratively confidential and must therefore be protected. Access to the database must be limited to those who have a need to know. The DBMS utilities will accommodate this requirement also. Since the DBMS is generalized, data migration across devices can be facilitated much easier as the proliferation of hardware increases. In governmental systems this is important considering the limitation of the ADP procurement policies.

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Managers of systems can not always predict the brand of hardware a particular procurement action will produce. Another consideration is that of an evolving functional distribution system. As the system grows horizontally or vertically, the new nodes that are placed on the system may or may not be compatible with existing system hardware. Existing equipment must be either directly compatible or must be able to interface through various protocols.

A current goal of the NFS is the development of a complete data dictionary to cover all the AIS. This is imperative for the proper control of the data validity. The data dictionary standardizes the data formats and the actual meaning cf the data elements for all command systems. This is not new to the AIS but simply a feature to have a fully functioning DBMS. The DBMS also permits various levels of access to the database. The DBA is be able to define the structure of the database through the use of the data definition language (DDL). The DDL includes terms for defining records, fields, keys, and relationships. It also provides facilities for expressing a variety of user views and allows the imposition of user constraints such as editing capability, interrecord and intrarecord browsing. Access to the database by application programmers is through the use of the database command language. Applications can be written for novice users of the system at EFDs and field activities such that the details of accessing the database are completely transparent. For more sophisticated users who wish to access the database directly, a query language is available. This permits queries to be made of the database to obtain quick answers to unanticipated or one-time queries.

b. Advantages of a DBMS

A generalized DBMS has many advantages over a
conventional file oriented structure. The DBMS allows more
information to be pulled from the same data. Consider a
distributed system where field ROICC offices would be able
to access a large database. Several applications could be
made from the same source data. For example, contract admin-
istration on a series of contracts could be used to track
the current workload at the ROICC level. The same data at
the EFD level could be used to review the distribution of
design efforts over the EFD's geographical area of responsi-
bility. At the NAVFAC level the same data could be used by a
program manager in the development of budget estimations for
the upcoming budget process. The partitioning of data in a
conventional file system makes the process of gathering data
for these different applications difficult. In the conven-
tional system, to avoid this difficulty it becomes necessary
to maintain a file for each application creating vast
amounts of data redundancy. Thus the DBMS saves memory
space, speeds processing and data entry, as well as enhances
the data integrity.

c. Disadvantages of a DBMS

With any improved system there also exist some
disadvantages and turning to a generalized DBMS from a
conventional file oriented system is no exception. DBMSs are
expensive to procure and implement requiring longer term
benefits to justify the initial cost. A generalized DBMS can
require a new series of processors. This is important if
the corporate processing involves more than just database
processing. A dedicated processor is often the best invest-
ment since it will permit parallel processing of database
accesses and applications. Highly trained personnel are

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required to maintain the DBMS environment and administration and control of the DBMS is more complex than the file oriented systems. Administrative and operating cost can be expected to increase. Considering the disadvantages and comparing them to the overall advantages, the long term benefits of the DBMS over the conventional file oriented system can easily justify any of the mentioned disadvantages.

3. Distributing The System

Another NFS initiative which reflects the changing philosophy of NAVFAC is that of expanding the number of users of the NFS. This expansion is being accomplished through decentralization and distribution of the NFS. Project smart (source management of resources and time) is being implemented for use at the EFD/OICC level. The project consists of installing minicomputers at the EFDs and OICCs to permit the implementation of local management tools and the standardization of existing office automation systems. The objectives of project smart are:

a) provide additional processing capability for the EFD/OICC;

b) achieve system revision and integration through evolution not revolution;

c) provide a user friendly interface to permit query language access to the generalized DBMS;

d) develop local application's from the initial installation.

Project smart is scheduled to be fully implemented in all EFDs and NAVFAC HQ by the end of FY87. [Ref. 1: p.5-10]

Another form of distributing the NFS has been the decision to provide "teleprocessing" to the EFDs. Hardware has been connected from the Facilities System Office (FACSO) in Port Hueneme, Ca. to the EFDs and to NAVFAC HQ through

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the use cf telecommunication lines. The hardware includes
terminals for input/output operations, and hardcopy
printers. The remote sites can input data directly to the
main computer at FACSC as well as receive management reports
at local printers. This type of distributed processing has
proven tc be more effective and efficient than the totally
centralized approach used previously. [Ref. 1: p.5-1]. The
benefits include reduced input time, a more accurate data
discipline, and improved delivery time for outputs.
Reporting requirements have also declined due to the ability
of the user to make cr-line queries of the database.

4. Automated Infcrmation Systems

Of the 15 AISs, only the EFD/MIS will be focused
upon in the remainder of the thesis. The EFD/MIS serves the
management requirements of the EFDs, large OICCs and NAVFAC
HQ. This distributed data processing (DDP) configuraticn is
shown in figure 3.2 below. The major data systems cf the
MIS are:

(1) The "AMALGAMAN" Data Base which supports the
following:
(a) Integrated Disbursing and Accounting (IDA)
(b) Integrated Program Management System (IPMS)
(c) Construction Management System (CMS)
(2) Design Management Information System (DMIS)
(3) Graphics Design System (GDS)
(4) Contractor Information System (CIS)

The EFD/MIS has over 200 computer programs and produces
approximately 200 standard titled reports. [Ref. 5: p.i]
The data systems which are of primary interest to the ROICC
are the CMS, DMIS and the CIS.

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EFD/MIS DDP CONFIGURATION

FLOPPY DISK (256KB each)

DIRECT ACCESS STORAGE (100MB each)

HIGH SPEED LINE PRINTER

FIXED HEAD DIRECT ACCESS STORAGE (2MB each)

MAGNETIC TAPE UNIT

SINGLE LINE SYNCHRONOUS COMM CONTROLLER

FACSO

OPERATOR CONSOLE

CENTRAL PROCESSOR & MAIN MEMORY (1MB)

MULTI LINE ASYNCHRONOUS COMMUNICATIONS CONTROLLER

CHARACTER PRINTER

SLAVE PRINTER

INTERACTIVE CRTs

GRAPHIC DIGITAL PLOTTER

ROICC
ROICC
ROICC
ROICC

• ANY ASYNCHRONOUS DEVICE OR MODEM UP TO 16 EXPANDABLE TO 32

Figure 3.2   EFD/MIS DDP Configuration.

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a. Construction Management System (CMS)

The objective of the CMS is to provide the
NAVFAC level program managers with the information required
to monitor and control the design and construction phases of
shore facilities projects. The reports produced provide
Project Status (used by EFD/OICC and HQ), Execution Status
(used by EFD and HQ), Work In Place (used by ROICC,
EFD/OICC, and HQ) and various other management reports.
[Ref. 5: p.31]

b. Design Management Information System (DMIS)

The DMIS is utilized by HQ and EFD/OICC design
managers to manage the engineering and design phases of the
NAVFAC mission. Three functional areas are directly
supported: design scheduling, criteria scheduling, and engi-
neering and design management.

(1) Design Scheduling.

Design scheduling involves design job
status, design scheduling, personnel resource allocation
(in-house vs. contract), job cost control, and design
performance appraisal.

(2) Criteria Scheduling.

This application involves the design
schedule, milestones, and funding information used in sched-
uling and coordinating the preparation of design criteria.
The system is used to plan goals that will be established in
the Command Management Plan (NAVFAC P-441), and to document
the progress of the design goals which have already been
established.

(3) Engineering and Design Management.

Used by EFD/CICC and HQ program managers,
this application combines data from several data files and
aggregates it to a high level to monitor the progress of
projects at the EFD/CICC and HQ levels.

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c. Contractor Information System (CIS)

The CIS is designed: 1) to standardize proce-
dures for maintaining contractor information for the A-E
slates and mailing lists; 2)   maintaining history of the
contractors efforts for the U.S.   Navy;   and 3) providing
contractor data to the CMS and IDA systems [Ref. 6: p.1].
The CIS is utilized by all levels of NAVFAC management for
all varieties of contractor information. The information for
the CIS is drawn from contractor submitted questionnaires
(A-E and Related Services SF 254) and Bidder's Mailing List
Application (SF 129). Updates are made periodically as more
information is accumulated on various contractors through
submittal of follow-on SF 254s.

d. NFS Goals for the EFD/MIS

The NFSP, [Ref. 1: pp.1-12 - 1-21] outlines
several short and long term goals for the EFD/MIS which in
general lead toward a distributed data processing system
where the end-user will be able to work directly from the
generalized database system in a virtual mode. Some specific
goals are:
* Implement automated procedures for reporting
   individual procurement actions (DD 350 reports).
* Develop a word processing/central processing
   interface for the ROICC.
* Convert AMALGAMAN/CMS to DBMS with on-line query
   capabilities.
* Implement Graphics Design System at the EFD and HQ
   levels.
* Convert the DMIS to DBMS for on-line query
   capabilities.

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B. FACILITIES SYSTEMS OFFICE

The Facilities Systems Office (FACSO) is the hub of the
NAVFAC data processing system. Located at the Construction
Battalion Center, Port Hueneme, Ca., FACSO is responsible
for the majority of the development and operation of the
NFS. FACSO's distributed network is shown in figure 3.3
below.

FACSO has an IBM 370/165-II computer system with 4
million characters of main memory, 22 gigabytes of on-line
storage, 26 tape drives, 2 high-speed non-impact printers,
and 6 high-speed impact printers. Two coupled Interactive
Data Base Processors (IDBPs) with 4 million bytes of memory
each were installed in 1981/82. The IDBPs handle all data-
base applications and share most of the peripheral equip-
ment, thus relieving the 370/165-II of considerable
workload. A COMTEN 3690 Front End Processor handles the
majority of the telecommunications interface. The device is
programmable and switchable so that a given port can handle
different types of input terminals and route messages under
program control. Communication ports are assigned
dynamically to accommodate the fluctuating load. [Ref. 1:
p.4-1]

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NFS PRIVATE LINE NETWORK

Figure 3.3   NFS Distributed Network.

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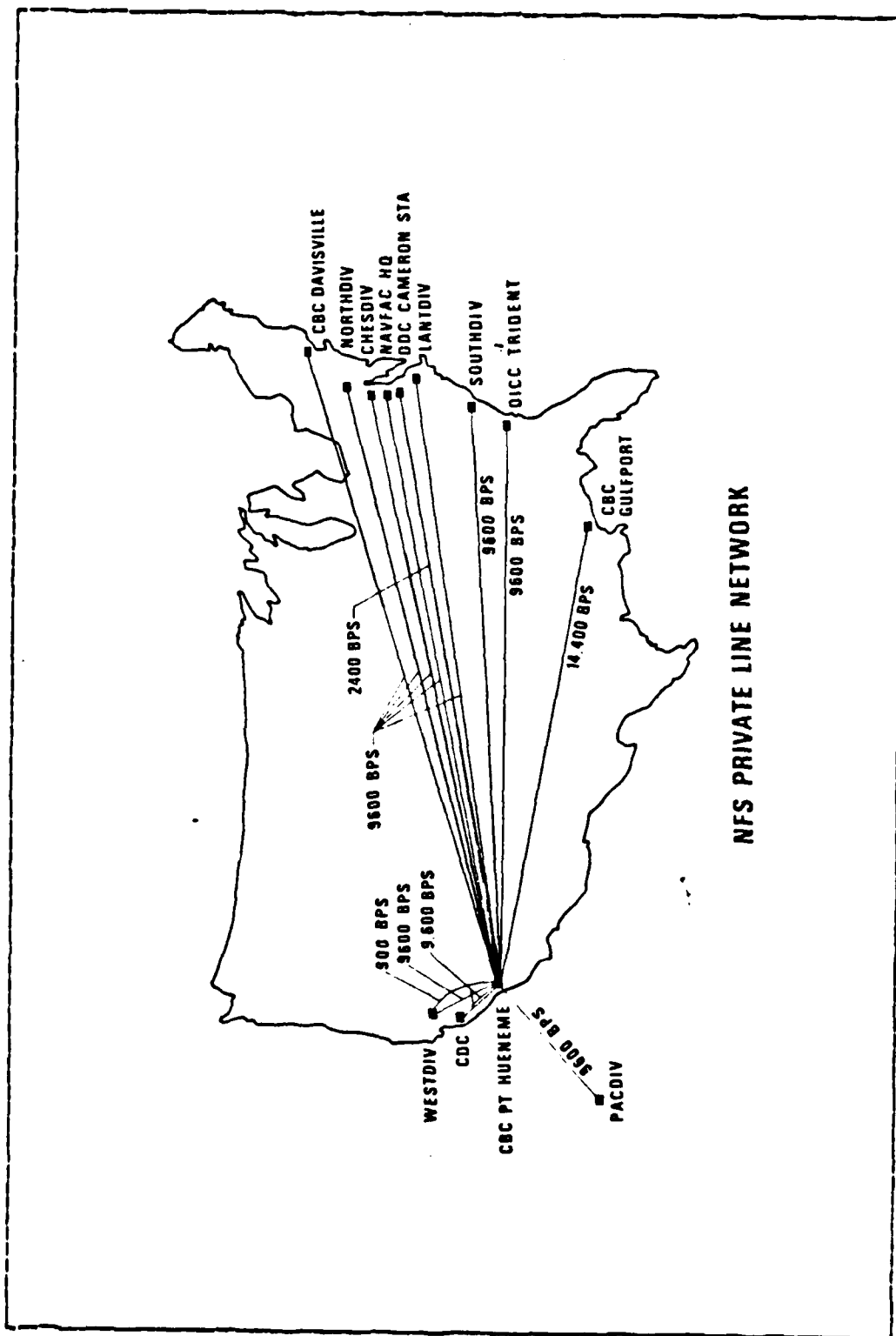
C. LIMITATIONS OF THE NAVAL FACILITIES SYSTEM

The paragraphs above have briefly explained the NFS and in particular the EFD/MIS. The life of the NFS continues to be a dynamic one as are all long term data processing systems. The system has shown all the signs of growth as described by Nolan [Ref. 7 : pp. 115-126]. The system began as a central data processing point where all input was either sent via the postal services or transmitted electronically via message. The data was required to be key punched on data cards and submitted in a batch mode with output reports sent to the users via the postal service. The time lapse from the time the field activities submitted their data to FACSO (via the EFD) to the time the output reports were received could be as long as five months but was normally in the order of at least three months. This management system did not meet the management needs of the field activities. Today however, the NFS provides the EFDs and NAVFAC HQ better management support due to the advances in telecommunications and the availability of distributed processing at the EFD level.

A large majority of the data for the EFD/MIS comes from the field ROICC offices. These offices accumulate this data over a period of a month, in most cases manually, and submit it to the EFD where it is validated and transmitted directly to FACSC through use of the EFD/MIS DDP system (Figure 3.2).The ROICC office will normally receive a management report within six weeks. This data is in the most part historical and can not be used to effectively manage a day to day operation. Therefore the collection and reporting of the data is only an overhead expense to the field activity.

Plans for the future for the NFS call for the field activities to have a virtual connection to FACSO just as the EFDs enjoy now. This will permit the ROICC to collect data

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electronically and in turn transmit probably via the EFD
processors to FACSO. The ROICC will also be able to keep
on-hand the data for management of daily operations. These
advances are just beginning to be seen for some ROICC
offices. WANG Office Information System (OIS) hardware/
software is used to permit collection of required data. The
data is presently transmitted to the EFD by mailing disks.
Direct transmission to the EFDs is not possible at the
present time. A main concern of this thesis is investi-
gating a method by which the field activities can locally
utilize the data which is collected for higher level manage-
ment. Currently, the majority of the data remains to be
historical in nature. Systems can be developed which will
incorporate the collected data into the daily management
functions of the field activity. The remainder of the chap-
ters will be devoted to the development of such a system for
the management of the A-E contracting process.

IV. A-E CONTRACTING PROCESS

A. GENERAL

As mentioned earlier, A-E contracts are used primarily
to procure the drawings and specifications for contemplated
construction projects [Ref. 2:   p.2.1.1].   These contracts
are awarded throughout the NAVFAC contracting chain. While
all the contracts are awarded by following the same required
contractual procedures [Ref. 2], the actual process will
differ from command to command due to differing management
styles of individual managers and the local "traditional
policies". The process described below is generic in the
·sense that all the A-E contracts go through the same three
phases no matter which command is concerned. There are many
rules and regulations which govern the process but it is not
the intent of this chapter to fully discuss all the legal
requirements of contracting but rather to focus primarily on
the process and the accompanying information flow that the
manager must be aware of in order to manage the process.

Within the A-E type of procurement there are several
different types of contracts. The main difference in the
various types is the number of "actions" or "products" which
can be delivered under one contract. Some contracts,
normally larger in award amount, require the design of one
construction project. Other contracts are "open-end" in that
a larger number of designs, normally small in nature, can be
accomplished under one contracting vehicle. Open-end
contracts often are not to exceed a predetermined total
amount. These contracts are negotiated based on hourly fees
for particular technical skills rather than for a total
design cost basis.   Follow-on work is negotiated   based on

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the hours required to accomplish a design task which is then translated into an award fee.

