NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

FEASIBILITY STUDY OF A
COMPUTERIZED MANAGEMENT INFORMATION SYSTEM
FOR THE NOAA CORPS PERSONNEL SYSTEM

by

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Thesis Advisor: John M. Shiels

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The National Oceanic and Atmospheric Administration (NOAA) Commissioned Personnel Division was in the situation of being subject to increasing demands for information and services and having a fixed number of office personnel to fulfill those demands. A study was performed to investigate the feasibility of converting some aspects of the manual data handling procedures to computerized handling. Objectives were defined as: reducing data

retrieval and information preparation time; increasing currency of data; aiding in monitoring suspense dates; eliminating some hard copy records; and improving information dissemination. A generalized computer system using a data base management system software package was designed. Alternatives for obtaining the requisite capabilities were evaluated and an implementation procedure was outlined. It was concluded that the automation of the system was feasible and would most likely result in increased effectiveness.

Feasibility Study of a Computerized Management Information System for the NOAA Corps Personnel System

by

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ABSTRACT

The National Oceanic and Atmospheric Administration (NOAA) Commissioned Personnel Division was in the situation of being subject to increasing demands for information and services and having a fixed number of office personnel to fulfill those demands. A study was performed to investigate the feasibility of converting some aspects of the manual data handling procedures to computerized handling. Objectives were defined as: reducing data retrieval and information preparation time; increasing currency of data; aiding in monitoring suspense dates; eliminating some hard copy records; and improving information dissemination. A generalized computer system using a data base management system software package was designed. Alternatives for obtaining the requisite capabilities were evaluated and an implementation procedure was outlined. It was concluded that the automation of the system was feasible and would most likely result in increased effectiveness.

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I. INTRODUCTION

In a time characterized by rapid advances in the development and utilization of computer systems technology, drastic increases in demands for information, and strong limitations on personnel and financial resources, government agencies are turning to computers in increasing numbers in an attempt to maintain an effective level of performance. Many new computer applications are becoming economically justifiable alternatives to present manual operations because of the drop in computer prices associated with the advancing technology. In this environment, many executives are being faced with the decision of whether or not it is feasible[1] at this time to "automate" a particular system.

In this context it is the main objective of this thesis to analyze the feasibility of converting some aspects of a small personnel management information system from manual to computerized handling. The information shall be presented in such a way as to create an overall picture that can be used by management in making the crucial decision of whether automating parts of the system will be of real benefit to the organization.

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[1]It is important at the onset to describe the author's use of the word feasible. The word feasible has its roots in the French word faire--to make, or to do. Based on this derivation the word has come to be defined as capable of being used or dealt with successfully, with the additional connotation of being reasonable or likely.

The secondary objective of this thesis involves the use of a system life cycle model as developed by IBM for Montgomery Ward [1:2] (Figure 1). In the event that a decision is made to proceed with the development and installation of an automated system, this document can be used as a basis for work on the system planning phase of the system's development as outlined in Figure 1.

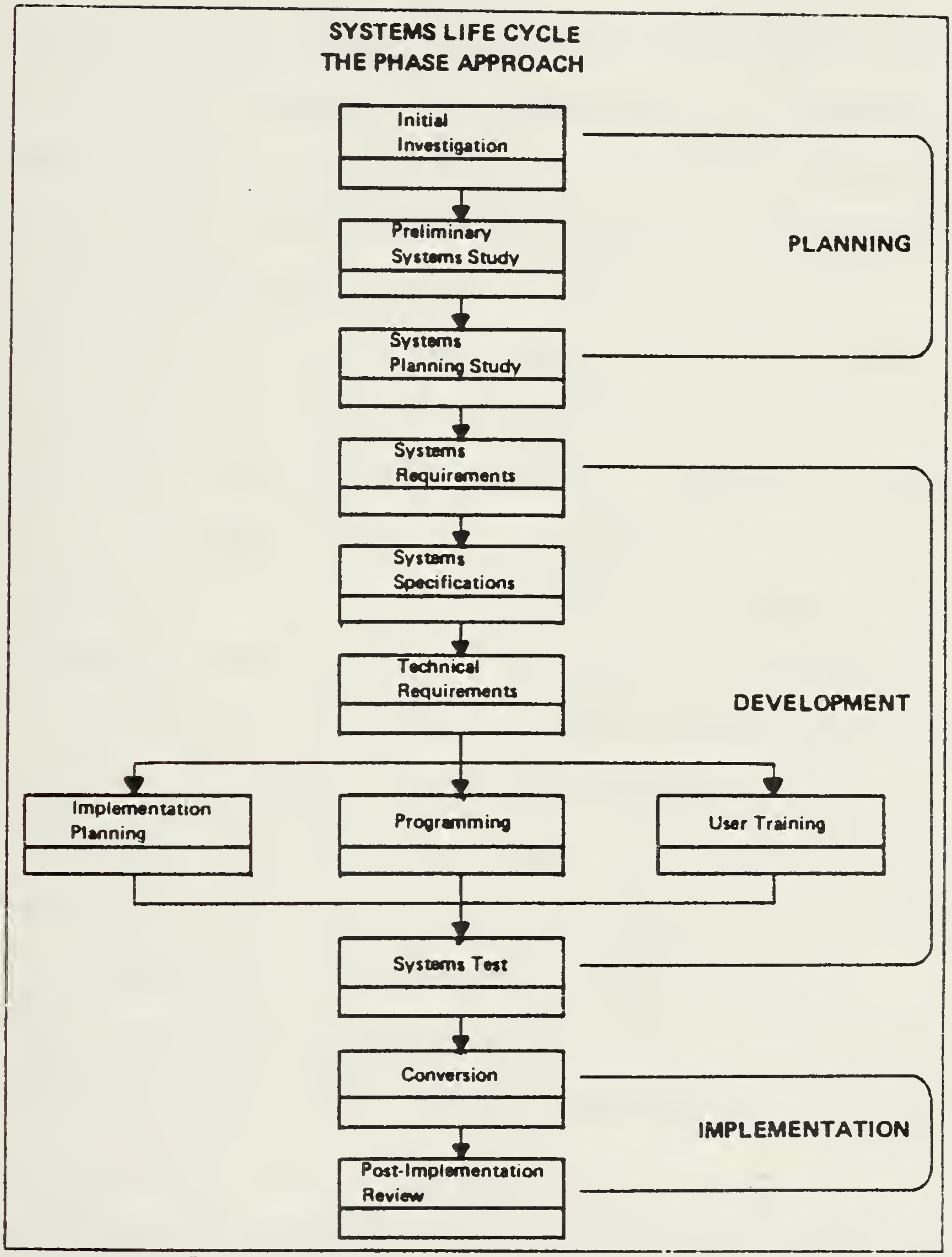
SYSTEMS LIFE CYCLE
THE PHASE APPROACH
Initial Investigation
Preliminary Systems Study
Systems Planning Study
PLANNING
Systems Requirements
Systems Specifications
Technical Requirements
DEVELOPMENT
Implementation Planning
Programming
User Training
Systems Test
Conversion
IMPLEMENTATION
Post-Implementation Review

Figure 1 [1:2]

II. HISTORY AND GENERAL PERSONNEL ORGANIZATION

The object of this study is the personnel system for the National Oceanic and Atmospheric Administration's Commissioned Corps (NOAA Corps). A short discussion of the history of the NOAA Corps will give some familiarity with its field operating characteristics and general administrative organization.