The A-E contracting process is broken into three phases, the pre-negotiation phase, the negotiation phase and the post-award phase. Each transition from one phase to another is marked by a distinct result or action. The pre-negotiation phase involves the initial request for a contract submitted by a customer. The phase ends when a slate of a few contractors is approved by the selection official for further consideration. The negotiation phase begins with the selection of the best qualified contractor from the slate and concludes with the awarding of a negotiated contract. Post-award is the actual contract execution phase. It begins immediately upon the signing of a contract and finishes when all contracted work has been accepted by the government and final payment to the contractor has been made.

There are several parties involved in the contracting process. These include the contracting officer (OICC, ROICC, ARCICC), the customer (organization whom the design is to benefit), the contract administration staff, government engineers (review the contractor's work and accept it as being correct), and lastly the contracted A-E firm. The parties are involved to differing levels throughout the contracting process as will be seen in the following paragraphs.

B. PRE-NEGOTIATION PHASE (I)

The steps in the Pre-Negotiation Phase (I) are carried out primarily by the contract administration staff. Other key participants in this phase are various board members as well as the customer. The customer may be someone in the immediate contracting organization itself or maybe an

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organization which is supported by the contracting office.
Figure 4.1 is a flowchart depicting the steps listed below.

I.1 Request for contract - The contracting officer receives
a request for an A-E contract. A determination has
already been made that the design cannot be handled by
the in-house engineering staff.

I.2 Contract Specialist (CS) assigned - The contracting
officer assigns a CS to handle the contract request.
This CS may administer the contract from the beginning
of the contract to the end or the CS may simply handle
the contract until the award is made, depending on the
local policy.

I.3 Development of Statement of Work (SOW) - The requesting
customer or the in-house engineering staff will develop
the SOW for the contract. The CS reviews the SOW for
completeness and correctness. The developer of the SOW
draws up the weighted criteria by which the best
qualified contractor can be selected.

I.4 Detailed Government Estimate (GE) - In most cases the
writer of the SOW also draws up the GE.

I.5 Required Clearances and Approvals - Depending on the
type of funds used for the design and the type of
design, certain clearances and/or approvals may be
necessary from higher command levels before further
action can be taken in the contract process.

I.6 Small Business Set Aside Recommendation - A
determination must be made as to whether the contract
will be open to large business or remain as a small
business set aside.

I.7 Commerce Business Daily Synopsis (CBD) - The CS will
prepare the synopsis for the CBD and ensure that it is
mailed. The CBD announcement is a notice of intent to
contract.
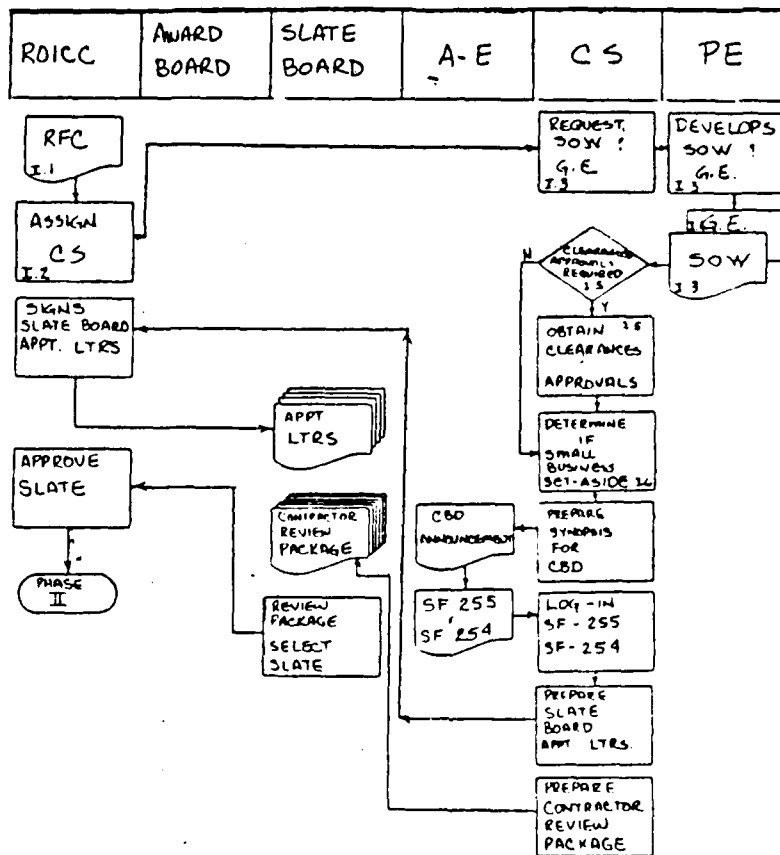
Figure 4.1   Pre-Negotiation Phase Flowchart.

I.8 Logging of SF 254s and 255s - Contractors responding to the contracting announcement in the CBD are required to submit their firm's qualification on the SF 254 (general contractor information) and the SF 255 (contractor information directed toward a particular announced contract action).

I.9 Board Appointment Letters - The A-E contracting process requires three contract boards: pre-selection board, selection board, and the negotiation and award board. Appointment letters assigning the members of the board must be sent out.

I.10 Pre-selection - The pre-selection process is carried out by the pre-selection board. All contractors submitting a SF 255 for the contract are considered. The SF 255s are reviewed by the board members and the field of qualified contractors is narrowed to a manageable number. The board members are guided in their selection of the qualified contractors by the selection criteria developed by the customer or engineering staff. The slate of qualified contractors is approved by the approving authority (based on the amount of the contract). The approval of the pre-selection board report by the proper authority is the concluding action of the pre-negotiation phase.

C. NEGOTIATION PHASE (II)

The Negotiation Phase carries the process through the actual award of the contract. The customer plays a minimal role in this phase with the key players being the pre-selected contractors, the selection and contract award board, the selected contractor and the CS. Figure 4.2 depicts the negotiation steps listed below.

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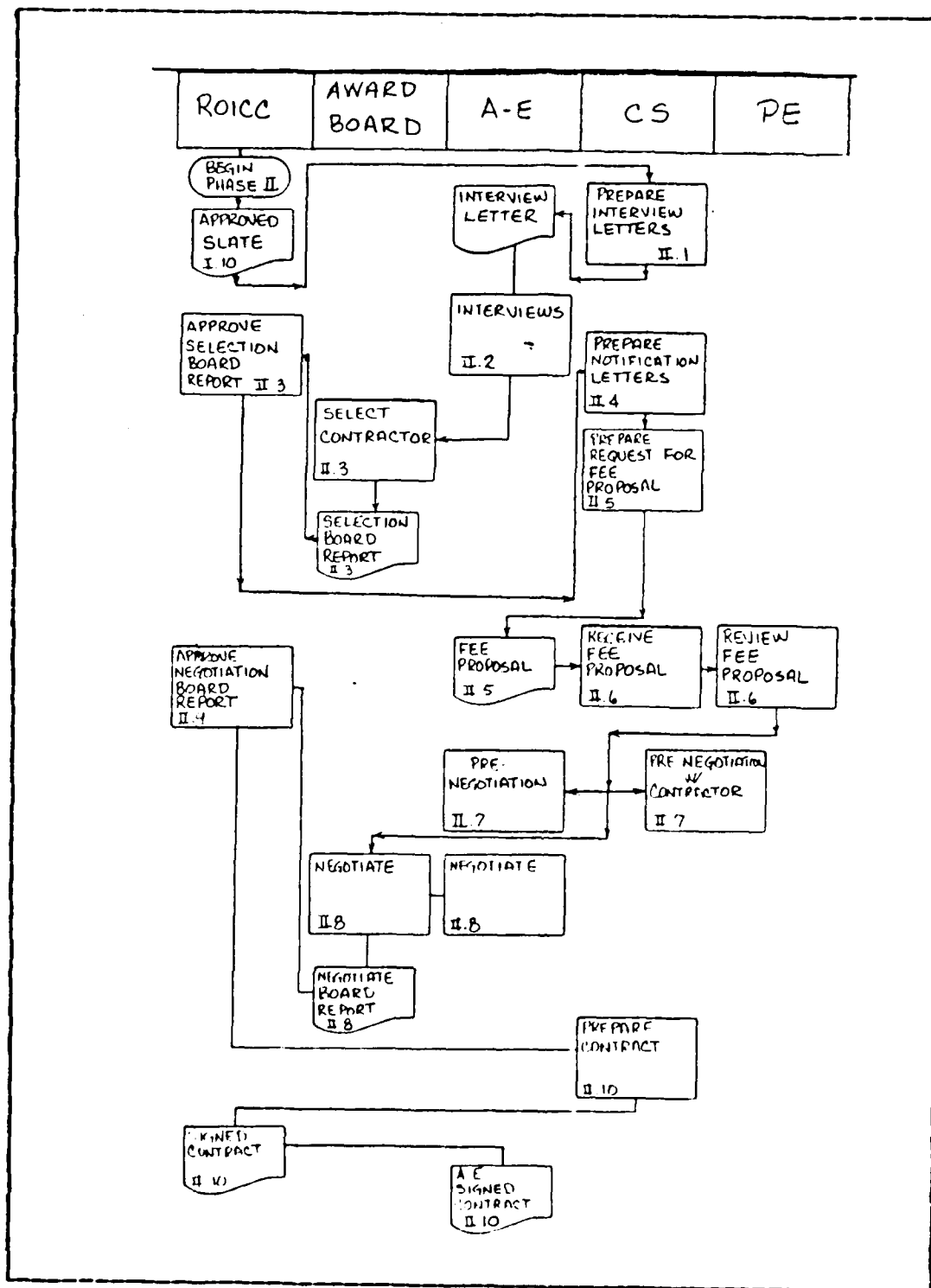
Figure 4.2   Negotiation Phase Flowchart.

II.1 Interview Letters - Those contractors approved on the Pre-Selection Board report are sent letters to inform them of their pre-selection and to establish a time and place for an in-depth interview before the Selection Board.

II.2 Interview of the A-E firms - Individual interviews are conducted for each A-E contractor. The Board members evaluate the contractors against the criteria published in the CBD announcement.

II.3 Selection of a contractor - Based on the interviews, the Selection board members select a contractor who best satisfies the selection criteria. A Board report is prepared and signed by all members of the Board. The proper approving authority (depending on the amount of the contract) will either approve or disapprove the selection of the Board.

II.4 Request for Fee Proposal - A request for a fee proposal is sent to the selected contractor. Depending on the size of the contract, various documents may also be required of the contractor.

II.5 Receipt of the Fee Proposal - The fee proposal when received is forward to a lead engineer for review. The engineer may or may not be the customer. In a multi-disciplined contract, the proposal may be sent to several engineers. The engineers may be on the Selection and Award Board as well. Here again, depending on the size of the contract, various clearances may be required.

II.6 Pre-negotiation - The lead engineers in conjunction with the CS will perform the pre-negotiations with the contractor. This can result in revisions of both the government estimate and the contractor estimate as well as clarifications of the SOW. All actions which take place are recorded by the CS.

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II.7 Negotiation Board meeting - Once negotiations with the
contractor are settled, the Negotiation Board is called
to meet in order to review the negotiation proceedings.
If the proceedings are agreeable to all the board
members, the board report is prepared and signed by all
the members and is then forwarded to the proper approval
authority for approval.

II.8 Negotiation Board Report Approval - The approving
authority reviews the Negotiation Board report and
approves or disapproves.

II.9 Contract Award - Once the approving authority approves
the Negotiation Board report the contract can be signed
by the proper authority. The signed contract is then
sent to the contractor for signature.

D. POST-AWARD PHASE (III)

The Post-Award Phase carries the contract process
through management and administration to the final payment
and closing of the contract. The normal players in this
phase are the contractor, the lead engineer who will review
the contractor's drawings, and the CS who must process the
payments for the contract. The contracting officer may get
involved if problems arise in the contract. Figure 4.3
illustrates the steps of this third phase. The contract
modification steps are not shown here since the same steps
are followed as in the negotiation phase.

III.1 Notification Letters - Letters are sent to all the
non-selected contractors. These letters inform the
contractors of the contract award.

III.2 Individual Procurement Action (DD Form 350) - Contract
actions exceeding $10,000 require the filing of a DD
Form 350. This form is normally submitted to the EFD.
The form contains information pertaining to the awarded
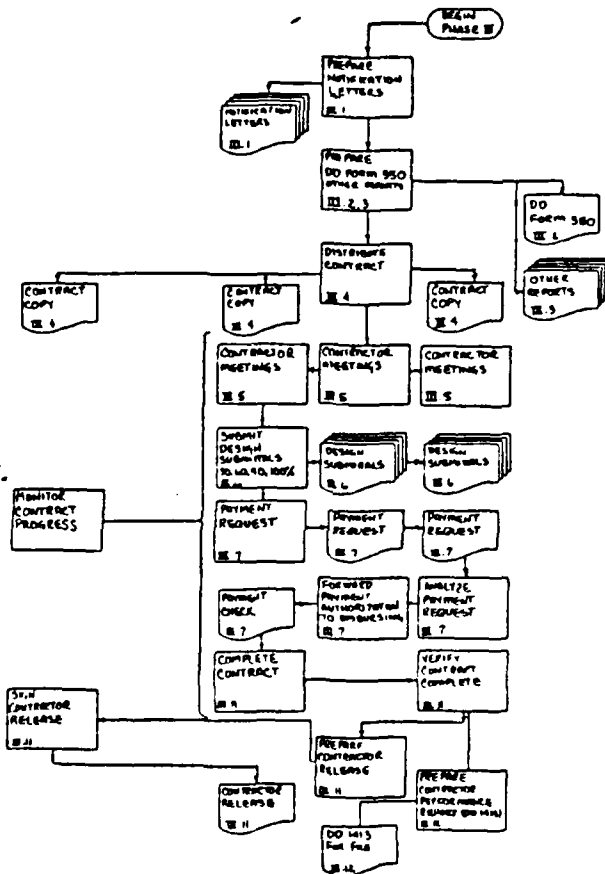
Figure 4.3   Post-Award Phase Flowchart.

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contract and the procedures utilized in awarding the contract.

III.3 Other Reports - Depending on the size of the contract, it may be necessary to notify NAVFAC of the award and also submit an award announcement to the CBD.

III.4 Distribution of Contract - Once all the signatures are obtained, the contract can be reproduced. The contractor will be sent several copies as will the EFD and the customer.

III.5 Contractor Meetings - Prior to the actual beginning of the design effort, it may be necessary to meet with the contractor to discuss administrative matters or design specifics. Similar meetings may occur throughout the life of the contract.

III.6 Design Reviews - Design reviews are for the purpose of reviewing the contractors work to ensure the government is obtaining the design as requested. It also is a key feedback mechanism to ensure customer satisfaction. Design reviews occur normally when the designs are at the 30%, 60%, 90% and final or 100% complete points. If the design is time critical, the 60% review will normally be waived. The lead engineer will coordinate the reviews with the customers. The customers are often non-technical and the lead engineer serves as the "interpreter". The lead engineer communicates to the CS whether or not the submittals meet the specifications of the contract. The relationship between the CS and the lead engineer is of upmost importance in the post-award phase.

III.7 Contract Modifications - Contract modification procedures are very similar to the procedures in the pre-award phase. The procedures are as follows:
1) Request for contract modification - This would normally be in the form of a request for

additional work or for a time extension for existing work. The customer will generate the request for additional work and the contractor would request the time extension.

2) Changes Board appointment letters - Letters are sent to Change Order Board members notifying them of the time, place and circumstances of the change.

3) SOW revision - The SOW is amended to reflect the change.

4) Preparation of the GE - The GE is developed by the lead engineer.

5) Request for Fee Proposal - The revised SOW is forwarded to the contractor with a request for the firm to provide a fee proposal.

6) Receipt of Fee Proposal - The contractor's Fee Proposal is received by the CS and forwarded to the lead engineer for review and validation.

7) Pre-Negotiation contact with the contractor - The contractor is contacted by the lead engineer and the CS to discuss differences in the contractor's estimate and the GE. If required, any clarifications are made and a preliminary agreement is established. The GE or the contractor's estimate may be adjusted as appropriate.

8) Preparation of the proposal analysis for the negotiation board - The CS will prepare an analysis for review by the change order negotiation board. The analysis will cover all the preliminary discussion between the contractor and the CS/lead engineer team.

9) Change order negotiation board meeting - The board meets to discuss the CS's prepared analysis and

to determine if the contractor's proposal is fair and reasonable.

10) Board report preparation - The CS prepares a board report for all the board members to sign.

11) Approval of board report - The signed board report is submitted to the approving authority for approval.

12) Signing of the Change Order - The approving authority signs the Change Order for the government.

13) Contractor sent Change Order - The signed Change Order is sent to the contractor.

III.8 Progress Payments - Periodically the contractor will submit a request for a progress payment to the CS. The CS will obtain an endorsement from the lead engineer on the request. Based upon the lead engineer's endorsement and upon the CS's own knowledge of the progress of the contractor, the CS will forward the request for payment to the proper government disbursing office.