The NOAA Corps is the present day name for an old and prestigious organization known as the Coast and Geodetic Survey Commissioned Corps (C&GS Corps) which was created by legislation in 1917. The C&GS Corps was an integral part of the parent organization from which it obtained its name, the Coast and Geodetic Survey (C&GS).[1] In general terms, the mission of the C&GS was twofold, to chart the coastal waters of the United States and to survey the continental United States using geodetic surveying methods. In times of war, the officers and ships of the C&GS were transferred to the War and Navy departments. Subsequent to the ending of hostilities, the officers and ships were again placed under the jurisdiction of the C&GS in the Department of Commerce.

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[1]The C&GS had its beginning with legislation signed by President Jefferson in 1807 which created the Survey of the Coast. With expansion of geodetic surveying responsibilities in 1870, the organization became known as the Coast and Geodetic Survey.

The C&GS Corps was organized around a field corps system which provided for officers being assigned to all phases of field operations. Careers were spent alternating between assignments to mobile field units, hydrographic survey vessels, survey aircraft and fixed shore duty. This type of organization ensured no division of responsibility, in that C&GS officers staffed and commanded virtually all levels of the C&GS from deck officers aboard survey ships through Officers In-Charge of field units and Commanding Officers of Survey Ships, to the Director of the C&GS. This organization also provided executive development procedures not unlike the military or large industrial firms. Significant benefits were inherent in the commissioned personnel system as applied to the C&GS. Professional officers with engineering and scientific backgrounds could be directed to serve when and where needed in any component of the Administration, regardless of the remoteness of the station, the length of family separation, or the hazards of the duty. The broad experience gained by each officer serving throughout the Administration contributed to a better understanding of the interrelations of the Administration's many functions and enhanced its total competence. C&GS Corps officers wore the rank designations of the Navy and Coast Guard officers. The uniform was patterned after those of the Navy. There were, however, no enlisted personnel. Positions not held by C&GS Corps officers were held by government general schedule and wage board employees.

In 1965 Presidential Reorganization Plan No. 2 consolidated the C&GS and the Weather Bureau to form the Environmental Science Services Administration (ESSA). Subsequent action by the Secretary of Commerce added the Central Radio Propagation Laboratory of the National Bureau of Standards to the new Administration which was designed to provide a single national focus on efforts to describe, understand, and predict the environment. In his message transmitting the Reorganization Plan to Congress, the President proclaimed that "Commissioned officers of the Coast and Geodetic Survey will become commissioned officers of the Administration and may serve at the discretion of the Secretary of Commerce throughout the Administration.[2:4]

The new role of the Commissioned Corps in ESSA thus required an increase in the scope of duties for officers which in turn complicated the manpower management responsibilities of the commissioned personnel branch of the personnel office in ESSA headquarters. Officers were now recruited with backgrounds other than the traditional ones of civil engineering and geodesy, and subsequently began to fill positions in other components of the new organization. The traditional career patterns began to change in that officers could now fill billets in different career disciplines. Well-structured career patterns in disciplines other than geodesy and engineering/hydrography were not possible in most cases. Upper level billets for officers in the non-traditional part of the organization had not been identified and filled. The majority of the officer billets were still in the surveying organization.

The limitations of a small officer corps necessitated some officers working temporarily outside their area of expertise.

The commissioned corps was again involved in a consolidation effort on July 9, 1970, when the President transmitted Reorganization Plan No. 4 to Congress. The Plan created the National Oceanic and Atmospheric Administration (NOAA) within the Department of Commerce. The new organization was composed of the National Ocean Survey (the old C&GS), the National Weather Service, the National Marine Fisheries Service, the Environmental Research Laboratories, the National Environmental Satellite Service, the Environmental Data Service, Sea Grant, and other smaller organizations. The ESSA Corps became the NOAA Corps, and provision was made for an officer of Rear Admiral (upper half) rank to act as its Director. The Director of the NOAA Corps became responsible for the recruitment, training, assignment and career development of commissioned officers. The mission of the NOAA Corps was established as follows:

> The mission of the NOAA Corps is to provide officers technically competent to assume positions of leadership in NOAA's programs. Members of a uniformed service, they serve as officers of the Department of Commerce or as military officers if transferred to the armed services during times of emergency. Discipline and flexibility are inherent in the Corps personnel system. NOAA officers are trained for positions of leadership and command in the operation of ships and aircraft; in the conduct of field projects on land, at and under

the sea, and in the air; in the management of NOAA observational and support facilities; as members or leaders of research efforts; and in the management of various organizational elements throughout NOAA.[2:5]

With the addition of substantial program responsibilities to the organization, the role of the commissioned corps again was diversified. The recruitment effort was broadened to obtain an ample number of officers from disciplines compatible with the new responsibilities. The new breed gradually began assuming positions in the new technical and ocean related operations. In spite of the fact that the new responsibilities given to the Administration did bring gradual increases in the size of the commissioned corps,[1] the problems of establishing viable career fields for commissioned officers in the new programs increased.

At the present time (1978), the NOAA organization has acquired even more program responsibilities and has recently undergone an internal reorganization. The main focus of the organization, however, remains the same as it was when first organized in 1970. Figure 2 shows the present organization structure of NOAA. (It should be noted that this is a snapshot view of a constantly changing structure.) The following is a breakdown of the Major Line Components (MLC's) under the Assistant Administrator offices shown in Figure 2. Components in which NOAA Corps officers are presently serving have been underlined.

[1]Present size is 380 officers.

U.S. DEPARTMENT OF COMMERCE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

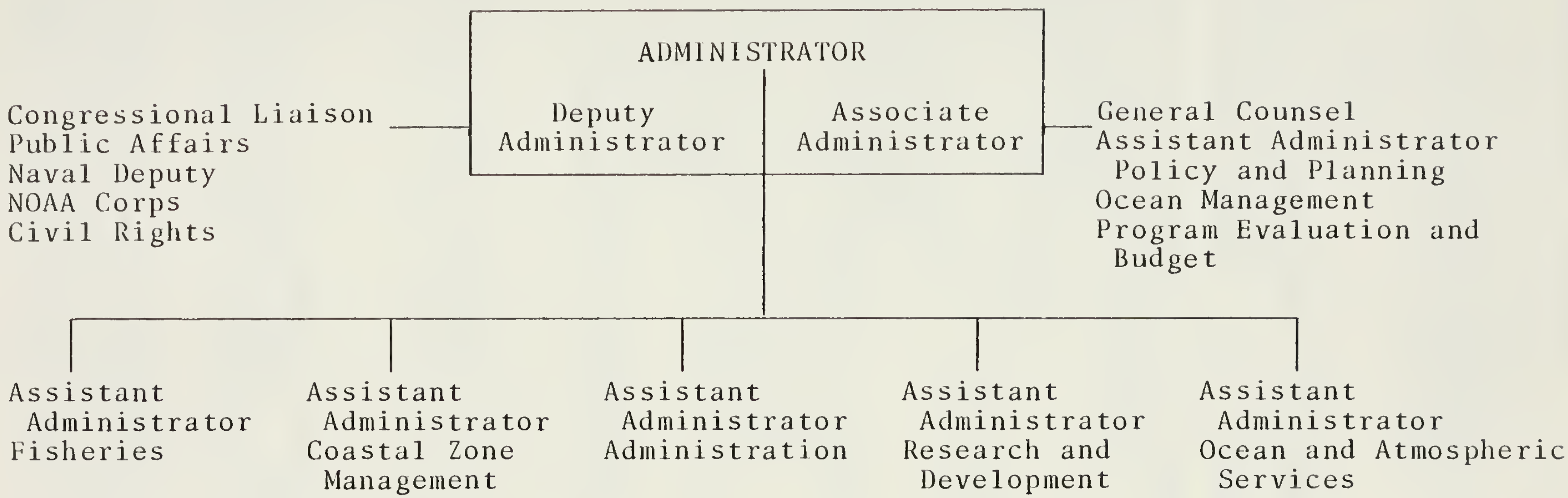

Figure 2

ASSISTANT ADMINISTRATOR FISHERIES

- Office of International Fisheries Affairs
- Office of Science and Environment
- Office of Resource Conservation and Management
- Office of Marine Mammals & Endangered Species
- Office of Utilization and Development
- Regional Offices
- Fisheries Centers

ASSISTANT ADMINISTRATOR COASTAL ZONE MANAGEMENT

- Office of State Programs
- Office of Coastal Energy Impact Programs

ASSISTANT ADMINISTRATOR RESEARCH AND DEVELOPMENT

- Environmental Research Laboratories
- Office of Sea Grant
- Office of Ocean Engineering
- *U.S. Climate Program Office

**ASSISTANT ADMINISTRATOR OCEANIC AND ATMOSPHERIC SERVICES

- National Weather Service
- ***National Ocean Survey
- Environmental Data Service
- National Environment Satellite Service

ASSISTANT ADMINISTRATOR ADMINISTRATION

- Office of Administrative Operations
- Office of Management and Computer Systems
- Office of Finance[1]
- Office of Personnel[2]
- Office of Radio Frequency Management
- Northwest Administrative Service Office

*Will not be established until Congress acts
**Contains 70% of NOAA employees
***Contains largest single number of officers

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[1]This office provides financial administrative support for the NOAA Corps Personnel Office. Constant hard copy transmission of necessary information is required from the NOAA Corps Personnel Office to the NOAA Personnel Office.

[2]This office, because of incompatible personnel administration procedures and responsibilities, is a separate office from the NOAA Corps Personnel Office under NOAA Corps as shown in Figure 2. Personnel data for record keeping flows from NOAA Corps to NOAA Personnel Office.

The Director of NOAA Corps administers the 380 officers of the Corps from a NOAA headquarters unit in Rockville, Maryland. As previously stated, he is responsible for the

Director, NOAA Corps (NC)

- CHIEF, Commissioned Personnel Division (NC1)
- CHIEF, Program Planning, Liaison and Training Division (NC2)

recruitment, training, assignment and career development of commissioned officers. To aid in meeting this responsibility he has the efforts of the two divisions shown above plus four part-time officer boards; the Officer Personnel Board (OPB), the Officer Assignment Board (OAB), the Flight Board, and the full-time University Training Board (FUT Board). The members of the boards are commissioned officers who take time from full-time positions in other NOAA components to meet on a periodic basis and made recommendations to the Director concerning their areas of responsibility. The Commissioned Personnel Division (NC1) is responsible for the general administrative details concerning the officers from the time they are recruited until after they are retired. The administrative details of the training and financial management of the corps falls to the Program Planning, Liaison and Training Division (NC2).

III. METHODOLOGY

In the introduction it was stated that the main objective of this thesis was to analyze the feasibility of automating some aspects of a small personnel management information system. The secondary and possibly equally important objective was to provide a basis from which further planning and design work could proceed in the event that a decision was made to proceed with the automation project.

The initial concentration of the thesis was to formulate and describe a problem statement for the manual personnel system. Further discussion then focused on the various causes that had combined to germinate the problem. This discussion also presented details about the day to day operation of the personnel system.

Having made a largely subjective determination of the problem, the next step involved an analysis of the needs of the system. These needs were gathered from substantial numbers of phone conversations, personal interviews with personnel directly involved with the system, and personal experience with the system. The personnel interviewed were classified into two groups--operators and users. The term operator refers to the personnel directly involved in the day to day operation of the system and user refers to the commissioned officers themselves. Almost without exception the comments of both groups referred to the need for an

automated system of some sort. With the exception of a few individuals, computer training or experience was extremely limited. As a result, some comments reflected needs that could require a consumption of resources far out of proportion to the possible benefits resulting from the new system. With the exception of a few of these rather costly needs, all expressed needs were considered in the construction of five specific objectives. These objectives were then discussed in terms of detailed actions or methods required.

Having defined the objectives to be reached by the implementation of an automated system, the next major step was the design of a general automated data handling and storage system. The system was designed in general terms in order to describe the size system needed to fulfill all of the collective needs identified during the analysis phase and to allow flexibility in the design of the final system if the decision was made to proceed. The system design included the development of a comprehensive data base, a description of hardware and software needs, a description of the system in operation, and a general discussion of many other design considerations.

Subsequent to the design of a general system came the presentation of alternative methods of providing a system to meet the objectives. The alternatives were evaluated using weighted evaluation criteria. The weights were supplied by the author. The evaluation process was designed to allow the final decision-maker to supply his own weights and, therefore, select the alternative best suited to the environment at the time of the decision.

The alternative selection process is followed by a discussion of the different factors to be considered in implementing a new automated system. The thesis ends with a discussion of conclusions and recommendations.

IV. DEFINITION AND ANALYSIS OF THE PROBLEM

A. DEFINITION

As in many complex organizational analyses, an exact determination of a specific problem in the operation of the NOAA Corps personnel system was not realistically possible. The generalized problem statement below was inferred somewhat subjectively from interviews and personal experience rather than extracted from a detailed analysis of the system and perhaps a subsequent determination of hampered mission effectiveness. It was felt that mission effectiveness, in this situation, was not quantifiable and that the results of a detailed analysis, were it made, would also be controlled to a large extent by many subjective decisions of the investigator. In either case, the description of the problem would be subjective.

Problem Statement:

Changing environmental conditions within and outside the NOAA Corps organization have hampered the effective performance of the overall NOAA Corps personnel system and potential exists for future deterioration of that effectiveness.

B. ANALYSIS

The cause of the stated problem again could not be narrowed down to a concise statement that would allow easy analysis and

correction. It was the opinion of the author, however, that many symptoms centered around an ever increasing workload in the Commissioned Personnel Division (NC1) of NOAA Corps Headquarters and that this situation had affected other aspects of the personnel system. The following is a discussion of some of the smaller causes of the general problem:

1. <u>Increasing Responsibilities of NC1</u>

The past few years had seen increases in the effort required to establish and maintain viable EEO and Affirmative Action programs. Contemporary attitudes toward these programs were expected to increase or at least remain at the same level in the future.

2. <u>Increasing Demands for Information from NC1 As a Result of Expanding Corps Size and Responsibilities</u>

a. NOAA Personnel System

The personnel offices of NOAA nad NOAA Corps were separate but interrelated offices. Some personnel and financial records in the two systems were duplicated because: (1) the NOAA office handled the financial transactions such as payroll and travel claims using appropriate data submitted from NC1; (2) the personnel systems were inherently different (civilian vs commissioned) and the types of records were not completely compatible; and (3) the NOAA personnel and finance systems were automated while the NOAA Corps systems were not.

The NOAA personnel system known as PERC, if kept current, required a great deal of attention in the form of constant transmittals of information via written documents

from NC1 to NOAA. In the past, time constraints in NC1 prevented the current transmittal of some personal information from NOAA Corps to NOAA. Increased pressure to keep NOAA records current resulted in an increased amount of time being devoted to the preparation and transmittal of information to the PERC system.

b. Dependents/Survivor Information

Recent years had seen a substantial proportional increase in the amount of information kept on officer dependents and survivors. This occurred for two basic reasons. The number of officers increased and the information required by administrators of the CHAMPUS program became more comprehensive.

c. EEO Statistics

With the advent of new EEO and affirmative action programs came the necessary effort to keep track of the various statistics involved.

d. Officer Assignment Board (OAB)

The OAB consisted of approximately seven officers representing ranks from Lieutenant (junior grade) to Captain. It met as required (usually three days a month) for one-half day sessions. The officers had other full-time jobs relegating to the OAB the status of a rather important collateral duty. In general the responsibility of the OAB was to monitor the assignments of NOAA Corps officers and recommend to the Director on a periodic basis assignment changes that were in the best interest of NOAA, the NOAA Corps, and the officer himself.