III.9 Disputes, errors and omissions, design deficiencies, A-E liability - The Contracting Officer, CS, lead engineer, and the contractor will be involved in the resolution of these matters. These matters are normally resolved at this low level but may progress through a complex process leading ultimately to court action if necessary.

III.10 Final Payment - When all design work has been completed and accepted by the government, the contractor will submit his request for the final contract payment. This payment is processed in a similar manner as progress payments except that the contractor is paid the full remaining balance of the contract fee with no contingency withheld.

III.11 Contractor Release - The contractor is released from the provisions of the contract once all work has been completed and final payment has been made.

III.12 A-E Performance Report (DD 1413) - The A-E performance report is a summary of the contractor's performance during the life of a particular contract. The CS will require the lead engineer to fill out the DD 1413. This report will remain in the contractors file for future reference on other contract considerations.

V. REQUIREMENTS DETERMINATION

A. WHY AN AUTOMATED SYSTEM?

The NAVFAC history on Automated Data Processing as
mentioned earlier goes back to the 1950's. ADP has progres-
sively proven to be a more advantageous tool to use in the
area of facilities management. The Naval Facilities System
has been built around the concepts of ADP and the emerging
technologies of the computer revolution. One goal of the NFS
is to extend the management resources available to the field
activities. This process of distributing the ADP capabili-
ties is evolutionary in nature with the EFDs becoming
increasingly more ADP oriented. The next phase of the evolu-
tion is to reach the commands and field activities supported
by the EFD. Several of the EFDs have begun to provide the
field activities with computer hardware and software which
will enable them to develop applications on the local level
as well as communicate directly with the EFDs. Most of the
communications planned will require use of commercial tele-
communication lines for distributed processing. Unlike field
activities in the continental United States, overseas activ-
ities have problems with this form of communication. The
costs and reliability factors as well as protocol complica-
tions make transoceanic telecommunication of data imprac-
tical at this time. These activities must depend therefore
on local independent computer systems.

Automation is not appropriate for every situation. For
some processes, total automation can be achieved and will
result in many benefits, while other processes do not lend
themselves to automation and should remain manual. The A-E
contracting process falls in the middle of the spectrum.

There are several benefits the ROICC can gain by automating portions of the process. Consider the following:

Time Savings - The A-E management procedures require a sizeable amount of correspondence, reports and standard memorandums. In an automated system form, letters, reports and memorandums are required to only be written one time. Form correspondence such as this only requires that unique information be inputted. This input can be made either from a database or in response to on-line queries. In advanced electronic office environments, much of the in-house correspondence can be sent via electronic mail producing time savings for both staff and managerial personnel. In considering the time required to locate information in a file, a computer based system utilizing a database management system can provide the information by simply responding to a query. The computer will locate the information as opposed to an individual having to manually look through a physical file.

Accuracy - There is a potential for greater accuracy. Once the data is entered into the system in the proper format, it is not necessary to reenter it. This reduces the number of times the data needs to be physically handled. Selective user interfaces and error reducing screen formats can aid greatly in reducing the number of data entry errors.

Data Collection - Methods for collecting the data can be much faster than manual systems. User interfaces can be designed to prompt the user for the data. Properly designed prompts and input screens remove, in a number of cases, any questions staff personnel have regarding the proper data.

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Data Storage - Manual systems require the collection of a high volume of redundant data. Computer based data storage can utilize database management systems which will greatly reduce the need for redundant data. As mentioned earlier, data in one database can be utilized to satisfy more than one requirement. This also reduces the size of the data storage. As an example, in the contract process, the name of a contractor normally appears on most of the contract documentation. With a database management system, the storage of this information would only be required once. Follow-on reports or correspondence could be provided the contractor's name from the database.

Personnel Turnover - In many cases an automated system can ease the problems associated with the turnover of personnel. The automated system if properly designed can guide new personnel in the work process. With built-in help facilities, the computer can be referenced when questions arise. Also for data entry, set formats provide the new personnel with a template for input process, removing some of the ambiguity of a new system.

Costs - Most improvements to a process result in cost savings. Computer based systems are no exception if they are properly designed to fit both the organizational needs and the process. Cost savings are seen in personnel, supplies (less paper in some systems), and time savings from data entry, storage, and retrieval.

B. THE COMPUTER-BASED ENVIRONMENT

For the proposed automated A-E contract management
process to be effective, it should provide the benefits
described above. Aron [Ref. 8: pp. 213-236] describes three
levels of information system design for organizational
information systems. The levels are:

1) simple data processing system
2) integrated file-oriented data processing system
3) management information system

A fourth level would be information resources management
systems (IRMS), a concept on the current edge of information
systems technology.   Each of the higher level systems
include the elements of the lower level systems since the
development of the systems from the first to the fourth has
occurred in an evolutionary process.   Let's consider each
level individually in relationship to the A-E contract
management process.

1. Simple Data Processing System

The simple data processing system consists of a
number of independent transaction-oriented tasks which
summarize inputs to produce reports.   The ROICC may want to
know at the conclusion of the fiscal year how many contracts
were awarded for A-E services.   A simple data processing
system approach to this request is shown in Figure 5.1.
During the year, as each contract is awarded, an input could
be made into a computer which would give the data for the
contract such as the contract number, title, A-E firm and
the fee. A program could be written to take this input and
produce a report at the end of the year which would summa-
rize the number of contracts and the total dollar amount of
fees awarded. This same approach could be made for a number
of desired reports.   The disadvantage of this type of system

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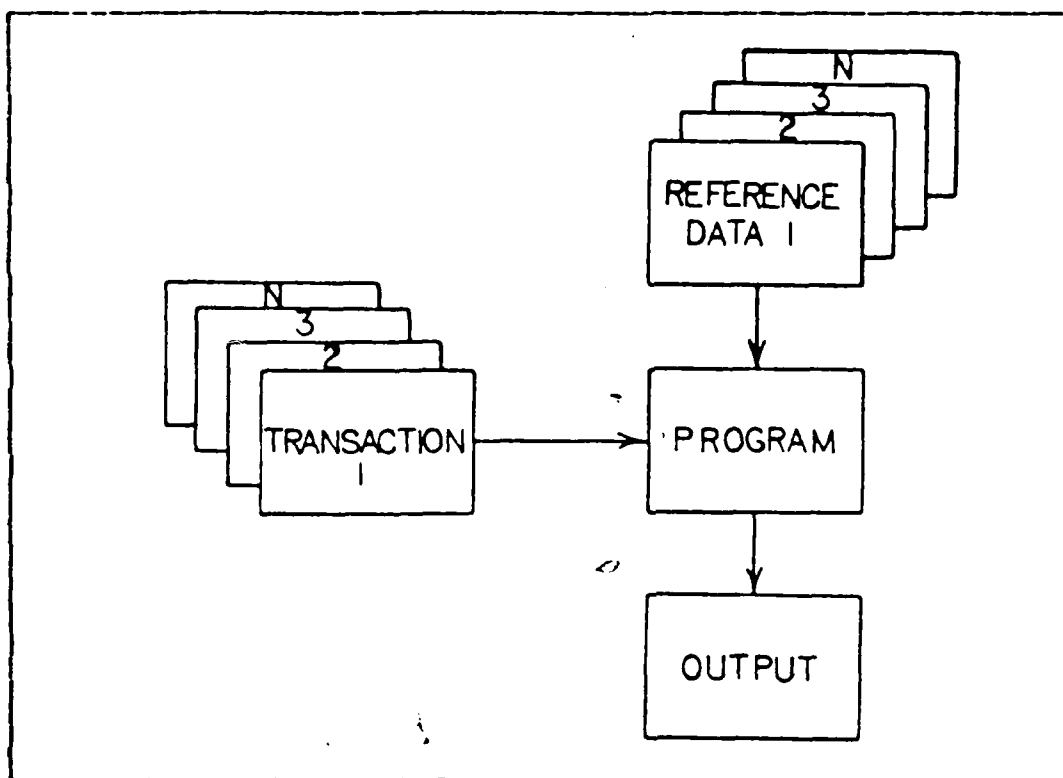
Figure 5.1   Simple Data Processing.

is that the reports are historical in nature and tend to
provide only record type information. Simple data processing
systems which produce historical data,   do not lend them-
selves to the day to day dynamic management requirements of
the RCICC.

2.   Integrated File-Oriented Data Processing System

Most shortcomings of the data processing system are
overcome by the development of the integrated file-oriented
data processing system. The integrated file-oriented data
processing system structures data such that facts can be
extracted according to many different criteria. A contractor
information system maintained by the ROICC can contain data

on contractors who either do business with the Government or who desire to be considered for upcoming contracts. The data is stored in a series of files made up from information the contractor has submitted via the SF 254 and possibly the SF 255. These forms provide demographic information on the contractor as well as the composition of the firm by discipline and a short concise history of the firm's past contract experience. The ROICC utilizing an integrated file-oriented data processing system can determine for example which contractors on record have the proper mix of engineering disciplines to perform a certain contract. This would be accomplished as shown in Figure 5.2. The data from the SFs would be inputted to database files as the forms are received by the ROICC. A series of program would be used by a supervisory program to select and extract the needed information from the proper data files in the database. The output would be formatted by one of the programs in the series and produced either as a newly created file or as a hardcopy report or as both.

3. **Management Information System**

The MIS adds another block to the information system structure. The MIS adds the foreknowledge of what decisions must be made by the ROICC in managing the contracting process. The MIS is an integrated system for providing information to support planning, control, and the operation of the ROICC shop. Figure 5.3 shows the basics of a typical MIS. The MIS combines the data bases of the integrated file-oriented system with a database of inference models and models for evaluation criteria. Application programs kept on file are utilized to draw data from the three databases to assist the ROICC in making decisions. The ROICC using a MIS could be guided to the proper reports required by a certain contract type or size. The MIS would evaluate the contract

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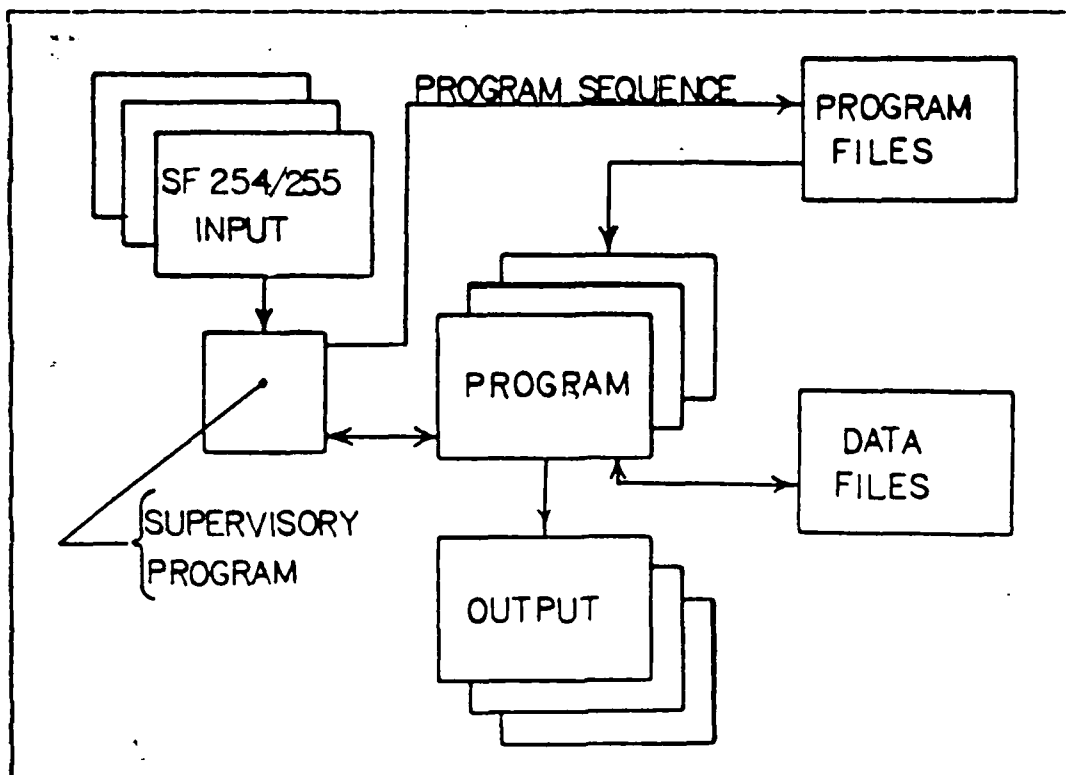
Figure 5.2   Integrated File-Oriented Processing.

based on the size of the contract fee to determine which
approvals would be required. The MIS would make this
requirement known and then would proceed to collect the
information from the main database to create the report and
produce it either for viewing on a CRT or in hardcopy.

4.   Information Resource Management System

The Information Resource Management System (IRMS) is
the current technology in information systems. The system is
the convergence of several information technologies, data
processing, communications and the automated office. In the
future, IRMS will permit the ROICC to teleconference with
the EFD and possibly permit the Award Board to interview the

DATABASES

PROGRAM FILES

PROGRAM SEQUENCE TERMINAL

INPUT DATA

MODELS
INFERENCE

PROGRAM

MODELS
EVALUATION

SUPERVISORY PROGRAM

OUTPUT

INPUT
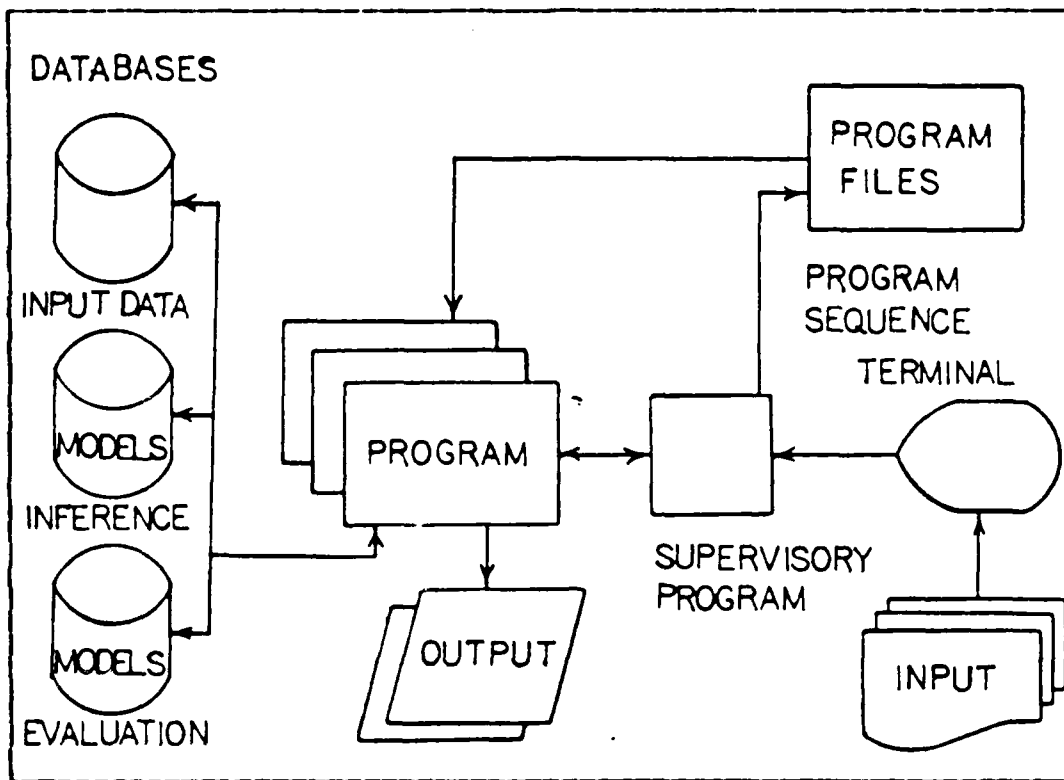
Figure 5.3   Management Information System.

contractor via teleconferencing. Most transactions in the
contracting process would be accomplished without paper. All
draft SOWs, drawings and payment requests would be trans-
mitted electronically. The futuristic IRMS would extend the
MIS capabilities so that Decision Support Systems would be
available to the ROICC from EFD resources.

C.   ROICC A-E CONTRACTING MIS

The IRMS is technologically in the future for the ROICC
and for NAVFAC as a whole. The data processing system and
the integrated file oriented processing systems seem only to
automate a currently manual system rather than provide an
improved management tool.   The complete contract management

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function of the ROICC which includes A-E and construction contracting management would be well supported by a MIS. The A-E contract management process would be only part of that system.

The system to support the ROICC MIS should enable the ROICC to do basic word processing, database management, and run applications to interface the database and the application programs. The size of the system would depend primarily on the size of the contract management task. The applications could consist of different modules: 1) to handle report and letter generation; 2) to track the individual contract phases; 3) to track the contract workload; and 4) to run rule based modules to assist the ROICC in deciding where and when to apply various regulations. With the addition of communication technologies, the system could be connected to the engineering department so that requirements such as SOWs and government estimates could be transmitted electronically. Further communication capabilities would enable the ROICC to send reports and copies of contracts to the EFD electronically.

D. PROPOSED A-E CONTRACTING SYSTEM

The following three chapters present a proposed automated A-E Contract Management System beginning with the pre-negotiation phase and concluding with the post-award phase. The proposed system is based on the idea of using a micro-computer and running commercially available software to develop application modules. The concepts used to develop the framework of the system are those discussed above. The approach taken in the proposal is not the only one that will produce a useable automated A-E MIS. It will provide the field with a useful management tool at a minimal cost through available current technology. As will be

discussed later, the hardware and software utilized to implement the proposed system can be used by the field activity in other ways. As an example of how such a system could be developed and might function, one major module of the proposed system, the Contractor Information System (CIS), has been developed and is presented in Appendix A.

VI. AUTOMATION OF THE PRE-NEGOTIATION PHASE

The Pre-Negotiation Phase will be the initiation phase of the majority of the automation of the entire management information process. Some functions for this phase will also be carried into the second and third phases. Each step will be investigated for possible automated procedures in the areas of applications, report generation and database applications. As will be seen, many of the automation procedures will require the interface of these three areas for effective building of management tools and improvements for the office staff.

A. REQUEST FOR CONTRACT (I.1)

The contracting officer after receiving the request for contract can initiate two automated management tools, the phase I/II tracking database and the contract file. The tracking database tracks the administrative contracting steps of phase I and II and is driven by an application module which guides the user through the proper control measures. The database would contain a listing of all the contracting steps with an estimated completion time calculated automatically by the driver application. The base of the completion times would be provided by the contracting officer. This aspect of the tracking system would permit the contracting officer to vary the times based on the conditions at hand (i.e. year-end obligations, predetermined performance criteria, etc.). As the steps are completed, the appropriate dates can be entered into the database by an automated timestamp.

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Another feature of the tracking system is the tickler function. This function permits the user to enter the current date and be given a listing of all actions which are due to be completed on that day and present a listing of the delinquent actions and signify if there is a comment in the file explaining the variance. Since delays can be expected, provisions exist for the user to adjust the schedule. A log in the database will be maintained to record adjustments for historical purposes.

The second management tool is the contract file which is simply an electronic file of contract documents and checklists. The contract file is not a static depository of electronically produced documents, but along with specific application programs will become the most extensively used management tool for the CS and contracting officer. The checklists in the file will aid the CS in the contracting process. Many documents will be placed in this file by various application programs. The file will be updated on many occasions automatically by the application programs. Access to the file is limited by procedures described below.

B. CONTRACT SPECIALIST ASSIGNED (I.2)

The contracting officer will maintain a database of the CSs in the organization and the contracts they are assigned. He will update the database as a new assignment is made as well as update the contract file to indicate the CS assigned. This update to the contract file is part of the security measures of the system. Only certain personnel determined by the contracting officer can access the contract file for a particular contract. Each CS and staff person is assigned a personal password. To gain entry to specific files the person desiring entry must first get through a password checking module. Limitations in file

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entry can be no access, read only access or full access
which allows both read and write access. The access to the
file can be changed at anytime by the contracting officer or
a designated assistant.

The first form letter from the report file is initiated
upon the assignment of the CS. The contracting officer
initiates a letter to the customer informing him of the
acceptance of the contract request, the CS assigned, the
contract number and also the need for a complete SOW and
government estimate (if the customer is the engineering
department, otherwise the CS will ensure that the government
estimate is developed). The basic form of the letter is
contained in a report generator file. This file is a collec-
tion of all the reports and letters required during the
entire contract process. The user is given the option when
using the form letters/reports to input the information
using a word processor type entry or to let the system
extract the information from the various databases in the
system. For example, the letter to the customer can obtain
the contract number and the CS assigned from the contract
file. The contracting officer needs only to identify the
correct contract file.

C. DEVELOPMENT OF STATEMENT OF WORK (I.3)

The SOW may be written by the customer using a word
processor and transmitted to the contract office via modem
or by sending a copy on a floppy disk to the CS. The CS can
proceed to use a word processor to proof the SOW and make
the appropriate changes then return the SOW to the customer
in a similar manner. If the SOW is electronically produced
it can be placed into the contract file. If not, a duplicate
physical file will have to be maintained for any
non-electronically produced documents.

D. DETAILED GOVERNMENT ESTIMATE (I.4)

An application module maintained by the contracting staff will be available for use by the engineering staff to develop the estimates. The module will permit the estimator to access a database of standard costs for various labor categories. A cost estimate worksheet will be provided the estimator from the reports/letters file which permits the estimator to build the estimate from the labor costs database. The estimator application module allows the estimator to enter a labor class and estimated effort from which the total cost for that labor class will be calculated. The module will supply the current applicable overhead, G&A, and other fees and calculate the bottom line figures. The estimator is provided the flexibility to change any estimate entered and request another calculation of the total. The estimate can then be electronically transmitted to the CS.

E. REQUIRED CLEARANCES AND APPROVALS (I.5)

Based on the provided government estimate, the CS can utilize a rule-based decision module to determine which clearances and approvals are required for the procurement action. The ruled-base is maintained by the contracting staff to reflect current contracting regulations. The CS would be guided through a series of possible requirements. If the module determines a clearance or approval is required, the CS determines if the report or letter should be prepared. If the report/letter is to be prepared, the report/letter file is accessed for the proper format and the information required can be obtained from the various databases or alternately may be provided by the CS. In the former case, the CS will be prompted for the information and be given the format for the information if a specific format is required. Copies of any correspondence will be placed in the contract record data file.

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F. SMALL BUSINESS SET ASIDE RECOMMENDATION (I.6)

This recommendation will be a part of the rule-based module described above. Once the decision is made, the contract file will be updated to reflect the decision.

G. CCMMERCE BUSINESS DAILY SYNOPSIS (I.7)

The CS will call up from the report/letter file the format for the letter to the Commerce Business Daily. The basic form such as the address and standard verbiage will be on the letter. The CS using a word processor can fill in the body of the letter with the information concerning the proposed contract then print a hard copy and mail it to the CBD. A copy of the CBD announcement letter will be placed in the contract file.

H. LOGGING OF SF 254 AND SF 255 (I.8)

The SF 254/255 provides information on the contractor and the firm's history of performance. The CS or a staff assistant will enter the summary information from the forms into the Contractor Information System (CIS) database. The application module permits a number of functions to be performed on the CIS database. These include adding, changing, deleting, viewing and printing of reports. A sample of an operational CIS application module is presented in Appendix A. An important aspect of the design of this application module is the data design and description. The Contractor Information System is a NAVFAC system included as part of the NFS. The data collected in this module must be as near as possible to the data format and descriptions as used in the NFS. This compatibility will insure that when future transmission of information between the EFD or FACSO becomes a reality, there will be minimal interface problems

and adjustments. The details of the CIS are discussed in the Appendix A.

The CS or contracting officer can use the CIS for developing bidder's lists for specific contract requirements. This is especially important to have in the advent of urgent design projects which must be accomplished under exceptional circumstances. Contractors who have previously submitted the SF 254 need not be reentered into the CIS. Their file will only require updating. Under normal conditions, most contracting offices have a stable base of contractors who continuously bid on contracts. This reduces the number of first time entries into the CIS.

I. BOARD APPOINTMENT LETTERS (I.9)

A database is maintained listing the eligible board members and the current boards they are sitting on as well as the last concluded board they sat on. A board member selection module will permit the selection of the members from the list simply by indicating an identifier (number or letter). The module will then access the reports/letters file and extract the notification letter for the board members. The letters will be printed out automatically or transmitted to the member's office if electronic mailing systems are in use. The contract file will be automatically updated to indicate the pre-selection board members.

J. PRE-SELECTION (I.10)

The reports/letters file contains a form pre-selection board letter. This form letter can be used by the Board to record the Board meeting results. The CS upon receiving the results of the board and an authorized signature copy of the board report will update the contract file with a copy of the board report.

All during the pre-negotiation phase the contract tracking system has been operational. The updates to this tracking system can either be performed automatically by the master module of the contracting MIS or by the CS as the steps are completed. This tracking system is carried through to the Negotiation Phase.

VII. AUTOMATION OF THE NEGOTIATION PHASE

Transition to the second phase of the A-E contracting phase from the first phase is transparent to the user. The same proposed tracking system, databases and the reports/ letters file are used. In fact the main driver program for the application modules is still in use.

A. INTERVIEW LETTERS (II.1)

The pre-selection board report produced the slate of contractors to be considered in the interviewing process of the negotiation phase. The names of these contractors were placed in the contract file as the closing action of the first phase. The CS can retrieve the form interview letter from the reports/letters file. The contractors names can be extracted from the contract file. The addresses of the selected contractors can be extracted from the CIS database. The CS will more than likely schedule the interviews around the availability of the board members and the contractors. Once a schedule has been established, the CS will note the times and place of the interviews, print the letters and send them to the contractors. A schedule of the interviews will be maintained in the contract file.

B. INTERVIEW OF THE A-E FIRMS (II.2)

Several items can be included in this step of the process but all the automated options are at the discretion of the contracting officer. A form interview evaluation sheet can be maintained in the reports/letters file. This type of uniform evaluation focus can ensure that all the board members evaluate the proper aspects of the contractor.

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This form would be used in conjunction with the predefined
evaluation criteria. The evaluation would be a standard form
used for all contract interviews. A listing of instruction
to the interviewers can also be prepared and maintained in
the file. If a standard evaluation algorithm is used by the
board to determine the best qualified contractor, a module
can be provided to calculate the results. While this would
provide an analytically determined best qualified
contractor, it is probably only a good starting point for
discussion by the selection board.

C. SELECTION OF A CONTRACTOR (II.3)

Once the board determines from the interviews who the
best qualified contractor is, a board report must be
produced for approval of the selection. Again the CS or the
head of the board can retrieve a form letter from the
reports/letters file. The heading and boilerplate informa-
tion will already be on the letter and the CS can use a word
processor to fill in the remainder of the letter based on
the findings of the board. After the selection has been
approved by the approval authority, the contract file will
again be updated by the CS.

D. REQUEST FOR FEE PROPOSAL (II.4)

The selected contractor is supplied with a standard
government estimate form. This ensures consistency between
the format of the contractors estimate and the government
estimate. The estimation form and the letter to forward the
form to the contractor are both contained in the reports/
letters file. The CS can add any instructions and comments
that are deemed appropriate for the particular contract.

If the contract is of sufficient size, various forms and
certificates will be required of the contractor. A

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rule-based module will again be employed to assist the CS in determining which forms and certificates are required of the contractor. The module will automatically retrieve any required forms and will also signify which certificates are necessary.

E. RECEIPT OF THE FEE PROPOSAL (II.5)

Once the fee proposal is received by the CS, the contract file is updated to show the receipt. The lead engineer (on the board) will review and compare the estimates. A spreadsheet type module could be developed for use in this comparison process. The module would evaluate the differences in particular items on the estimates. This however is not recommended since in most instances the estimates will vary in the classes of labor that will be used. It would be comparing dissimilar items which is no comparison. The expense of development and the overhead of maintaining such a module probably could not be justified.

The amount of the fee may require that other clearances be obtained. A rule-based module will again be used to assist the CS in identifying the clearances needed. If forms are needed they will be produced along with a forwarding letter to the contractor.

F. PRE-NEGOTIATION (II.6)

No automation is needed in this step except for possibly the writing of memorandums using a word processor. The letter would be a record of any pre-negotiation discussions the CS or engineers have with the contractor. These documents would be filed in the contract file.

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G. NEGOTIATION BOARD MEETING (II.7)

The negotiation board report form letter is maintained in the reports/letters file. The CS, upon completion of the negotiations with the contractor and agreement between the board members, will prepare the board report using a word processor to fill-in the form letter. The letter would then be forwarded to the approval authority for signature.

H. NEGOTIATION BOARD REPORT APPROVAL (II.8)

Since this function occurs outside of the contracting office in most cases, no automation is required. However, if electronic mail is in use, the letter can be sent through this system. Signatures in an electronic mail system can be implemented through the use of specially assigned password type keys. For example, unique control sequence entries into the designated signature block of the letter can be recorded but not seen. The tail or head of the control sequence can contain the visible initials or name of the person whose unseen signature is present. A module can be used in the system to decipher the signature for verification purposes.

I. CONTRACT AWARD (II.9)

The approved contract award report is filed in the contract file. This step requires the CS to build the actual contract by using an on-line file of standard provisions and special provisions. The CS can place all the required contract documentation in a single working file and upon completion have the the contract printed. The contracting office copy of the contract need not be printed since it will be placed in the contract file and can be reviewed at any time by the contracting staff. The complete contract can then be forwarded to the contractor for signature.

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VIII. AUTOMATION OF THE POST-AWARD PROCESS

The end of the second phase is also the end of the proposed tracking system used in the first two phases. A new proposed tracking system is initiated at the beginning of the third phase of the A-E contracting process which is similar to previous one with the exception being the things that are tracked. The tracking database contains the project number and title (relating to any special project designs that are being accomplished), contract number, A-E's name and number, fee for the design, current working estimate, engineer in charge of the design effort and the award date of the contract. Dates to be tracked are the scheduled and actual submittal dates for the 30%, 60%, 90%, and 100% from the contractor as well as the comparable dates for the government review process of the contractor's work.

This tracking system is initiated by the CS with the aid of a module which actually creates the database from existing databases and the contract file once the CS signifies which contract is to be tracked. The tracking system can be used by the contracting officer or the CS to see which actions are required to be completed on a certain day. The system also provides a profile of the actions due for completion over a specified period of time. This feature will be most helpful at peak operating period such as the end of the fiscal year.

A. NOTIFICATION LETTERS (III.1)

The CS utilizes the reports/letters file to retrieve the notification letter format. In most cases, this letter is completely standardized with the only information to be

added being the names of the receiving contractor and the contractor who was awarded the contract. The CS can either put these in using a word processor or the system can perform this automatically by the CS indicating which contractor was awarded the contract. The remainder of the information can be obtained from the contract file where all the considered contractors names and addresses are listed. Copies of these letters are not retained but a notation is made in the contract file that the letters were sent.

B. INDIVIDUAL PROCUREMENT ACTION (DD FORM 350) (III.2)

The DD 350 reports to higher commands information concerning individual procurements. It is to be submitted the day after a contract has been awarded. An application module is provided to permit the CS to supply the information for the completion of the report. The format for the interface with the module can take on many forms depending upon the design of the system. One interface would be for the CS to be prompted for the information that is not already available in the contract file or the Contractor Information System database. For information which already exists the CS can verify the correctness. Once the information is gathered, a standard format can be used from the reports/letters file to print the form. An enhancement would be to transmit the form electronically to either the EFD or to NAVFAC directly if the communication resources are in place. A copy of the report would be placed in the contract file.

The DD Form 1057 is a monthly summary of contracts awarded by the activity. A similar procedure can be used by the contracting staff to produce this report. As systems evolve, reports such as the DD 350 and 1057 will become obsolete. The information required by the EFD and NAVFAC

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will be available to these upper levels of command at all
times. Communications and networks will exist such that the
application modules to retrieve the information currently
provided by these reports will reside at the level where the
information is required. These modules will be able to
access specially designated databases at the field levels
whenever the data is desired.

C. OTHER REPORTS (III.3)

As mentioned in the other two phases, rule-based appli-
cation modules will determine which reports are required for
the individual contracts. These modules will indicate the
required reports and guide the CS in preparing them for
submission. The report formats themselves will reside in the
reports/letters file. Any reports submitted will be filed in
the contract file.

D. DISTRIBUTION OF CONTRACT (III.4)

Copies of the contract will be sent to various parties.
If the parties to receive the copies have electronic mailing
systems, the copies can be sent this way expediting the
mailings and reducing the mailing costs as well as aiding in
the storage of such documentation at the receiving end. Many
EFDs require a copy of each contract awarded so information
can be obtained for reference purposes. This procedure may
change in the future as the information transfer
possibilities are expanded.

E. CONTRACTOR MEETINGS (III.5)

These meetings may occur for a variety of reasons and
all should be documented. The engineer or the CS could use
the word processor to record the events of the meeting. A

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copy cf the meeting minutes will be placed in the contract file. Scme contracts, especially those with a first time contractor, require a preliminary meeting to discuss standard administrative items. Checklists to cover the requirements cf the meeting can be maintained in the reports/letters file for use by the CS or engineer as a guide for the meetings.

F. DESIGN REVIEWS (III.6)

The tracking system is the key management tool in this procedure. Other valuable computerized tools would be a database of the assigned drawing numbers. This would permit the recording of the drawings numbers and titles. This database could be expanded to act as an index for future references to the location cf drawings which would be useful to the larger engineering departments. The documentation which accompanies the review process (comment sheets on submittals) can be maintained in their basic form in the reports/ letters file.

G. CONTRACT MODIFICATIONS (III.7)

Contract modifications are not tracked on the third phase tracking system. A note is made on the tracking system that a modification is taking or has taken place. It is proposed that a separate tracking system be established for these mcdifications. This modification tracking database would contain many of the data elements that the phase I and II system tracked including a brief description of the modification, contract number, dates (estimated and actual) for SOW and government estimate submission, request for and receipt cf the fee prcposal, negotiation board meeting and the signing of the change order. The estimated days are generated automatically based on past experience. The CS will enter the actual days.