Changes of program responsibilities from the rather narrow one of the C&GS to the many and varied ones of NOAA, the increased number of officers, and the recruitment of officers from many new disciplines drastically increased the complexity of the task of the OAB. They were faced with decisions that required more information about the officers and possible assignments. Much of this information was required of NC1 at a time when other demands for information were also increasing.

e. Officer Personnel Board (OPB)

The OPB consisted of approximately six officers in the ranks of Commander and Captain. It met as required (usually one day a month) for a half-day session. These officers also had other full time jobs in the upper management levels of NOAA. In general their responsibilities as members of the OPB were (1) to review all applicants to the Corps and make recommendations to the Director on acceptance or rejection; (2) to review questionable personnel situations and make recommendations to the Director concerning appropriate disciplinary action; (3) to annually review the experience and qualifications of all officers below the rank of Rear Admiral and make recommendations to the Director to adjust relative positions on the lineal list to insure that it was in order of increasing experience, qualifications, and overall competence for promotional purposes; and (4) to review all officers

in consideration for promotion and make appropriate recommendations to the Director.

Responsibilities (3) and (4), because of the increased size of the Corps again caused proportional increase in the amount of information needed from NC1 files. Responsibility (3) was especially demanding because all available appropriate background material had to be current for the annual review.

f. Full-Time University Training Board (FUT)

The FUT Board was composed of approximately three senior officers who met as required to consider officer applications for full-time university training and make appropriate recommendations to the Director. These officers also had other full time assignments in NOAA and in some cases served on more than one board.

This board, being relatively new, placed another demand (albiet not a substantial one) on NC1.

g. NOAA Corps Aviation Advisory Board (Flight Board)

The Flight Board was composed of approximately six officers representing the ranks of Lieutenant Commander to Captain. It was responsible for reviewing the qualifications of applicants to the flight program and recommending those best qualified to the Director. The Flight Board also monitored the training and performance of pilots, along with the current need for pilots in NOAA and made recommendations on pilot assignments and the size of the officer flight program.

The information required by the Flight Board from NC1 had also increased because of an expansion of the number of officers in the flight program. The nature of much of the information needed by the Flight Board was unique in comparison to the standard records kept on the rest of the Corps in that it involved qualifications, training, and flight hours in different types of aircraft.

h. Program Planning, Liaison and Training Division (NC2)

The information demands of NC2 were related mainly to financial accounting information that was monitored and transmitted to the NOAA finance office when it concerned financial obligations that required payment. These information requirements had grown in direct proportion to the growth of the Corps.

i. NOAA Corps Officers

The increased size of the Corps caused a proportional increase in the volume of records that were kept which resulted in increased search time to satisfy each request for information. Examples of information required included individual inquiries, periodic reports, and catalogued data for the various boards. Requests from individual officers such as confirmation of eligibility for VA mortgage insurance also increased in direct proportion to the increase in the number of officers.

j. Recruiting

The job of attracting well motivated and qualified applicants from the engineering and scientific communities had become increasingly more complex. The demand for

competent people within these disciplines was high in the public and private sectors and the competition faced by NOAA Corps recruiters was increasing. The increasing demands of a viable affirmative action plan also stimulated competition for qualified applicants from the minority populations.[3]

With the increased complexity and competitiveness of the recruiting atmosphere came a need for better informed recruiters and increased demands for current information from NC1.[4]

k. Liaison Officers

The increased responsibilities of NOAA Corps officers in programs other than NOS and the subsequent increased need for coordination between the NOAA Corps personnel system and those program administrators lead to the designation of an officer in each program as a liaison officer. To be effective, these officers needed current information on officers working in their areas of responsibility, including pending transfers in and out. This need for information was becoming quite important. The volume was increasing while the need for currency remained the most critical factor about the information requested.[5]

3. <u>Personnel Ceilings</u>

In spite of the growth in the size and complexity of the information demands on the NOAA Corps personnel system, the number of permanent personnel staffing the system had not been allowed to grow for more than ten years.[6]

The resulting gap between the size of the workload (specifically in NC1) and the available personnel to perform

the work necessitated the development of an informal priority system that dictated what would and would not be done.

V. NEEDS AND OBJECTIVES

The overriding objective of most organizations in implementing an automated data handling system is to increase the overall effectiveness of the organization involved. In the private sector this translates into increased profits. In the public sector it means merely increased effectiveness. One significant phenomenon that is representative of many system installations, both private and public, is that the time saved by using a computer to perform routine functions is quite often absorbed by efforts needed to implement and maintain the system. The end result can increase the availability of current, accurate information but it is seldom accompanied by a substantial overall time savings or a reduction in operating costs.[7:14] In the case of the NOAA personnel system, because of the nature of the data involved, it was likely that more time would be required to operate the automated personnel system, with a concurrent increase in the cost of operating the system. The overriding objective in this case was to increase the effectiveness of the personnel system at the lowest possible increase in costs.

In order to define more specific objectives for the automated system the author conducted personal or telephone interviews with personnel from virtually all groups that were a part of the commissioned personnel system. This included NC1, NC2, NOAA personnel, advisory boards, recruiters, liaison officers and NOAA Corps officers themselves. Information from

these interviews and personal experience with different aspects of the system were then used to describe the perceived needs of the present personnel system.

The needs centered around the basic requirement to collect, monitor, process, use and disseminate NOAA Corps personnel data. In an environment of restricted and sometimes declining personnel resources, it was not realistic to assume that this help could come in the form of an increase in office personnel. The only other viable source of help was the use of data handling equipment of some sort. It is understandable then that most of the comments concerning needs involved the use of a computerized data handling system to help the commissioned personnel division to deal with the increasing workload.

The path towards fulfillment of the discussed needs can be defined by five specific objectives:

- Reduce time needed for data retrieval and information preparation.
- Increase currency of data.
- Aid in monitoring suspense dates.
- Eliminate hard copy records where possible.
- Improve data and information dissemination to field units and NOAA headquarters.

A. REDUCE TIME NEEDED FOR DATA RETRIEVAL AND INFORMATION PREPARATION

Data retrieval efforts in NC1 were mainly concerned with answering specific questions concerning an officer's current

status or history, maintaining current listings such as the location roster, and compiling reports on a periodic basis. A time savings could be realized in each of these areas with the use of computerized data processing equipment.

Specific inquiries concerning an individual officer could be answered in a fraction of the normal time if the individual doing the retrieval had easy access to a terminal tied to a computer system. Representative examples of possible topics for inquiries included dependent eligibility for Champus, FHA mortgage insurance information, Survivor Benefit Elections for Retired officers, and withholdings for the G.I. Bill educational program.[6] The data items pertaining to these topics are presented in Appendix A. Inquiries need not be limited to these topics only. An interactive computer system, if properly designed, would be able to access any information in the data base.

The time saving that could be realized using an interactive system to retrieve data would be dependent upon the amount of time saved on each inquiry and the number of inquiries performed.

In an attempt to determine the extent of possible time savings that could be realized by automating the retrieval and processing of lists and reports, a short data analysis was performed. Initial research identified ten existing listings and reports that were generated from data in an officer's personnel records. These listings and reports are shown below with comments on their periods of updating:

1. Retired List (maintained current, published yearly)

2. Roster (maintained current, published yearly)
3. Location Roster (maintained current, published yearly)
4. Sea/Shore/Mobile Printout (updated weekly OAB)
5. OPB Report (updated yearly)
6. Promotion Zone Report (continuous)
7. Approved Assignment Changes (published monthly)
8. Change of Location Roster (published monthly)
9. Man-Day Count (maintained current, reported yearly)
10. Resignation/Retirement/Separation Report (on demand).