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Board member appointments and letters of notification
are required. This is handled utilizing the same modules
that were used in the earlier phases. The processing of the
SOW and government estimate are identical to step I.3 and
I.4. In essence, this process follows the same procedures
as are followed in the negotiation phase of the contract and
requires the same management attention. For open-ended
contracts, the modification process can be in progress for
different proposed changes. This requires that management of
the contract modifications be effective and accurate.

H. PROGRESS PAYMENTS (III.8)

Management of the progress payment process is most
important for good working relations with the contractor.
Even though the contracting office is not the actual payer
of the funds, mismanagement of the request for payment can
have damaging effects. A spreadsheet type file is maintained
for the contract which contains the dates and amounts of
requested payments as well as the date and amount of the
actual payments. The payment data may be difficult to
obtain depending on the arrangements made between the
contracting office and the paying office. This relationship
should be established such that the CS can obtain accurate
information in a timely manner.

The CS receives the request for payment from the
contractor. A standard form from the reports/letters file
will be used by the CS to transmit to the lead engineer the
information regarding the payment request. The engineer must
annotate the form indicating his approval of the percentage
complete on the project. This percentage is used to deter-
mine the amount of the payment to the contractor. If elec-
tronic mail is in use, this process can be accomplished
electronically. The final copy of the engineer's annotated

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copy is placed in the contract file. The spreadsheet data-
base is updated on each request. An application module
performs the calculations on the amounts to be withheld and
amounts to be paid based on predetermined standards. The
system then generates the proper form requesting the paying
activity to pay the contractor the specified amount or
transmitted electronically to the disbursing agent.

I. DISPUTES, ERRORS, OMISSIONS, DESIGN DEFICIENCES, A-E LIABILITY (III.9)

The actual handling of these actions is determined at
the local level. Boards are often convened to make determi-
nations. In this case, the modules used to establish board
members can again be utilized. Also, some reports may be
necessary in certain circumstances. These reports can be
maintained in the reports/letters file. All matters
concerning disputes, errors and omissions, design defici-
ences, etc. require correspondence. A word processor can be
used to produce these documents. Copies of any documents
should be placed in the contract file.

J. FINAL PAYMENT (III.10)

The final payment request is handled in the same manner
as the progress payments except the contract must be checked
to ensure that all requirements have been met. The same
spreadsheet database is used in this process.

K. CONTRACTOR RELEASE (III.11)

The tracking system is used to ensure that all required
submissions have been made. The lead engineer must also
provide his approval. The document form is maintained in the
reports/letters file for the contractor release. A copy of
the release form is placed in the contract file.

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L. A-E PERFORMANCE REPORT DD 1413 (III.12)

The form report is contained in the reports/letters file. The CS and lead engineer complete the form and the completed form is added to the Contractor Information System file. The report is also distributed to the required distribution. The required distribution listing can be maintained with the form.

IX. END-USER INTERFACE

A. END-USER PERCEPTIONS

The A-E contract MIS described in the previous three chapters is intended to aid the contracting officer and the CS in managing and administering the A-E contracting process. The end-users of the system, the contracting officer and his staff, perceive automated systems and the use of computers in different frames of reference. The contracting officer, in previous tours or through formal schooling, has possibly been exposed to the use of computers and possibly programming. The staff members may or may not have ever used a computer. The computer to them may be perceived to be a threat to their jobs or a new method and style of work. Therefore, there may be resistance to the change from a fully manual process to one in which the computer is an integral part.

Users judge and accept a system on the basis of their personal experience with it. If the system is easy to learn and use then it is normally accepted and becomes a useful tool. On the other hand, if the system is threatening and difficult to use they will probably not use it. This can cause extreme problems if the previous methods of performing the work tasks are being replaced with the automated process. Larson [Ref. 9: p.2] identifies the following factors as affecting the end-user's perception of a computer system:

Time. How long does it take the end user to perform his task?

Learning. How long does it take a novice to learn the system?

Recall. How easy is it for an end user to recall how to use the system after he has not used it for some time?

Versatility. Can the system be used to perform a variety of tasks that the end user faces?

Errors. How many errors does the end user make and how serious are they?

Help. Does the system provide help when the end user has trouble?

Adaptability. Does the system adjust to the end user's level of competence as he becomes more experienced? Does the system tailor itself to the habits and styles of different users?

Concentration. How many things must an end user keep in mind while using the system?

Fatigue. How quickly does the user tire while using the system?

Uniformity. Are the commands of this system identical to equivalent commands of other systems?

Fun. Does the end user enjoy the system?

Chapters 6-8 described various automated tools which can be used in the three phases of the A-E contracting process. The design and development of these tools could be excellent but if the end-user has difficulty in understanding or using the tools they are useless. End-user interfaces must be designed into the system to ensure the above factors are satisfied. Failure to satisfy them can result in the users not using the system or not gaining the full benefits from the use of the system.

B. SCREEN DESIGNS

The A-E contracting MIS must be designed to permit the user to perform the contracting process tasks in a smooth manner. A major element in achieving this is the structure of the

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system and how it is configured.   This will be described in
the following chapter. The second element to this achieve-
ment is the design of the methods by which the user is
"guided" through the system.   These methods include the use
of menus, prompts, information presentation, data presenta-
tion, text presentation, messages and replies,   and help
facilities [Ref. 10: pp.19-21,34,36-37].

1. Menus

Menus present the user with a number of choices, the user
keys in his choice and the system moves on. Menus can
present any number of choices,   however as the number
increases so does the confusion of the user. Menu options
should be limited to as small a number as possible. As an
example consider the main menu used in the Contractor

```
                         MAIN MENU
                A)    Add a record
                D)    Delete a record
                E)  · Exit ( work completed )
                H)    Help
                P)    Print a report
                Q)    make a Query
                U)    Update a record
                V)    View a record
           Choose an option: _
```

Figure 9.1   Contractor Information System Main Menu.

Information System, Figure 9.1. This menu offers the user a
selection of all the possible options and features available

under the CIS application module. The user knows by the
names used for the options what can be performed by using
this module. The options are listed in alphabetical order
where the option selection keys, (A, D, E, H, P, Q, U, and
V), correspond to the key word of the option. If more than
nine options are necessary, it is better to divide the menu
into two separate menus, chaining them together.

2. Prompts

Prompts are text on the screen identifying the type
of information that the system desires the user to enter. In
simple terms, they are just questions and answers. At the
conclusion of entering a new record into the CIS database
the user is ask, "DO YOU WANT TO INPUT ANOTHER RECORD? (Y OR
N)". The system waits for a response from the user before
any other action takes place.

Prompts can also take the form of screen overlays
which show the format for the entry of data. Figure 9.2 is
the data entry format used to add records to the CIS data-
base. In this approach, the cursor appears at the first
entry point, Contractor Number, for the entry of the first
data. Only four digits are permitted for the contractor
number. This limitation is shown by the number of blank
spaces in the prompt. Rather than using blanks, reverse
video highlights the entry areas and limitation on the allo-
wable data entry field length. Reverse video is not provided
on all terminals. After the user has entered the first data,
the cursor jumps to the next data entry area, Phone. The
user can move back to a previous data entry area to change
data if required. Methods for this movement between data
areas is dependent upon the hardware utilized. The cursor
continues to move to the next data entry area until all the
data has been entered for this screen. The CIS requires two
screens to input all the contractor information. The

completicn of the last data item, Fee for project 3, will
automatically call the next screen up for the user to
complete. If any data item is not known or not applicable,
the entry area can be skipped by pressing the return key.

The entry screens should call for the information as
it appears on the source documents. This will permit the
user to go through the source document smoothly rather than
jumping randomly over it. Crcwding too much on one screen
makes the entry process difficult. There should be space
between each data entry area.

```
┌─────────────────────────────────────────────────────────────┐
│                                                              │
│                    CCNTRACTOR DATA FILE                      │
│  Contractor Number - ____        Phone - (___)-___-____      │
│  Contractor Name -                                           │
│                  - ========================================  │
│                    ========================================  │
│  Street or P.O.Box - _____   │
│  City - _____    State - __  Zip - _____        │
│              ---------- PROJECT HISTORY ----------           │
│  Project 1 - _____  │
│  Fee -                                                       │
│  Prcject 2 - _____  │
│  Fee -                                                       │
│  Project 3 - _____  │
│  Fee - _____                                                │
│                                                              │
└─────────────────────────────────────────────────────────────┘
```

Figure 9.2   Data Entry Screen for CIS.

3. Information Presentation

Information presented to the user should be in a
usable form. For example, the tracking systems for all the
contracting phases require the entry of several dates by the
user. The dates should always be asked for by the system in
a form that is normally used by the user (i.e. DD/MM/YY,

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MM/DD/YY or even May 18, 1984). These forms are common to everyday use. While these forms are easiest for the user, the julian date system is more practical for use in computations undertaken by the computer. The input from the user in one of the above forms can be easily converted to a julian date by the computer. Likewise the output or presentation of the information to the user should be in a normally acceptable form. The computer should convert any internal data format to a readable format for the user. The user should never have to rely on a coding scheme to decipher information presented by the computer for his use.

4. Data Presentation

Data presentation concerns the display of non-native language information on the screen. Most of the information presented in the proposed A-E MIS is in a readable form. There could be applications which would list cost data along with cost category codes or contractor numbers. The data should be identified by titles or headings of some sort. Displays such as 47528052347654, where 4752 is the contractor number and (805)-234-7654 is the contractors phone number, make no sense to the normal user. An example of acceptable data presentation is the Contractor Discipline Profile screen shown in Figure 9.3. The main body of the screen displays the discipline codes and the number of personnel are in the discipline category. The discipline codes are numeric as are the count of personnel in the categories. Each code and count number are separated and the definition of the code is listed (i.e. 10 __25 Civil Eng indicating there are 25 persons in discipline category 10 which is Civil Engineers).

```
                CONTRACTOR DISCIPLINE PROFILE

Contractor Number - ____
Contractor Name - _____

Discipline Code - Number of Personnel
  01 __24    Administrative      02 __20   Electrical Eng
  03 ____    Oceanograhers       04 __10   Architect
  05 ____    Estimators          06 ____   Urban Planners
  07 ____    Chemical Eng        08 ____   Geologists
  09 ___3    Sanitary Eng        10 __25   Civil Eng
  11 ____    Hydrologists        12 __     Soils Eng
  13 ____    Construct Insptr    14 ___8   Inter. Design
  15 ____    Spec Writer         16 __12   Draftsman
  17 ___4    Landscape Arch      18 ____   Structural Eng
  19 __      Ecologists          20 ___9   Mechanical Eng
  21 __10    Surveyors           22 ____   Economists
  23 ____    Mining Eng          24 ____   Transport Eng
  25 ____    General

--> DO YOU WANT TO INPUT ANOTHER RECORD? ( Y or N )
```

Figure 9.3   CIS Contractor Discipline Profile Screen.

5. Text Presentation

It is often necessary to give instructions or present information in the form of text. For reading ease, the text should be in upper and lower case. The text should be presented in short sentences, allowing enough space between paragraphs so as not to crowd the screen. If necessary, use more than one screen to display the information rather than crowd too much on one screen. Figure 9.4 illustrates these concepts. The instructions appear in the module used to view contractor data. The instructions are brief and to the point. Since there is more information than can be presented on one screen, two screens are used. The user can scroll to the second screen by simply hitting any key. The browsing instructions given on the second screen also appear on the data screens in an abbreviated form. Simplicity and understandability are the key elements to be followed.

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```
                        **SCREEN 1**

To view a specific contractor's data record you need
to know the contractor number.
If a specific number is not used you will begin with
the first record. The records are arranged in
alphabetical order by contractor name.

You can also just browse thru the records.


PRESS ANY KEY TO CONTINUE
------------------------------------------------------------
                        **SCREEN 2**

The following options are available in browse:

          B) ack--Takes you to the previous record.
          F) orward--Takes you to the next record.
          P) rofile--Displays the Discipline Profile.
                  of the contractor.
          N) umber--Permits you to locate a contractor
                  by the contractor number.
          Q) uit--Returns you to the main menu.

Do you need to see a listing of the contractor numbers?
```

Figure 9.4   Text Presentation in the CIS Module.

6. Messages and Replies

Communications that emanate from the computer to the
user form a direct psychological link between the user and
the computer.   These communications give the computer some
human-like qualities that tend to be perceived to threaten
the user.   Like conversing with an individual, the computer
should never produce a blank screen. This lack of feedback
often gives the user a feeling of being lost.   If a process
is being carried out which requires more than 3 seconds, it
is best to provide a message to the user that a process is
taking place.   In the CIS module, the initialization of
memory variables requires approximately 10 seconds. During

this time, the user is presented with a sign-on screen display as shown in Figure 9.5. The display of the screen does not make the initialization process go any faster, but the user is told of the time requirement and exactly what is going on.

```
                         NAVFACENGCOM
                Contractor Information System

              A Micrc-Processor Application
                            of
                       FACSO's CIS

                       Developed by:

                       TOM ETHERIDGE

                  SPRING QUARTER 1984
             NAVAL POSTGRADUATE SCHOOL

      Wait 10 seconds for system initialization to complete.
      ----------> Press any key to continue <------------
```

Figure 9.5   CIS Sign-on Screen Display.

The most valuable messages in terms of system control and protection are error messages. They inform the user of mistakes or the failure to comply with system imposed constraints such as data formats. Error messages should be concise and yet provide enough information for the user to recover from an error. Verbosity and error messages do not go together. When possible, the error message should permit an escape for the user. Figure 9.6 is an example of an error message used in the delete module of the CIS. This message appears when the user requests to delete a contractor record that does not exist in the file. The user

is told that the contractor record does not exist. Then the user is given an option or an escape. The user is not left wondering what should be done.

```
That contractor number is not in the file.

Do you want to:
        1) Try again or,
        2) Return to main menu.
```

Figure 9.6   Sample Error Message.

7. Help Facilities

On-line help facilities are an advantage if they can provide information for the user in a capsulated form. If extensive helps are required they should be provided in the user's manual. Concise helps or memory aids can save the user the effort of having to continuously go to the refer- ence material.   For a large diverse system it is best to design the help facilities such that they reside in the modules in which they are needed rather than in one large separate module. A menu of help information should be presented where the user can choose the desired help.

C. INTERFACE TRADE-OFFS

All the interfaces described in the above paragraphs are included in the system to improve the "friendliness" of the system. These aids to system use require storage space in

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memory as do the application modules and data. There has to be a limit to the aids provided in order to balance the storage requirements. Consideration must be given to the number of help facilities and the amount of information contained in each. The other trade-off to be considered is the time response of the system when a large number of interface aids are provided. These problems of storage are being overcome by the current advances in storage technologies.

X. SYSTEM INTEGRATION

Chapters 6 through 8 presented a proposal for an automated approach to the management of the A-E contracting process. The last chapter stressed the importance of the interface between the user and the automated system. This chapter will present the system components in a MIS framework and explore the hardware and software aspects to be considered for implementation of the MIS.

A. OVERVIEW

In Chapter 5, a MIS framework was described as an integrated system for providing planning, operation, and control of a management function. The proposed A-E automated tracking and management system presented earlier fits best into this framework as shown in Figure 10.1. The functions of the databases, reports/letter file, contract files, and application programs are integrated to form the A-E MIS. The user accesses the MIS through the use of a workstation equipped with a keyboard for data entry, a CRT for viewing system responses and dialogue screens, and a printer utilized to produce hardcopy printouts of reports, letters, and schedules. The user interacts with the MIS at the highest level through the supervisory program. This program, through menus and user friendly prompts, permits the user to select one of the functions or applications[1] available for use. After a selecting of one of the functions, control of the MIS shifts to that function, meaning that the user interacts directly with the function. This

---

[1]A complete listing of the application programs, reports/letters file, contract files, and databases proposed for the A-E MIS can be found in Appendix B.

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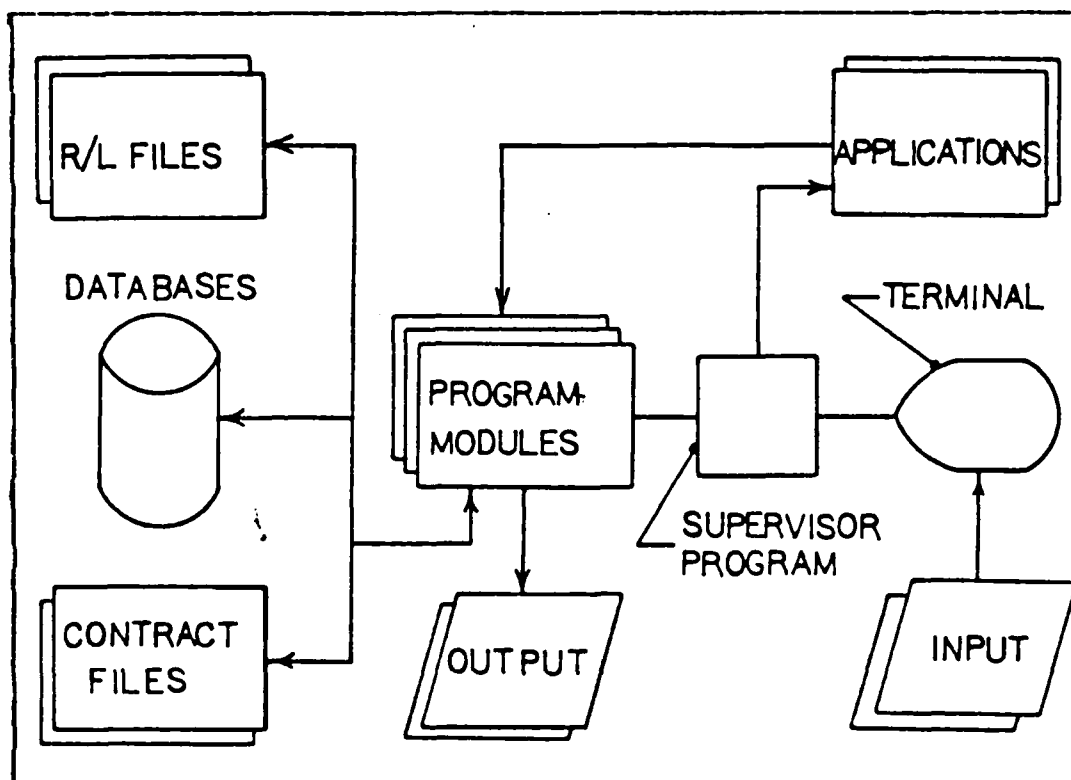
Figure 10.1   A-E Contracting MIS.

level cf control is below that of the supervisory program in
a manner that when the user completes the use of the
selected function, ccntrol always reverts back to the super-
visory program.   Application programs normally consist of
several modules much like the CIS application program listed
in Appendix A.   During execution of an application, ccntrol
may be passed to any cf the modules. But, just as with the
superviscry program, when the modules' process is complete,
control returns to the main module of the application.

Once the user has access to a particular application,
other functions of the MIS come into play. The application
program may call or access one of the databases,   a form
report/letter from the reports/letters file, a contract file

or any combination of these functions. As mentioned above, when the user is finished with the application or function, control returns back to the supervisory program where the user can activate another application or simply leave the system.

B. DATA DICTIONARY

A subsystem not shown in Figure 10.1 but which plays an important role in the useability of the MIS is the data dictionary. The data dictionary is documentation of the data items included in the databases together with their relationships with other data and programs or routines that use them. The major purpose of the data dictionary is to aid in the consistency of the MIS data. It normally contains data field definitions (how many spaces are permitted for a data element), data definitions (what is and is not included in the data element), and comment information to explain any ambiguities in the data elements. Data dictionaries can contain explanations of any restrictions on data, enforcement measures utilized by the database (error checking for data entry), or modules for monitoring the usage of data. The data dictionary can be either in hardcopy form such as [Ref. 6], or be available on-line. In most cases, it is best to have hardcopy documentation of the data dictionary with an abbreviated form available on-line since microcomputer systems normally have limited storage capability. This constraint will vary from system to system and will become less and less a constraint as storage technology advances.

C. IMPLEMENTATION OF THE MIS

The concepts proposed in the previous chapters have been based on the idea that the field activities need the ability to manage and control their functional responsibilities

through the use of existing computer technologies. The hardware and software required to implement the proposed A-E MIS, as well as any other small activity management systems, currently exists on the commercial market. The A-E MIS is suitable for operation on most business microcomputers being used today. The microcomputer has several advantages over a larger system for this application, of which the first is cost. Most micro-based systems can be purchased for less than $5,000 and many less than $3,000. The second is that technologically better computers are produced at a lower cost while at the same time the amount of storage capacity built in them drastically increases. The standard business micro-computer in 1983 had 192K to 256K of internal memory with normally dual 300K to 400K floppy disk drives providing the user with 600K to 800K of easily accessed memory. In 1984, micro-computers are equipped with the same amount of internal memory but with a greater than tenfold increase in storage memory of 10 Megabytes. In 1985, micro- computers are projected to provide 512K of internal memory and possibly 205 Megabytes of storage memory. In the next few years, it is projected that read only laser disk storage providing up to 4 gigabytes of read only storage will be available. All the storage memory devices will be located within the actual micro-computer frame. Existing microcomputer can be upgraded to take advantage of the advances in storage memory. A third advantage of the micro- computer is its ability to be easily adapted to the organizational management style. The size and cost of the micro- computer permits management to place the computing power on the desk of those who need it.

Commercial software products are available which provide the facilities necessary to implement the proposed A-E MIS. These application products can also be used by the aggressive manager to develop personal management tools as well as

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expand on those proposed herein. The ease of use and the high level orientation of these products make the need for systems programmers obsolete for the development of simpler applications.

The CIS programs listed in Appendix A were developed on a Zenith Z-100[2] through the use of two compatible software products, dBASE II[3] and 'WordStar'.[4] dBASE II is a database management tool that allows easy manipulation of small and medium sized databases using English-like commands. WordStar is a word processing program. These two application packages could be used to develop the entire A-E MIS. Other software packages could be used but these two are completely compatible taking a major effort of internal system interfacing out of the design effort. The systems should also work on any IBM compatible and a large variety of CP/M[5] systems.

_____

[2] Zenith Z-100 is a registered trademark of Zenith Data Systems.

[3] dBASE II is a registered trademark of Ashton-Tate.

[4] WordStar is a registered trademark of MicroPro International.

[5] CP/M is a registered trademark of Digital Research.

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XI. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

For NAVFAC to effectively carry out their mission objec-
tives, enormous amounts of data are required to be
collected, organized into logical informational forms, and
analyzed. Well developed information management systems are
used to make this possible. The systems utilized are
reviewed annually to ensure that they adequately support the
mission. Systems enhancements are developed and installed to
further the inclusion of improved technological advances.

The majority of the computing power used by the NAVFAC
Naval Facilities System is centrally located in Port
Hueneme, Ca. at FACSO. The data from field activities is
collected at decentralized sites (EFDs) and forwarded to the
central site (FACSO). The reports utilized for management of
NAVFAC functions are distributed in hardcopy form to the
field activities. The major decisions concerning planning
and requirements definition for the Naval Facilities System
Plan is centralized at NAVFAC Headquarters. The execution
and implementation of the plans is centralized at FACSO.

The current objective of the Naval Facilities System is
to depart from the wholly centralized approach of data
processing and to decentralize some system functions
[Ref. 1: p.5-1]. The initial decentralization is focused at
the EFDs, Public Works Centers and larger Public Works
Departments. This is a decentralization of hardware and
software but not systems development. Development of major
systems is to remain at FACSO and planning for NAVFAC-wide
systems will remain at NAVFAC Headquarters. The
decentralized sites will be able to develop local systems

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and applications which can effectively improve procedures and management. This decentralization is slowly evolving down to the field activity level. Some applications have been developed to support field activities, however most are presently geared toward collecting and submitting data in support of the major NAVFAC data processing systems.

Several management processes exercised at the field activity level could be improved and modernized by the development of automated data processing applications. The A-E contracting management process is just one of these processes. Develop of applications as described in Chapters 6-8 is possible as evidenced by the development of the Contractor Information System shown in Appendix A.

Current micro-computer technology will support the automation requirements of field activities since advances have greatly increased the secondary storage capacity of these machines. Many application building tools such as word processing, database, and electronic spreadsheets software are available for development of management systems. These tools are at the level that the aggressive manager can develop local applications to improve his own management techniques and performance. Micro-computers can easily be adapted for transmission of data to other computers as well as integrated into local area networks where several micro-computer can share applications and computing power. The cost/benefit/performance considerations of micro-computers make them excellent tools.

B. RECOMMENDATIONS

The main theme of the recommendations to be made is to take a unified planning approach in evaluating data processing for field activities. The recommendations are as follows:

1. A centralized approach should be taken to identify the key needs of the field activities in the area of data processing. Only those functions which are of benefit to the majority of the activities should be pursued. Possibly subgroups can be identified for secondary consideration by those activities affected.

2. A centralized evaluation and selection of available software (word processors, database managers, and electronic spreadsheets) should be made to reduce the cause of inconsistent applications development. The number of permitted software products should be kept to a minimum while at the same time permit enough diversification to avoid dependence on one vendor or system.

3. Similar to 2 above, a centralized evaluation should be made of available micro-computers. Limiting the selection to not only operating systems [Ref. 11], but also to vendors would again aid in reducing the proliferation of hardware.

4. Establish field activity user groups where communications can begin for the purpose of sharing ideas, problem solutions, and applications. Due to the large geographic dispersion of the activities, central centers for information exchange should be identified (newsletters, regional periodic meetings, software exchanges).

5. An aggressive approach toward the integration of the field activity systems into the VFS will take advantage of current technology. The increased sophistication of small computer systems and the advances of communications software bring these two functions closer together.

6. Incorporate a total system approach to systems development to merge the areas of office automation,

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data processing, and communications technology. This should lead to future developments leading toward Information Resource Management.

7. Institute learning centers for the purpose of exploiting the benefits of micro-computers at the field activity level. These centers could be located at EFDs, PWCs, or at the Civil Engineer Corps Officers School in Port Hueneme, Ca.

8. Include in the Navy Facilities System Plan, Ref. 1, long range plans for the development of data processing systems for field activities.

9. Design and implement the A-E contract management system similar to that described in this thesis. The system should be field tested, refined and distributed to other field activities for use.
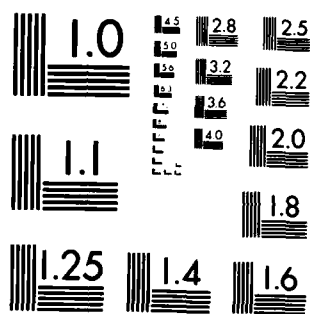
MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS 1963 A

APPENDIX A

SAMPLE APPLICATION

CONTRACTOR INFORMATION SYSTEM

- A dBASE II PROGRAM -

The dBASE II command language has been used to implement a contractor information system used by Naval Facilities Engineering Command. The system has been designed under the following assumptions:

a) Users of the systems are inexperienced in computer usage.

b) The system should permit facilities to add, delete and browse thru the data. It should also permit any persons knowledgeable with dBASE II to use the query language on the database. (This is made only under the premise that the system will be used by a small group (3-4 persons). It should also be pointed that by having access to the database that a person can change the database by deleting records or modifying existing data.

c) The system is used by a small group of people.

d) The database should as much as possible be designed to match the database structure of the existing NAVFAC database. This will make future interfacing with easier.

Two files are maintained. The contractor data file (cdata) and the contractor discipline file (cdis). The cdata.dbf contains basic demographic information plus a short history of the contractor's work for the USN. The cdis.dbf contains a breakdown of the composition of the contractor's engineering workforce. This data is taken from the SF 254 and SF 255. These forms are the U.S. Governments contractor resume forms. The information is maintained for future Invitation For Bid mailing lists and also for a reference for the Public Works Officer to consult when he needs a rapid response design to solve an emergent problem.

The file structures for the two dbfs are given below. A brief data dictionary is also given to aid in defining the fields and data elements.

```
STRUCTURE FOR FILE:    CDATA.DBF
NUMBER OF RECORDS:     00010
DATE OF LAST UPDATE:   06/12/84
PRIMARY USE DATABASE
FLD         NAME        TYPE WIDTH     DEC
001         CNUM1         C    004
002         CNAME1        C    036
003         CNAME2        C    036
004         STPOB         C    040
005         CITY          C    021
006         STATE         C    002
007         ZIP           C    005
008         PHONE         C    014
009         PROJ1         C    050
```

```
010        FEE1              C      006
011        PROJ2             C      050
012        FEE2              C      006
013        PROJ3             C      050
014        FEE3              C      006
015        DELETED           C      007
** TOTAL **                       00334
```

-+-+-+-+-+-+-+-   CDATA Data Dictionary -+-+-+-+-+-+-+-

Field

1	CNUM1	Contractor number assigned automatically by the system. 4 alphanumeric spaces are permitted.
2	CNAME1	Contractor name, first line. 36 alpha characters are permitted.
3	CNAME2	Contractor name, second line. 36 alpha characters are permitted.
4	STPOB	Street address or the post office box. 40 alphanumeric characters permitted.
5	CITY	City of the address. 21 alpha characters are permitted.
6	STATE	State of the address, 2 letter abbreviations. 2 alpha charcaters are permitted.
7	ZIP	Zip code associated with the address. 5 alphanumeric characters are permitted.
8	PHONE	Telephone number of the contractor including the area code. 14 alphanumeric characters are permitted.
9	PROJ1	Brief description of the latest project completed by the contractor for the government. 50 alpha characters are permitted.
10	FEE1	The fee in thousands of dollars paid to the contractor for the projected completed above. 6 alphanumeric characters are permitted.
11	PROJ2	Same as PROJ1 except for second project.
12	FEE2	Same as FEE1 except represents PROJ2.
13	PROJ3	See above.
14	FEE3	See above.
15	DELETED	Field used to indicate that a record has been identified for deletion. 7 alpha characters are permitted.

-+-

The cdata file is indexed to the file NAMES.NDX by the contractor
names. A sample of the data in the cdata.dbf:

```
00001    1234 WESCOTT BROTHERS DESIGN AND ESTIMATE
00002    2345 JOHNSON AND JOHNSON ASSOC. INC.
00003    3456 ABC ENGINEERING
00004    4567 FIRST RATE GUYS WITH A SLIDE RULE
00005    5678 ONE MAN ENGINNERING COMPANY
00006    6787 KEPLER FRANK AND WESPEPPER
00007    8765 ZEDE PLUMBING AND HEATING
00008    9065 BROWN AND ROOT
00009    7303 DIEBOLD PIPE AND STEEL ENGINEERS
00010    4532 WERE YOU THERE
```

        The CDIS dbf:

```
STRUCTURE FOR FILE:   CDIS.DBF
NUMBER OF RECORDS:    00010
DATE OF LAST UPDATE:  06/12/84
SECONDARY USE DATABASE
FLD        NAME      TYPE  WIDTH    DEC
001        CNUM2      C     004
002        NAD        C     004
003        NEE        C     004
```

```
004        NOG              C      004
005        NA               C      004
006        NEST             C      004
007        NUP              C      004
008        NCHE             C      004
009        NGE              C      004
010        NSNE             C      004
011        NCE              C      004
012        NHY              C      004
013        NSOE             C      004
014        NCI              C      004
015        NID              C      004
016        NSPW             C      004
017        NDMN             C      004
018        NLA              C      004
019        NSTE             C      004
020        NECO             C      004
021        NME              C      004
022        NSUR             C      004
023        NECN             C      004
024        NMNE             C      004
025        NTRE             C      004
026        NGE              C      004
027        TOTEMP           C      006
** TCIAL **                       00111
```

-+-+-+-+-+-+-+-   CDIS Data Dictionary   -+-+-+-+-+-+-+-

Field
1   CNUM2   Contractor number assigned by the system.
                  This is the same number as CNUM1.
                  4 alphanumeric characters are permitted.
2   NAD   Number of administrative personnel.
                  4 alphanumeric characters are permitted.
3   NEE   Number of electrical engineers.
                  4 alphanumeric characters are permitted.
4   NOG   Number of oceanographers.
                  4 alphanumeric characters are permitted.
5   NA   Number of architects.
                  4 alphanumeric characters are permitted.
6   NEST   Number of estimators.
                  4 alphanumeric characters are permitted.
7   NUP   Number of urban planners.
                  4 alphanumeric characters are permitted.
8   NCHE   Number of chemical engineers.
                  4 alphanumeric characters are permitted.
9   NGE   Number of geologists.
                  4 alphanumeric characters are permitted.
10   NSNE   Number of sanitary engineers.
                  4 alphanumeric characters are permitted.
11   NCE   Number of civil engineers.
                  4 alphanumeric characters are permitted.
12   NHY   Number of hydrologists.
                  4 alphanumeric characters are permitted.
13   NSCE   Number of soil engineers.
                  4 alphanumeric characters are permitted.
14   NCI   Number of construction inspectors.
                  4 alphanumeric characters are permitted.
15   NID   Number of interior designers.
                  4 alphanumeric characters are permitted.
16   NSPW   Number of spec writers.
                  4 alphanumeric characters are permitted.
17   NDMN   Number of draftsmen.
                  4 alphanumeric characters are permitted.
18   NLA   Number of landscape architects.
                  4 alphanumeric characters are permittel.
19   NSTE   Number of structural engineers.
                  4 alphanumeric characters are permitted.
20   NECO   Number of ecologists.

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```
                    4 alphanumeric characters are permitted.
21      NME         Number of mechanical engineers.
                    4 alphanumeric characters are permitted.
22      NSUR        Number of surveyors.
                    4 alphanumeric characters are permitted.
23      NECN        Number of economists.
                    4 alphanumeric characters are permitted.
24      NMNE        Number of mining engineers.
                    4 alphanumeric characters are permitted.
25      NTRE        Number of transportation engineers.
                    4 alphanumeric characters are permitted.
26      NGE         Number of general engineers.
                    4 alphanumeric characters are permitted.
```

-+-

The command files used in the system are:

```
MAIN.CMD        SIGN-ON.CMD     INIT.CMD
ADD.CMD         DELETE.CMD      QUERY.CMD
VIEW.CMD
```

These files are attached in the order that they appear here.