The contents of these listings and reports are presented in Appendix B. An examination of the data items in each revealed that of the 46 items represented, only 13 were used more than once. Of those 13 items only 5 were used more than twice. The usage rates of the items used more than once are presented in Appendix C. It was apparent from the analysis that redundancy of data items between listings and reports was relatively limited. However, a time savings could be expected in this area which would be a result of less time being needed to physically retrieve and prepare the data. An automated system could generate accurate listings and reports on a moment's notice if the data in storage were accurate and current.

In general the overall time savings that would be realized by converting to an automated data retrieval and information preparation system would be a result of the increased speed of the computer in retrieving information from manual files. It was also very probable that some of

the time saved by increasing the speed of retrieving and processing this data would be needed to input the data into the computer system and ensure that it was both accurate and current. Another likelihood was that increased efficiencies in handling data would result in increased data requirements being placed on NC1. The result of implementing and maintaining an automated system therefore might not be an abundance of extra time for personnel to perform other tasks. The result should, however, be more rapid access to more current information, which could be presented in flexible formats.

B. AID IN MONITORING SUSPENSE DATES

The NOAA Corps personnel office was responsible for monitoring a substantial number of action or suspense dates on or about which different actions had to take place. These dates were monitored using manual methods which required constant vigilance and attention to detail. The following list is fairly representative of the type of dates that had to be accounted for.[8]

Pending detachment and reporting dates.

Date of next longevity pay increase.

Date of next aviation career incentive pay increase.

Promotion eligibility date.

Date of next uniform allowance.

Date of expiration of flag officers warrant.

Champus eligibility dates for dependents.

Temporary disability retirement dates (physicals, completion of five years)

For the most part these dates were computed using other data in the officer's personnel record such as promotion control date and date of entry on duty. It was possible that the computer could be used to compute these suspense dates more accurately and automatically, and produce a daily printout of actions required by NC1. The implementation of a capability such as this would require relatively little additional costs in the form of software development if the base data was already present in a computerized system. The overall benefit of automating this aspect of the personnel system would be time saved in maintaining physical records of suspense dates, time saved in searching records for pending dates, and increased effectiveness in monitoring these dates.

C. INCREASED CURRENCY OF DATA

The NOAA Corps personnel information system involved a number of periodic inputs of information, primarily forms submitted by individual officers. In many instances, the timely arrival of this information was relatively important, not only to the personnel office but to the advisory boards, upper management, and the officers themselves. Inherent communication problems involved with a group of such widely scattered and sometimes isolated individuals oftentimes encouraged or allowed late submittal or non-submittal of some required information.

It was felt by some NC1 personnel that an automated tickler system involving at least the following items would be helpful in monitoring late or non-submittals and issuing reminders.[8]

*Periodic Physicals (Avaiation Career Incentive Pay Physicals Included)

*Fitness Reports

Record of Emergency Data

*Endorsed PCS Orders

Service Reports

*Receipt of "Final Papers" on Separation

*PCS Travel Questionnaire.

The items marked with an asterisk (*) were due on dates that depended on the occurrence of an initiating action such as a pending PCS transfer and as such might be included under the previously discussed suspense date monitoring system. The items without an asterisk were due at a fixed time each year. Recording the receipt of these items in a computer's data file would be helpful in that current listings and answers to specific inquiries could be generated quite rapidly. Another useful function of the computer would be to generate address labels and print tickler letters.

An alternative to handling the non-asterisked items would be to log them on paper, generate a "tardy" list, gather the mailing address from the presently used source, and print the tickler letters using a newly acquired word processor. Recording the receipt of the forms would be necessary in either case.

If a tickler system were implemented to help increase the currency of the data held by NC1 the use of a computer would save time in generating the tardy list, in listing the necessary addresses and even printing address labels and

tickler letters. The new software needed to generate the tardy list with addresses would be relatively simple to develop.

D. IMPROVE DATA COMMUNICATIONS

This objective concerns creating new procedures for communicating information between NC1 and other parts of the NOAA personnel system. The changing structure and responsibilities of NOAA and the NOAA Corps had created new situations in which the timely communication of data from NC1 was required to effectively manage NOAA Corps resources. New needs that were identified during telephone conversations and interviews with individuals dependent on NC1 for information are listed below:

- Flight Board Report
- Recruiter Report
- Liaison Officer Report (Including Marine Centers)
- Officer Personnel Record Report
- Service Index Report (Need Pending)
- NOAA Uniform Automated Data Processing System for Personnel Management (PERC)

In general these new reports required the collection of little new data. Assuming the current personnel records were automated and data was stored in a data base, the additional work required to communicate this information would be limited to generating a computer printout in the desired format and mailing the hard copy to the users on a

periodic basis. The listings of the data items involved are presented in Appendix D.

The data items listed for these reports were preliminary. Further study with the prospective users should be performed to analyze trade-offs concerning users need to know, the additional effort required to collect new data, and the frequency of report transmittal.

As an alternative to having NC1 generate these reports it might be (depending on system chosen) technically possible and economically justifiable to allow users to access this information in an interactive mode from remote terminals.

1. Flight Board Report

The Flight Board, acting in an advisory capacity, had use for information in monitoring NOAA Corps officers within the flight program. There was little formal exchange of data between the board and NC1.

If the personnel record data items as described in Appendix B were to be entered into a computerized system, the additional effort needed to generate this report would be minimal. Of the nine data items in this record, seven would already be in storage. An additional software program might be needed to completely automate the generation of this report. Two data items would have to be added to the data base. They were, however, items that were already being stored in hard copy form.

2. Recruiting Report

Three full time NOAA recruiters annually visited approximately 100 colleges and universities throughout the country. They were quite often faced with situations in which knowledge of the data listed in Appendix D, Item 2, would be of value in contacting or referring to other NOAA Corps officers. Methods of obtaining this information were often time consuming and the information was often outdated when received.

Additional effort needed to generate this report also would be minimal assuming prior automation of Appendix B items. Of the seven data items required, five would already be recorded. The other two were recorded elsewhere in hard copy form. Another short program would be required to be able to generate the report with very little effort. The additional effort that would be needed consisted of entering the data items initially, requesting system to generate the printout, and mailing the printout.

3. Liaison Officer Report (Including Marine Centers)

The position of liaison officer was relatively new. It essentially was a collateral duty of a designated officer serving in one of NOAA's major line components such as National Marine Fisheries Service, Environmental Research Laboratories, or the National Ocean Survey. The officer was responsible for coordinating NOAA Corps dealings with his respective Main Line Component (MLC).

With the changing role of the NOAA Corps, the numbers of officers in each MLC other than National Ocean Survey were increasing, causing a subsequent increase in the responsibilities of the liaison officers. To adequately meet these responsibilities, the liaison officers needed current information on officers PCSing into his MLC, serving within his MLC, and PSCing to another assignment within or outside his MLC.[5]

Again the generation of this report would require little extra effort on the part of NC1. Of 13 data items listed, seven would already be in the computerized system and the other six were kept in other hard copy records. A new program would be needed to retrieve and print the data in a predetermined format.

4. Officer Personnel Record Report

This report could be used not only to keep the individual officers better informed about the contents of their personnel records, it could also be used to correct errors in each file. The report would consist of all information kept on the automated system which applies to each officer.

The new effort needed from NC1 would be to generate and mail the printout and then make any subsequent changes to the data base. The capability to output such a report would again require a new software program. The end result, however, would be a better informed group and a more accurate data base.