The format files used are:

```
GETCDATA.FMT    GETCDIS.FMT     SAYCDATA.FMT
SAYCDIS.FMT     VCDATA.FMT      VCDIS.FMT
MAIN.FMT
```
These files along with the images they produce are attached.

Two memory files are used, cdata.mem and cdis.mem. These files were not printed out. Their structure is inputted in the init.cmd file.

The following pages contain the above mentioned files and images.

```
*****************************************************************
* main.cmd 6/5/84   jte                                         *
* version: 1.0                                                  *
* purpose: sets the main selection screen and permits the user  *
*          to select which option they would like to operate    *
*          from. processing narrative: the sign-on is displayed *
*          followed by the initialization of the system. the    *
*          main selection screen is then presented. all         *
*          terminated selection return the user to the main menu.*
* superordinate modules: none                                   *
* subordinate modules: sign-on.cmd, init.cmd, main.fmt, add.cmd,*
*                      delete.cmd, view.cmd                      *
* author: Tom Etheridge                                         *
*****************************************************************
*display sign-on message
DO sign-on
SET CONSOLE OFF
WAIT
SET CONSCLE ON
*
*initialize variables and set the environment
DO init
*
*set up the main loop
DO WHILE t
*
   *set up screen
   SET FORMAT TO main
   STORE " " TO command
   *
   *display the main menu
   READ
   *
   *perform selected function
   DO CASE
      *
      CASE command = "A"
      DO add
      *
      CASE command = "D"
      DO delete
      *
      CASE command = "E"
      ERASE
      *prevent dBASE ll sign-off msg
      SET CONSOLE OFF
      QUIT
      *
*     CASE command = "H"
*     DO help
      *
*     CASE command = "P"
*     DO print
      *
      CASE command = "Q"
      DO query
      *
*     CASE command = "U"
*     DO update
      *
      CASE command = "V"
      DO view
      *
   ENDCASE
*loop back
ENDDO
```

Sign-on Command Module

```
****************************************************************
* sign-on.cmd  6/5/84                                          *
* version: 1.0                                                 *
* purpose: to display the sign-on message                      *
* processing narrative: the sign-on msg is displayed. control is *
*                       transferred back to main.cmd when the  *
*                       user enters a keystroke.               *
* superordinate modules: main.cmd                             *
* subordinate modules: none                                    *
* author: Tom Etheridge                                        *
****************************************************************
ERASE
?  "                        NAVFACENGCOM"
?  "              Contractor Information System"




?  "                        Developed by:"

?  "                        TOM ETHERIDGE"

?  "                     SPRING QUARTER 1984"
?  "                  NAVAL POSTGRADUATE SCHOOL"

?  "----> Wait 10 seconds for system initialization to complete <----"
?  "------------> Press any key to continue <--------------"
```

Initiation Command Module

```
********************************************************************
* init.cmd   6/5/84   jte                                         *
* version: 1.0                                                     *
* purpose: to initialize variables and set the system environment *
* processing narrative: the environment is set up followed by the *
*                       initialing of the variables used in the   *
*                       add.cmd module. creates cdata.mem and      *
*                       cdis.mem.                                  *
* superordinate modules: main.cmd                                 *
* subordinate modules: none                                       *
* author: Tom Etheridge                                           *
********************************************************************
*run once to initialize the variables and set up the environment
SET TALK OFF
SET INTENSITY OFF
*
*initialize the variables
*currently set to initialize variables during each run of system
* IF .NOT. FILE("cdata.mem")
  STORE " " TO deleted
  STORE "0000" TO mcnum
  STORE "                            " TO mcname1
  STORE "                          " TO mcname2
  STORE "                         " TO mstpob
  STORE "                  " TO mcity
  STORE "  " TO mstate
  STORE "  " TO mzip
  STORE "  " TO mphone
  STORE "                                    " TO mproj1
  STORE "       " TO mfee1
  STORE "                              " TO mproj2
  STORE "       " TO mfee2
  STORE "                              " TO mproj3
  STORE "       " TO mfee3
  *create cdata.mem
  SAVE TO cdata
  *clear the memory
  RELEASE ALL
*ENDIF
*IF .NOT. FILE("cdis.mem")
  STORE "0000" TO mcnum
  STORE "  " TO mnad
  STORE "  " TO mnee
  STORE "  " TO mnog
  STORE "  " TO mna
  STORE "  " TO mnest
  STORE "  " TO mnur
  STORE "  " TO mnche
  STORE "  " TO mnge
  STORE "  " TO mnsne
  STORE "  " TO mnce
  STORE "  " TO mnhy
  STORE "  " TO mnsce
  STORE "  " TO mnci
  STORE "  " TO mnid
  STORE "  " TO mnspw
  STORE "  " TO mndmn
  STORE "  " TO mnla
  STORE "  " TO mnste
  STORE "  " TO mneco
  STORE "  " TO mnme
  STORE "  " TO mnsur
  STORE "  " TO mnecn
  STORE "  " TO mnmne
  STORE "  " TO mntre
  STORE "  " TO mnge
  STORE " " TO answer
```

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```
      *create cdis.mem
       SAVE TO cdis
       *clear memory
       RELEASE ALL
*ENDIF
*set up the file environment
SELECT PRIMARY
USE cdata
SELECT SECONDARY
USE cdis
*return to main.cmd
```

Add A Contractor Command Module

```
************************************************************
* add.cmd  6/6/84   jte                                    *
* version 1.0                                              *
* purpose: to permit the addition of records to the file   *
* processing narrative: using the getcdata and getcdis formats *
*                       data is collected from the user and *
*                       placed in the cdata and cdis files. *
* superordinate modules: main.cmd                          *
* subordinate modules: getcdata & getcdis formats          *
* author: Tom Etheridge                                    *
************************************************************
*set up environment
SET INTENSITY ON
*set up the loop
STORE t TO more
DO WHILE more
  *set up screen for cdata entry
  SET FORMAT TO getcdata
  *get new set of memory variables for data entry
  RESTORE FROM cdata
  SELECT PRIMARY
  *let user enter data
  READ
  *add data to the file
  ? "  STORING THE DATA.... ONE MOMENT PLEASE."
  APPEND BLANK
  REPLACE cnum1 WITH mcnum, cname1 WITH mcname1
  REPLACE cname2 WITH mcname2
  REPLACE stpob WITH mstpob, city WITH mcity, state WITH mstate
  REPLACE zip WITH mzip
  REPLACE phone WITH mphone, proj1 WITH mproj1, fee1 WITH mfee1
  REPLACE proj2 WITH mproj2, fee2 WITH mfee2, proj3 WITH mproj3
  REPLACE fee3 WITH mfee3
  *wait for the user response
  *release all variables
  RELEASE ALL
  * set screen for cdis input
  SET FORMAT TO getcdis
  *get variables for cdis
  RESTORE FROM cdis
  *pass the contractor number to the cdis file
  STORE cnum1 TO mcnum2
  * get the cdis data file
  SELECT SECONDARY
  *let the user input data
  READ
  *store the data in the cdis file
  APPEND BLANK
  REPLACE cnum2 WITH mcnum2
  REPLACE nad WITH mnad, nee WITH mnee, nog WITH mnog
  REPLACE na WITH mna
  REPLACE nest WITH mnest, nup WITH mnup, nche WITH mnche
  REPLACE nge WITH mnge
  REPLACE nsne WITH mnsne, nce WITH mnce, nhy WITH mnhy
  REPLACE nsoe WITH mnsoe
  REPLACE nci WITH mnci, nid WITH mnid, nspw WITH mnspw
  REPLACE ndmn WITH mndmn
  REPLACE nla WITH mnla, nste WITH mnste, neco WITH mneco
  REPLACE nme WITH mnme, nsur WITH mnsur, necn WITH mnecn
  REPLACE nmne WITH mnmne
  REPLACE ntre WITH mntre, nge WITH mnge
  *are there more inputs?
  IF !(answer) = "Y"
      RELEASE ALL
      STORE t TO more
    ELSE
      RELEASE ALL
```

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```
            STORE f TO more
       ENDIF
*loop back
ENDDO
*set up the index on the names
SELECT PRIMARY
INDEX ON cname1 TO names
*set original environment
USE cdata
SELECT SECONDARY
USE cdis
SET INTENSITY OFF
```

Delete Command Module

```
*******************************************************************
* delete.cmd  6/9/84  jte                                         *
* version: 1.0                                                    *
* purpose: to delete records from the cdata and cdis files        *
* processing narrative: local variables are initialized. the user *
*                       is offered a look at the records in the   *
*                       file to determine the contractor number   *
*                       to delete. the record requested by the    *
*                       user is displayed to verify that it is to *
*                       be deleted. the record is then deleted,   *
*                       first the cdata file record then the cdis *
*                       file record. if more are to be deleted    *
*                       then the loop begins again else control   *
*                       goes back to the main menu.               *
* superordinate modules: main.cmd                                 *
* subordinate modules: saycdata.fmt                               *
* author: Tom Etheridge                                           *
*******************************************************************
*clear the screen
ERASE
*initialize the local variables
STORE t TO more
STORE " " TO answer1
STORE " " TO answer2
STORE " " TO answer3
STORE "deleted" TO mdeleted
*set up the deletion loop
DO WHILE more
   ?
   ?
   ?
   ?
   ?
   ?
   ? "      To delete records you need to know the assigned"
   ? "      contractor number."
   ?
   ? "      Do you need to see a listing of all the assigned"
   ? "      contractor numbers and names? ( Y or N )."
*wait for answer1
WAIT TO answer1
*evaluate the response and act on it
IF !(answer1) = "Y"
     STORE " " TO answer1
     *display the contractor numbers and names
     ERASE
     SELECT PRIMARY
     ? "             #       NAME"
     ?
     DISPLAY ALL deleted, cnum1, cname1 OFF
     ?
     ? "PRESS ANY KEY TO CONTINUE"
     WAIT
ENDIF
*get the contractor number
ERASE
?
?
?
?
ACCEPT "     What is the contractor number?" TO mcnumd
*find the record
SELECT PRIMARY
SET EXACT ON
LOCATE FOR cnum1 = !(mcnumd)
*check for eof
IF EOF
```

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```
                    ERASE
                    ? "That contractor number is not in the file"
                    ? "Do you want to:"
                    ?
                    ? "           1) Try again or,"
                    ACCEPT "           2) Return to main menu" TO choice
                    IF !(choice) = "1"
                           LOOP
                       ELSE
                           *remove the record and compress the file
                           PACK
                           SELECT SECONDARY
                           PACK
                           *return to main.cmd
                           RETURN
                    ENDIF
          ENDIF
          *display the record to see if it is the correct one
          SET FORMAT TO saycdata
          READ
          *get the answer2
          IF !(answer2) = "N"
              STORE " " TO answer2
              LOOP
            ELSE
              *mark it for deletion
              REPLACE deleted WITH mdeleted
              DELETE
              *get the cdis file
              SELECT SECONDARY
              LOCATE FOR cnum2 = !(mcnumd)
              SET EXACT OFF
              *mark the cdis record for deletion
              DELETE
              *find if we're done
              ?
              ?
              ?
              ?
              ? " Do you want to delete more records? ( Y or N )"
              WAIT TO answer3
              *get answer3
              IF !(answer3) = "Y"
                     *start over
                     STORE " " TO answer3
                     LOOP
                 ELSE
                     *remove the marked records and compress files
                     USE cdata
                     PACK
                     USE cdis
                     PACK
                     *end the loop
                     STORE f TO more
              ENDIF
          *end answer2 if
          ENDIF
      *end the main loop
      ENDDO
```

Query Command Module

```
******************************************************************
* query.cmd  6/11/84 jte                                          *
* version: 1.0                                                    *
* purpose: to permit the dBASE user to access the command mode    *
* processing narrative: the user is told the purpose and          *
*                       requirements of using the command mode.   *
*                       he is told how to return from the         *
*                       command mode to the menu mode.            *
* superordinate modules: main.cmd                                 *
* subordinate modules: none                                       *
* author: Tom Etheridge                                           *
******************************************************************
*clear the screen
ERASE
?
?
?
?
?
?

? "This will put you into the dBASE 11 command mode for queries."
? "of the database. You must know the command language to make "
? "the queries."
?
*get the response
ACCEPT "Do you want to proceed? (Y or N)" TO mquery
*analyze the response and act on it
IF !(mquery) = "Y"
    ERASE
    ?
    ?
    ? "To return to the menu mode type DO MAIN in the command mode."
    ?
    ? "Press any key to continue........good luck!!!"
    ?
    WAIT
     *exit menu mode to command mode
     ERASE
     QUIT TO 'DBASE B'
   ELSE
     *return to main.cmd
     RETURN
ENDIF
```

View Command Module

```
********************************************************************
* view.cmd  6/9/84   jte                                          *
* version: 1.0                                                     *
* purpose: to browse thru the data                                *
* processing narrative: user is given intro and offered to see    *
*                       the numbers and the names of the          *
*                       contractors. error checking off inputted  *
*                       numbers is followed by presenting the     *
*                       records either in the indexed order from  *
*                       the top of the file or beginning at the   *
*                       specified number.                         *
* superordinate modules: main.cmd                                 *
* subordinate modules: vcdata.fmt, vcdis.fmt                      *
* author: Tom Etheridge                                           *
********************************************************************
*initialize the local variables
STORE t TO view
STORE t TO ahead
STORE " " TO vcommand
*clear screen
ERASE
*set the viewing environment
SELECT PRIMARY
USE cdata INDEX names
SELECT SECONDARY
USE cdis
*give intro
?
?
?
?
? "To view a specific contractor's data record you need"
? "to know the contractor number."
? "If a specific number is not used you will begin with"
? "the first record. The records are arranged in alphabetical"
? "order by contractor name."
?
? "You can also just browse thru the records."
?
?
?
?
? "PRESS ANY KEY TO CONTINUE"
WAIT
ERASE
?
?
?
? "The following options are available in browse:"
?
? "           B)ack--Takes you to the previous record"
? "           F)orward--Takes you to the next record"
? "           P)rofile--Displays the Discipline Profile"
? "                     of the contractor"
? "           N)umber--Permits you to locate a contractor"
? "                    by the contractor number"
? "           Q)uit--Returns you to the main menu"
?
? "Do you need to see a listing of the contractor numbers"
ACCEPT "and names? ( Y or N ) " TO answer1
*set loop
DO WHILE ahead
  *get answer1
  IF !(answer1) = "Y"
     *clear screen and show the numbers
```

```
        ERASE
        SELECT PRIMARY
        ? " #    NAME"
        ?
        DISPLAY ALL cnum1, cname1 OFF
        ?
        ? "---PRESS ANY KEY TO CONTINUE---"
        WAIT
    ENDIF
    *get the user's desires
    ?
    ACCEPT "Do you want to see a specific record? ( Y or N )" TO answer2
    IF !(answer2) = "Y"
        ?
        ACCEPT "What is the contractor number?" TO mcnumb
      ELSE
        *if no use the first record
        GOTO TOP
        STORE cnum1 TO mcnumb
    ENDIF
    *set up to check for erroneous data entry and recovery
    SELECT PRIMARY
    SET EXACT ON
    IF !(answer2) = "Y"
        LOCATE FOR cnum1 = !(mcnumb)
        IF EOF
            ? "That is not a valid number."
            ACCEPT "Do you need to see the listed numbers again?
                (Y or N)" TO bad
            IF !(bad) = "Y"
                STORE 'Y' TO answer1
                LOOP
              ELSE
                ? "The first record in the file will be displayed."
                ? "--Press any key to continue--"
                WAIT
                GOTO TOP
                STORE cnum1 TO mcnumb
            ENDIF
        ENDIF
    ENDIF
    *end the loop
    STORE f TO ahead
ENDDO
*set up the browsing loop
DO WHILE view
    STORE cname1 TO name
    *set up the screen
    SET FORMAT TO vcdata
    READ
    *evaluate the choice
    DO CASE
        *check option
        CASE vcommand = "B"
        SKIP -1
        STORE cnum1 to mcnumb
        *
        CASE vcommand = "F"
        SKIP
        STORE cnum1 to mcnumb
        *
        CASE vcommand = "P"
        SELECT SECONDARY
        *start at the top
        GOTO TOP
        *find the correct record
        LOCATE FOR cnum2 = !(mcnumb)
        *get the screen ready
        SET FORMAT TO vcdis
```

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```
      *show it
      READ
      WAIT
      *restore the main file
      SELECT PRIMARY
      *
      CASE vcommand = "Q"
      STORE f TO view
      *
      CASE vcommand = "N"
      ERASE
      *get the number
      ACCEPT "What is the contractor number?" TO mcnumb
      *find it
      LOCATE FOR cnum1 = !(mcnumb)
      *is it valid
      IF EOF
         GOTO TOP
         ? "That number is not valid. Try again.."
         ? "---Press any key to continue---"
         WAIT
      ENDIF
   *loop back
   ENDCASE
   *reset the variable
   STORE " " TO vcommand
   ENDDO
*restore the memory
RELEASE ALL
*reset the main environment
USE cdata
SELECT SECONDARY
USE cdis
*return to the main menu
```

```
************************************************************** **
* main.fmt 6/5/84 jte
a  1, 0 SAY "._____
a  2, 0 SAY "|_____.                    MAIN MENU
a  3, 0 SAY "|             |"
a  4, 0 SAY "|             |"              A)    Add a record
a  5, 0 SAY "|             |"
a  6, 0 SAY "|             |"              D)    Delete a record
a  7, 0 SAY "|             |"
a  8, 0 SAY "|             |"              E)    Exit ( work completed )
a  9, 0 SAY "|             |"
a 10, 0 SAY "|             |"           * H)    Help
a 11, 0 SAY "|             |"
a 12, 0 SAY "|             |"           * P)    Print a report
a 13, 0 SAY "|             |"
a 14, 0 SAY "|             |"              Q)    make a Query
a 15, 0 SAY "|             |"
a 16, 0 SAY "|             |"           * U)    Update a record
a 17, 0 SAY "|             |"
a 18, 0 SAY "|             |"              V)    View a record
a 19, 0 SAY "|             |"                                    *- currently
a 20, 0 SAY "|             |"          Choose an option:"
a 20,28 GET command
a 20,43 SAY "not available          | |"
a 21, 0 SAY "|_____| |"_____
a 22, 1 SAY "_____| |"_____
                   _____| |"
```