5. Service Index Report

The service index was a personnel evaluation tool devised by John D. Bossler, CDR, NOAA Corps in 1977. The

index was proposed for use by the OPB as an aid in its annual review of the competence and performance factor of each NOAA Corps officer. The use of the system involved the computation of an individual service index from personnel data such as education, experience, service time, and awards.

The service index system as proposed was designed for use with an automated personnel data handling system and, partially because of the absence of such a system, was not implemented. Of the 24 data items needed for the computation, 5 items would already exist in the previously discussed automated data base. Ten items would have to be computed or added at the time of the service index computation and the remainder of the items were kept in hard copy form.

The additional effort that would be required to supply such a service index report would involve keeping current approximately 14 relatively inactive data items, and entering OPB supplied Bias Correctors prior to the computer run which would generate the report. The software that would be required would be somewhat more complicated than ones mentioned previously because of a few computations that would be required.

The benefit of this report would be a relatively current, objective evaluation tool for use by the OPB in performing what had historically been a very complex and laborious task. A detailed description of the service index report is presented in Appendix E.

6. <u>Uniform Automated Data Processing System for Personnel Management (PERC)</u>

The NOAA personnel ADP system, commonly called PERC, was implemented in 1969. It was the result of one of the recommendations of a study conducted by the Office of Management and Organization, Department of Commerce in 1964-1965. The study concluded that adoption of a Department-wide Uniform ADP Personnel Management System would:

a. Result in more effective personnel management.
b. Increase productivity.
c. Improve record quality.
d. Facilitate personnel planning.
e. Result in more accurate and timely personnel reporting.

In 1970 with creation of the NOAA Corps from the ESSA Corps, the administrative support personnel for commissioned officers were separated functionally from the NOAA personnel system. The new office came under the newly established position of Director, NOAA Corps. Since that time, because of the rather large, inherent differences in the personnel serviced by those two systems, the two systems had been operating separately with but two functional lines of communication: Financial data communications necessitated by the fact that the NOAA office retained the payroll check printing function, and personnel data communications necessitated by the obligation to feed the PERC system. These communications were accomplished using basically three manually

prepared documents (NOAA Forms 56-1, 2, 3) and letters of transmittal. The communications are mainly one-way (NC1 to the NOAA finance and personnel officers). The NOAA finance and personnel data processing centers were set up to obtain all information in hard copy. The data was processed in a batch mode with subsequent reports and payroll checks prepared by the computer.[9]

A comparison of the PERC data base with data items kept in NCL files (presented in Appendix F) revealed a rather drastic disparity between the content of the two systems. Data submittals to the PERC system were also analyzed (Appendix F) in an attempt to identify actions that could be improved by the automation of NOAA Corps data base. It was concluded, in light of the methods used by the PERC system in processing data and the wide disparity in the content of the data bases, that any benefit that could be derived from the automation of NC1 personnel files would be limited to computer assisted preparation of hard copy data submittals. It was possible that if data entry methods used for the PERC system were changed to permit direct access of PERC software to the NC1 data and visa versa, considerable time and effort could be saved in transmitting this information. The savings, however, would be in the PERC office, and not in NC1.

The same situation as just described was present in the transmittal of information to the NOAA finance section. Commissioned officers and civilian pay structures have little if anything in common necessitating different forms and different procedures for transmitting the information. If,

however, the financial data input procedures were changed and the financial section's software had access to NOAA Corps financial data, the effort necessary to transmit the data manually could be eliminated. Particular care should understandably be taken in implementing such a system as any foul-ups that would normally be routine could cause a great deal of unrest with the NOAA personnel involved.

E. ELIMINATE MAINTENANCE OF HARD COPY RECORDS WHERE POSSIBLE

The manual data handling system required that considerable time be devoted to maintaining hard copy lists and records. Automating the NC1 data base would reduce the amount of time needed for this maintenance function by not having to manually update redundant information that might be present in several locations. If and when hard copy records and lists would be needed, software programs could generate them in short order via a terminal or line printer in the designated format and they would (or should) contain current information. The following list of records and lists represented an initial attempt to identify possible candidates for computerized storage, maintenance and printing. These records and reports contained data items that were required to be current and were printed on a periodic basis.

Service Record

Sea/Short/Mobile Printout

Roster

Location Roster

Retired List

Address List (Home)

*Recruiter's Report

*Liaison Officer's Report

*Flight Board Report

*Proposed New Reports

VI. SYSTEM DESIGN

A. INTRODUCTION

The purpose of this chapter is to define an automated data management system that is capable of fulfilling the objectives outlined in Chapter V.

B. DEFINITIONS

1. Data Base Management System (DBMS) is a software tool that provides an integrated source of data for multiple users, while presenting different views of the data to different users. It can be characterized as generalized software which provides a single flexible facility for accommodating different data files and operations, while demanding less programming effort than conventional programming languages. It features easy access to the data; facilities for storage and maintenance of large volumes of data; and most importantly, the capability for sharing the data resources among different types of users.

Data Base Management systems range from elementary systems with single record structures, providing rudimentary report formating facilities, to very elaborate systems handling several files with hierarchial structures, performing functions in an on line mode, and having sophisticated query and report-writing capabilities.[26:9]

2. Data Definition Language (DDL) describes the name and type of each data item, as well as the way items are grouped into records. Also the DDL must indicate primary and secondary keys and be able to represent record relationships such as trees and networks.[26:131]

3. Data Manipulation Language (DML) describes the techniques used to process the data base. It tells how the records can be retrieved, replaced, inserted, and detected. It is a high level language that allows the user to communicate with the DBMS using English-like statements.[26:133]

4. Record is a group of data items. Name and SSN would be data items in an officer record.

5. Variable Length Record is a record for which there is no standard length. Computer storage of these records is more complicated than for fixed length records but the ability to store variable length records reduces the amount of storage space that is required for a data base.

6. Repeating Records are records for which there would be more than one occurrence of the same type of information in the same format. For example, a fitness report record would have many occurrences of the same type of information.

7. Application Program refers to a software program that is written to perform a specific function or provide a specific output product such as a list or report.

8. Query is an interrogation/command from the user to the DBMS.

9. On Line is a term referring to a situation in which the subject information is directly accessible to use through terminals when it is required.

10. Operating System is the software which controls and schedules the actions of the computer.

C. GENERAL DESCRIPTIONS AND HARDWARE

An automated system that was adequate for meeting the stated objectives required several capabilities. In order to provide query and real time input and output capabilities the system had to be what is referred to as "on line." Users had to have direct access to the data base via remote terminals. This necessitated that the system also have a remote printing capability such as a line printer and/or teletype and that the data base be stored on a direct access secondary storage medium. The CPU, operating system and core storage of the computer involved had to be capable of outputting data to a magnetic tape storage medium for possible batch processing of historical records at some point in the future. To provide access to the system by different NOAA elements across the U.S., a telecommunications capability had to be provided. In summary, the system was to consist of the following components:

- Computer (Micro, Mini, or Main Frame)
- DBMS (Compatible with computer)

·Terminals (CRT or teletype)

·Line Printer

·Secondary Storage
  Direct Access - Disc Drive
  Sequential Access - Magnetic Tape Drive

·Telecommunications Capability

D. DATA BASE DESIGN

The design of the NOAA Corps data base was a function of two basic factors. They were the determination of which data items should be included and the selection of data and storage structures for the data base.

The determination of which data items should be included proceeded from an analysis of the information flow into and out of NC1. By necessity, this also included the information kept in permanent storage in NC1 files. A more specific account of documents involved in this information flow and storage is listed below. The data included in most of these documents can be found in Appendices A, B, D and F.