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```
*****************************************************************
* GETCDATA.FMT 6/5/84 jte
@  1, 0  SAY "-----------------------------------------------
                         -----------------"
@  2,21  SAY "CONTRACTOR DATA FILE"
@  4, 0  SAY "Contractor Number -"
@  4,20  GET mcnum
@  4,39  SAY "Phone -"
@  4,47  GET mphone PICTURE ' (999)-999-9999'
@  6, 0  SAY "Contractor Name -"
@  6,18  GET mcname1
@  7,16  SAY "-"
@  7,18  GET mcname2
@  9, 0  SAY "Street cr P.O.Box -"
@  9,20  GET mstpob
@ 11, 0  SAY "City -"
@ 11, 7  GET mcity
@ 11,37  SAY "State -"
@ 11,45  GET mstate
@ 11,54  SAY "Zip -"
@ 11,60  GET mzip
@ 13,10  SAY "---------- PROJECT HISTORY  ----------"
@ 14, 0  SAY "Project 1 -"
@ 14,12  GET mproj1
@ 15, 0  SAY "Fee -"
@ 15, 6  GET mfee1
@ 16, 0  SAY "Project 2 -"
@ 16,12  GET mproj2
@ 17, 0  SAY "Fee -"
@ 17, 6  GET mfee2
@ 18, 0  SAY "Project 3 -"
@ 18,12  GET mproj3
@ 19, 0  SAY "Fee -"
@ 19, 6  GET mfee3
```

·

Getcdis Screen Format

```
****************************************************************
* GETCDIS.FMT 6/5/84 jte
@  1, 0 SAY "-----------------------------------------------------
                      -------------------"
@  2,18 SAY "CONTRACTCR DISCIPLINE PROFILE"
@  4, 0 SAY "Contractcr Number -"
@  4,20 SAY cnum1
@  5, 0 SAY "Contractcr Name -"
@  5,18 SAY cname1
@  7, 0 SAY "Discipline Code - Number of Personnel"
@  8, 5 SAY "01"
@  8, 8 GET mnad
@  8,15 SAY "Administrative          02"
@  8,44 GET mnee
@  8,51 SAY "Electrical Eng"
@  9, 5 SAY "03"
@  9, 8 GET mnog
@  9,15 SAY "Oceanograhers           04"
@  9,44 GET mna
@  9,51 SAY "Architect"
@ 10, 5 SAY "05"
@ 10, 8 GET mnest
@ 10,15 SAY "Estimators              06"
@ 10,44 GET mnup
@ 10,51 SAY "Urban Planners"
@ 11, 5 SAY "07"
@ 11, 8 GET mnche
@ 11,15 SAY "Chemical Eng            08"
@ 11,44 GET mnge
@ 11,51 SAY "Geologists"
@ 12, 5 SAY "09"
@ 12, 8 GET mnsne
@ 12,15 SAY "Sanitary Eng            10"
@ 12,44 GET mnce
@ 12,51 SAY "Civil Eng"
@ 13, 5 SAY "11"
@ 13, 8 GET mnhy
@ 13,15 SAY "Hydrologists            12"
@ 13,44 GET mnsoe
@ 13,51 SAY "Soils Eng"
@ 14, 5 SAY "13"
@ 14, 8 GET mnci
@ 14,15 SAY "Construct Insptr        14"
@ 14,44 GET mnid
@ 14,51 SAY "Interior Designer"
@ 15, 5 SAY "15"
@ 15, 8 GET mnspw
@ 15,15 SAY "Spec Writer             16"
@ 15,44 GET mndmn
@ 15,51 SAY "Draftsman"
@ 16, 5 SAY "17"
@ 16, 8 GET mnla
@ 16,15 SAY "Landscape Arch          18"
@ 16,44 GET mnste
@ 16,51 SAY "Structural Eng"
@ 17, 5 SAY "19"
@ 17, 8 GET mneco
@ 17,15 SAY "Ecologists              20"
@ 17,44 GET mnme
@ 17,51 SAY "Mechanical Eng"
@ 18, 5 SAY "21"
@ 18, 8 GET mnsur
@ 18,15 SAY "Surveyors               22"
@ 18,44 GET mnecn
@ 18,51 SAY "Economists"
@ 19, 5 SAY "23"
@ 19, 8 GET mnmne
```

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```
@ 19,15 SAY "Mining Eng                24"
@@ 19,44 GET mntre
@@ 19,51 SAY "Transport Eng"
@@ 20, 5 SAY "25"
@@ 20, 8 GET mnge
@@ 20,15 SAY "General"
@@ 22, 0 SAY "-----> DO YOU WANT TO INPUT ANOTHER RECORD? ( Y or N )"
@ 22,55 GET answer
```

Saycdata Screen Format

```
*********************************************************************
* SAYCDATA.FMT 6/5/84 jte
@  1, 0 SAY "-----------------------------------------------------
                          -------------------"
@  2,21 SAY "CONTRACTCR DATA FILE"
@  4, 0 SAY "Contractcr Number -"
@  4,20 SAY cnum1
@  4,38 SAY "Phone -"
@  4,46 SAY phone
@  6, 0 SAY "Contractcr Name -"
@  6,18 SAY cname1
@  7,16 SAY "-"
@  7,18 SAY cname2
@  9, 0 SAY "Street cr P.O.Box -"
@  9,20 SAY stpob
@ 11, 0 SAY "City -"
@ 11, 7 SAY city
@ 11,36 SAY "State -"
@ 11,44 SAY state
@ 11,52 SAY "Zip -"
@ 11,58 SAY zip
@ 13,10 SAY "---------- PROJECT HISTORY  ----------"
@ 14, 0 SAY "Project 1 -"
@ 14,12 SAY proj1
@ 15, 0 SAY "Fee -"
@ 15, 6 SAY fee1
@ 16, 0 SAY "Project 2 -"
@ 16,12 SAY proj2
@ 17, 0 SAY "Fee -"
@ 17, 6 SAY fee2
@ 18, 0 SAY "Project 3 -"
@ 19,12 SAY proj3
@ 19, 0 SAY "Fee -"
@ 19, 6 SAY fee3
@ 21, 0 SAY "-----> IS THIS THE RECORD YOU WANT? ( Y or N )"
@ 21,47 GET answer2
```

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Saycdis Screen Format

```
*****************************************************************
* SAYCDIS.FMT 6/5/84 jte
@ 1, 0 SAY "--------------------------------------------------
                    -------------------"
@ 2,18 SAY "CONTRACTOR DISCIPLINE PROFILE"
@ 4, 0 SAY "Contractor Number -"
@ 4,20 SAY cnum1
@ 5, 0 SAY "Contractor Name -"
@ 5,18 SAY cname1
@ 7, 0 SAY "Discipline Code - Number of Personnel"
@ 8, 5 SAY "01"
@ 8, 8 SAY nad
@ 8,14 SAY "Administrative            02"
@ 8,43 SAY nee
@ 8,49 SAY "Electrical Eng"
@ 9, 5 SAY "03"
@ 9, 8 SAY nog
@ 9,14 SAY "Oceanograhers             04"
@ 9,43 SAY na
@ 9,49 SAY "Architect"
@ 10, 5 SAY "05"
@ 10, 8 SAY nest
@ 10,14 SAY "Estimators                06"
@ 10,43 SAY nup
@ 10,49 SAY "Urban Planners"
@ 11, 5 SAY "07"
@ 11, 8 SAY nche
@ 11,14 SAY "Chemical Eng              08"
@ 11,43 SAY nge
@ 11,49 SAY "Geologists"
@ 12, 5 SAY "09"
@ 12, 8 SAY nsne
@ 12,14 SAY "Sanitary Eng              10"
@ 12,43 SAY nce
@ 12,49 SAY "Civil Eng"
@ 13, 5 SAY "11"
@ 13, 8 SAY nhy
@ 13,14 SAY "Hydrologists              12"
@ 13,43 SAY nsoe
@ 13,49 SAY "Soils Eng"
@ 14, 5 SAY "13"
@ 14, 8 SAY nci
@ 14,14 SAY "Construct Insptr          14"
@ 14,43 SAY nid
@ 14,49 SAY "Interior Designer"
@ 15, 5 SAY "15"
@ 15, 8 SAY nspw
@ 15,14 SAY "Spec Writer               16"
@ 15,43 SAY ndmn
@ 15,49 SAY "Draftsman"
@ 16, 5 SAY "17"
@ 16, 8 SAY nla
@ 16,14 SAY "Landscape Arch            18"
@ 16,43 SAY nste
@ 16,49 SAY "Structural Eng"
@ 17, 5 SAY "19"
@ 17, 8 SAY neco
@ 17,14 SAY "Ecologists                20"
@ 17,43 SAY nme
@ 17,49 SAY "Mechanical Eng"
@ 18, 5 SAY "21"
@ 18, 8 SAY nsur
@ 18,14 SAY "Surveyors                 22"
@ 18,43 SAY necn
@ 18,49 SAY "Economists"
@ 19, 5 SAY "23"
@ 19, 8 SAY nmne
```

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```
@ 19,14 SAY "Mining Eng                    24"
@@ 19,43 SAY ntre
@@@ 19,49 SAY "Transport Eng"
@@@ 20, 5 SAY "25"
@@@@@ 20, 8 SAY nge
@@@@@ 20,14 SAY "General"
@@@@ 21, 0 SAY "Choose cne of the following options:"
@@@ 22, 0 SAY "B)ackward, D)ata file, F)orward, H)elp, or Q)uit"
@ 22,52 GET answer
```

```
                    Viewdata Screen Format
************************************************************************
* VCDATA.FMT 6/5/84 jte
@  1, 0 SAY "------------------------------------------------
                  -----------------"
@  2,21 SAY "CONTRACTOR DATA FILE"
@  4, 0 SAY "Contractor Number -"
@  4,20 SAY cnum1
@  4,38 SAY "Phone -"
@  4,46 SAY phone
@  6, 0 SAY "Contractor Name -"
@  6,18 SAY cname1
@  7,16 SAY "-"
@  7,18 SAY cname2
@  9, 0 SAY "Street or P.O.Box -"
@  9,20 SAY stpob
@ 11, 0 SAY "City -"
@ 11, 7 SAY city
@ 11,36 SAY "State -"
@ 11,44 SAY state
@ 11,52 SAY "Zip -"
@ 11,58 SAY zip
@ 13,10 SAY "---------- PROJECT HISTORY  ----------"
@ 14, 0 SAY "Project 1 -"
@ 14,12 SAY proj1
@ 15, 0 SAY "Fee -"
@ 15, 6 SAY fee1
@ 16, 0 SAY "Project 2 -"
@ 16,12 SAY proj2
@ 17, 0 SAY "Fee -"
@ 17, 6 SAY fee2
@ 18, 0 SAY "Project 3 -"
@ 18,12 SAY proj3
@ 19, 0 SAY "Fee -"
@ 19, 6 SAY fee3
@ 20, 0 SAY "------------------------------------------------
                  -----------------"
@ 21, 1 SAY "B)ack  F)orward  P)rofile  N)umber  Q)uit"
@ 21,54 GET vcommand
```

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```
****************************************************************************
VCDIS.FMT 6/5 /84 jte
@  0, 0 SAY "-----------------------------------------------------------
                           ------------------------"
@  1,18 SAY "CONTRACTCR DISCIPLINE PROFILE"
@  3, 0 SAY "Contractcr Number -"
@  3,20 SAY cnum2
@  4, 0 SAY "Contractcr Name -"
@  4,18 SAY name
@  6, 0 SAY "Discipline Code - Number of Personnel"
@  7, 5 SAY "01"
@  7, 8 SAY nad
@  7,14 SAY "Administrative              02"
@  7,43 SAY nee
@  7,49 SAY "Electrical Eng"
@  8, 5 SAY "03"
@  8, 8 SAY nog
@  8,14 SAY "Oceanograhers               04"
@  8,43 SAY na
@  8,49 SAY "Architect"
@  9, 5 SAY "05"
@  9, 8 SAY nest
@  9,14 SAY "Estimatcrs                  06"
@  9,43 SAY nup
@  9,49 SAY "Urban Planners"
@ 10, 5 SAY "07"
@ 10, 8 SAY nche
@ 10,14 SAY "Chemical Eng                08"
@ 10,43 SAY nge
@ 10,49 SAY "Geologists"
@ 11, 5 SAY "09"
@ 11, 8 SAY nsne
@ 11,14 SAY "Sanitary Eng                10"
@ 11,43 SAY nce
@ 11,49 SAY "Civil Eng"
@ 12, 5 SAY "11"
@ 12, 8 SAY nhy
@ 12,14 SAY "Hydrologists                12"
@ 12,43 SAY nsoe
@ 12,49 SAY "Soils Eng"
@ 13, 5 SAY "13"
@ 13, 8 SAY nci
@ 13,14 SAY "Construct Insptr            14"
@ 13,43 SAY nid
@ 13,49 SAY "Interior Designer"
@ 14, 5 SAY "15"
@ 14, 8 SAY nspw
@ 14,14 SAY "Spec Writer                 16"
@ 14,43 SAY ndmn
@ 14,49 SAY "Draftsman"
@ 15, 5 SAY "17"
@ 15, 8 SAY nla
@ 15,14 SAY "Landscape Arch              18"
@ 15,43 SAY nste
@ 15,49 SAY "Structural Eng"
@ 16, 5 SAY "19"
@ 16, 8 SAY neco
@ 16,14 SAY "Ecologists                  20"
@ 16,43 SAY nme
@ 16,49 SAY "Mechanical Eng"
@ 17, 5 SAY "21"
@ 17, 8 SAY nsur
@ 17,14 SAY "Surveyors                   22"
@ 17,43 SAY necn
@ 17,49 SAY "Economists"
@ 18, 5 SAY "23"
@ 18, 8 SAY nmne
@ 18,14 SAY "Mining Erg                  24"
```

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```
@ 18,43 SAY ntre
@@ 18,49 SAY "Transport Eng"
@@@ 19, 5 SAY "25"
@@@ 19, 8 SAY nqe
@@@ 19,14 SAY "General"
@@ 20, 0 SAY "--------------------------------------------------
                  -------------------"
@ 21, 0 SAY "------>Press any key to continue........"
```

APPENDIX B
A-E MANAGEMENT INFORMATION SYSTEM COMPONENTS

Below is a listing of the components which makeup the A-E Management Information System. The listing is broken into four categories: databases, files, reports/letters file, and applications.

Databases

Phases I&II Tracking	Contract Specialist
Labor Costs	Contractor Information
Board Members	System
Provisions	Phase III Tracking
Drawing Numbers	Modifications Tracking
Payments	

Applications

Phase I&II Tracking	Phase III Tracking
Contract Assignment	Estimates
Clearances/Approvals I	Contractor Information
Certificates/Approvals	System
II/III	Board Selections
Evaluation Calculator	Estimate Evaluator
Signature	DD 350
DD 1057	DD 1413
Progress Payment	

Files
Contracts

Reports/Letters

Customer Notification   Cost Estimate

Clearances/Approvals   Worksheet

CBD   .   Board Appointments

Pre-Selection Board   Interview Letter

    Report   Interview Evaluation

Interviewers Instructions   Sheet

Selection Board Report   G.E. Form

Negotiation Board Report   DD 350

Contractor Notification   DD 1057

    Letter   DD 1413

Contractor Meeting   Design Review

    Checklist   Documents

Contractor Release

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3.   Naval Material Command, Washington, D.C., P-4202, <u>Navy Contracting Directives</u> (NCD/NPD), Sections 1-401.53 and 7-603.2.

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