Retired List

Roster

Location Roster

Sea/Shore/Mobile Printout

OPB Report

Promotion Zone Report

Approved Assignment Changes Report

PERC Submittals

Change of Location Roster

Man-Day Count

Resignation/Retirement/Separation Report

*Periodic Physicals

*Dependency Certificate

*Fitness Reports

*Record of Emergency Data

*Service Reports

*PCS Travel Orders - Endorsed

**Flight Board Report

**Recruiter Report

**Liaison Officer Report

**Officer Personnel Record Report

**Service Index Report

***Service Record

Information for data items was also collected from interviews and written correspondence with personnel intimately involved with the personnel system (Interviews and Letter References).

It was not felt necessary to include every data item from each source of information in the automated data base. The amount of effort needed to obtain and enter some items of data, coupled with increased storage capacity needed and subsequent longer retrieval times far overshadowed the possible benefit that could be gained from having that information on line.

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*Info. input to NC1
**Proposed new info. outputs from NC1
***Permanent record, updated and held for reference

As presented in this thesis, the author's value judgments were used to define a comprehensive data base that would be useful without being overly demanding. Future evaluations of update and usage rates of these data items should be made to reduce the size of the data base as indicated as any questionable items were resolved in favor of inclusion in the data base.

The second factor involved in defining the data base was the selection of data and storage structures. These two factors are basic evaluation criteria in the selection of a DBMS, however, the data structure is the only factor that must be decided upon prior to designing the data base.

The storage structure is the method that is used to physically store the data on a storage medium. Although the combination of the data and storage structure are important in determining the efficiency with which the DBMS handles information (response time), the selection of a specific storage structure need not be made until the data base is designed. Also, in the case of a relatively small data base such as this, DBMS efficiency is less important than with a large complicated data base since any reasonable scheme for a small data base will yield acceptable search times.

The data structure is the conceptual or symbolic view of the relationship between data items. It determines eventually the procedures by which the computer stores and accesses the data items [25:11-12]. In this situation, because of the nature of the data, two data structures called

tree[1] and network structures allowed the same data base schematic (Fig. 3). This permits great flexibility in the selection of a DBMS because the majority of the DBMS on the market are based on these two structures.[2]

NOAA Corps Data Base Data Structure
Tree/Network

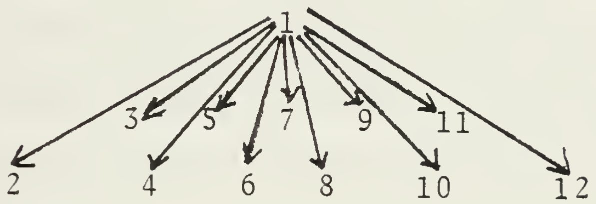

Fig. 3

1. Officer Record
2. Fitness Report Record
3. Education Record
4. Training Record
5. Publications Record
6. Professional Licenses/Qualifications Record
7. Assignment Preference Record
8. Dependents Record
9. Promotion Record
10. Track Record
11. Organizations and Societies Record
12. Assignment Record

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[1]A tree data structure is the most elementary case of network structure.

[2]A detailed understanding of the nature of data structure is not essential in using or understanding the applications of the DBMS. It is important in designing the data records and determining what logical relationships they will have among themselves.

In data structure lingo, record number one is called a parent record and records two through twelve are known as children records. An officer record (1) would exist for each officer in the Corps. Several occurrences of each child record could be stored for each parent. The individual child records therefore were designed to contain related data items that tend to repeat as a group. The DBMS stored and accessed these children groups by way of the parent group or officer record. The officer record was by far the largest record and contained information about the officer that was general and tended not to repeat.

Appendix G is a first cut version of the data items required in parent and child records. Considerable time was spent in an effort to include <u>all reasonable</u> data items that are needed to represent the present and proposed information storage and retrieval needs of NC1. It would be necessary before this data base would be implemented in a system to have the users take a long hard look at each of the data items to determine if the effort needed to maintain the item would be justified by the value of having that piece of data on line.

To aid in determining the storage capabilities that would be needed in a system that could handle the data base, a worst case analysis was performed to estimate the maximum number of characters that would be needed to provide all of the requisite information. These results are presented in Table I. The repeating factors represent the maximum number of occurrences of that record that could be expected to be stored at any time during an officer's career. The final

multiplication factor of 900 officer records is approximately 35% higher than what existed in the personnel system in July 1978. The total number of characters as computed does not take into account storage efficiencies, which depend on the storage structure used, or the required secondary storage space for the software needed to run the system. These factors will vary with the type of hardware and software selected and will raise the amount of storage required. The 13,010,000 characters figure, however, can be used as a basis of determining what size system will be needed. It should be restated here that any questionable data items in the determination of the size of this data base were included in the data base.

In addition to the data base size analysis presented in Table I, a data base content analysis was performed. These results are presented in Table II. This analysis gave a little more insight into the "personality" of the data base.

The characteristics in Table II correspond to those listed for each data item in Appendix G.

Of the 161 data items listed, only 57 (35%) were used for more than one purpose, such as being present in more than one report (excluding the proposed Officer Personnel Record Report and periodic queries). Any judgment on whether or not that figure is too low to realize the advantage from automated handling should depend on the number of times those 57 items are used, the effort necessary to keep them current and the value of having quick access to them.

Another valuable statistic involved characteristic 2, the measure of activity of the data item. It is one measure of

Table I

NOAA Corps Data Base
Size Computations

Record	Characters	Repeative X Factor	Total Characters
1. Officer	2773	1	2,773
2. Fitness Report	84	40	3,360
3. Education	52	4	208
4. Training	93	15	1,395
5. Publications	166	5	830
6. Professional Licenses	75	8	600
7. Assignment Preference	111	5	555
8. Dependents	165	10	1,650
9. Promotion	8	10	80
10. Track	67	15	1,005
11. Organizations & Societies	25	5	125
12. Assignments	75	25	1,875

Characters Needed Per Officer (Worst Case) = 14,456

Number of Officers in Data Base (Worst Case)

200 Applicants
500 Active Duty
200 Retired
900 Officer Records

Data Base Storage Space Needed 14,456
x 900
13,010,000 characters

Table II

NOAA Corps Data Base
Characteristics Analysis

Characteristic	Occurrence
1. Item can be used for more than one report or retrieval.	57
2. Item is active--changes periodically or is part of a repeating record.	109
3. Item can have more than one occurrence within its record (repeating item).	3
4. Item is of variable length.	46
5. Item could be computed from other data base information.	13
TOTAL NUMBER OF DATA ITEMS	161

how much effort will be needed to keep the data base current. In this data base 109 or 68 per cent of the data items would change at least once during a career or were members of a repeating record. Again, determining if that number would require an excessive amount of maintenance effort depends on the number of times the items change and the value of having the items on line.

A low figure for characteristic 3 indicated that the system would not expend significant resources manipulating information to keep track of storage locations for the repeating items. In contrast, characteristic 4--the number of variable length items--does indicate that the system could spend a fair amount of time "housekeeping" or keeping track of physical storage locations depending on the type of storage scheme used. If the storage scheme were one that reserves a fixed amount of storage space for each variable length record, the amount of housekeeping would be low but storage requirements would be high. If the storage scheme is one that conserves storage space by assigning each variable record the exact amount of space needed, the housekeeping would be high. Characteristic 5 is useful in that it points out the number of data items that could be computed and stored by the system itself with little human attention. A software program would be required, however, that could update these items on a periodic basis or on command.

E. METHOD OF OPERATION

1. <u>Status of Officer Record</u>

Buried within the data base in the officer record--data item 19--is an item with an importance far out of proportion to its size. This "Officer Status" item, in essence, would monitor the passage of each particular officer record[1] through its "on-line" life cycle. This life cycle would start when an individual applies for commissioning in the NOAA Corps at which time the word "applicant" would be placed in the Officer Status field and any further, available information would be entered into the system through a terminal. The data base record on that individual would be created at that time.

If that individual is invited to enter the Corps and he accepts, he would obtain a temporary commission and the Officer Status field would be changed to "Active." If that individual is rejected or fails to accept, the Officer Status field would be changed to "Surveyed" which identifies that record as ready for removal from the "on line" system. The records so marked would be removed to magnetic tape by a special program on a periodic basis. These tapes would then be available for "off line" statistical analysis. For applicants in "hold"--not invited, not rejected--the record would remain "on line" for quick access for a pre-specified period of time (e.g., two years).

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[1]Referring to all data stored on each officer.

The record for an officer who enters the Corps would be expanded as that officer's career progressed. During that time the data items would be filled, altered, deleted and accessed as the need arose. It is unlikely that an officer's record as designed would ever be complete. Many of the data items would not be filled for all officers.

In the event the officer resigns his commission or dies, an appropriate code would be entered into the Officer Status field and after a predetermined period of time this record also would be dumped to magnetic tape for future "off line" analysis. At this time the officer's hard copy records would be archived and microfiche transparencies of those records retained at NC1.

The Officer Status field for an officer who retires from active duty would be coded "retired" and at that time most of the final entries would be made in the record. It would not be necessary nor desirable that this record be taken "off line" and dumped to tape until all possible needs for the information have expired (addresses, insurance coverages, dependent's information). The luxury of keeping little used information "on line" would be made possible by drastically decreasing costs of "on line," direct access storage and the relatively few numbers of living retired officers. When the records are no longer needed they would be stored on magnetic tape and the hard copy records archived with microfiche transparencies kept at NC1.

2. Daily Routine

This discussion begins with the assumption that the data base is "on line" and current. The process of implementing the data base will be discussed in Chapter VIII.

During the course of a normal work day in NC1, several actions involving the personnel data base would occur. The initial action would be to obtain from the computer system a listing of suspense dates and tickler dates that pertain to that day or week. The system would be constantly updated throughout the day as data is identified and entered as an addition or change, or a deletion. The task of actually inputting data would be relegated to a few specific people to allow for reasonable control of what goes into the system. All qualified personnel that need access to the data base would be trained in the necessary data retrieval procedures.

It would be advisable to identify which data items change in response to different personnel actions. These listings would not be unlike the change submittals necessary for the PERC system and would be used in updating the needed items in the data base. Judicious use of these lists while entering data would be a big factor in keeping the data base accurate and current. Examples of possible update listing topics are officer application, commissioning, promotion, change of station, resignation, and retirement.

Throughout the day the system would be accessed via the terminal or terminals to obtain specific data items on an officer (e.g., current address), listings of data items

on an officer (e.g., fitness report records), listings of officers with specific data items (all officers who are Ensigns and work in NOS), and pre-programmed reports (e.g., Sea/Shore/Mobile printout). The possible data requests that could be made would be many and varied. The data retrievals would be presented either on a terminal (e.g., cathode ray tube or teletype) or a line printer.

The computer would also be accessed from terminals outside the NC1 office. These other users would be Marine centers, liaison officers, recruiters, and possibly the PERC and NOAA finance offices. The computer software would have the capability of limiting access by any users to data items that are within their need to know.

In the event that the change input procedure to the PERC system had not been changed, the NC1 personnel would be using the computer to help prepare the change inputs to the PERC system. These PERC changes would be prepared only after the required information is updated in the NC1 data base. The operator could then use the NC1 system to provide the appropriate constants and data items from the NC1 data base. He could input the additional items through the terminal and the end result would be a computer printed PERC change submittal.

A portion of the day would also be used to prepare computer generated reports to be distributed to different information users such as the OPB, OAB, Flight and FUT boards.

F. SOFTWARE REQUIREMENTS

The capabilities desired in the previously described automated system could be provided by the use of a data base management system (DBMS) software package. In this application it would be most advantageous to purchase a generalized DBMS off the shelf rather than suffer the expense and time delay that would be necessary to program a DBMS specifically for this application.

A generalized DBMS software package can be regarded as a layer of software which performs user data services. The functions of a generalized DBMS can be identified as follows:

1. It accepts a data definition from the user in what is commonly referred to as a Data Definition Language (DDL). The DDL in essence describes the makeup of the data base and the logical relationships between the data base records.

2. It maps logical data onto the physical storage devices by developing a data organization scheme.

3. It manages the storage space and the data base.

4. It performs data manipulation functions such as retrieval of data for display, retrieval of data for reports, changing data, and deleting data.

5. It provides languages for human interface which usually are either English-like or host language calls (COBOL, FORTRAN, or PL/1) with appropriate linkage to the DBMS.

6. It provides various controls and checks for data validity, integrity, security and privacy, plus various utility programs[28:3].

Figure 4 depicts the functional components of a generalized DBMS. A user defines the data to a DBMS via the provided data definition language. From the raw data and the data definition, the DBMS creates the data base on a physical mass storage device. The data management functions are accomplished by software which translates or interprets user requests to deliver retrieval records or to perform the necessary maintenance activities for the data base.

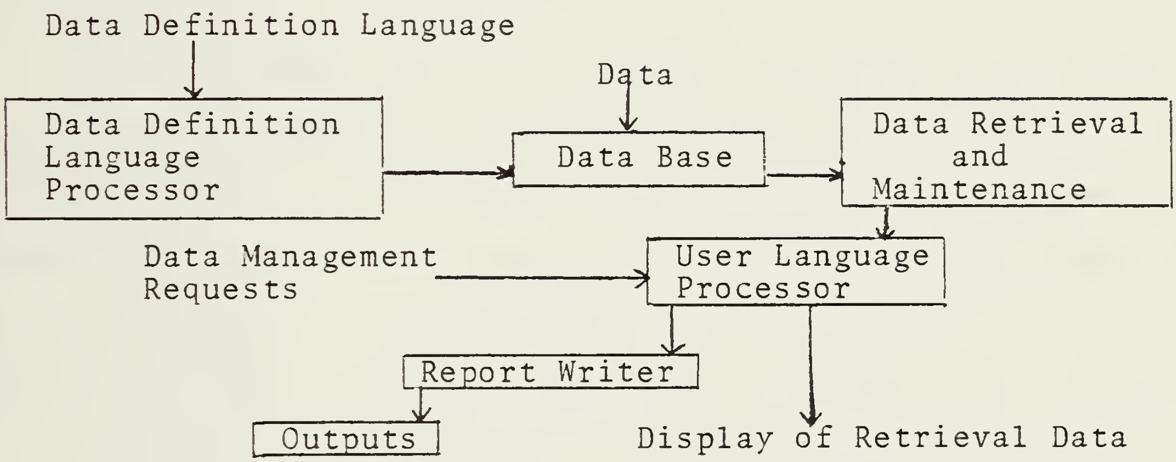

Fig. 4. DBMS Functional Components[28:5]

The big advantage of implementing a DBMS would be that it does not require the user (NC1 office personnel, Marine centers, recruiters, and liaison officers) to know a great deal about the computer system or the structure of the data base. Once the data base is formulated, described to the DBMS via the DDL, and entered into the DBMS, the task of using the system is relatively simple. Using the system on a daily basis would involve two basic functions: updating and retrieving specific information from the data base by the use of an interface language; and retrieving information from the data base by the

use of stored programs which generate reports and listings in pre-determined formats.

To present examples of the update and retrieval of specific information function the capabilities of the DMS 1100-DBMS on the Sperry Univac 1100 Series computer system is presented in Appendix H. The tool used for supplying this function is called the Query Language Processor (QLP). Through this QLP a user may select, retrieve, update, or create data in a DMS 1100 data base.

The second major use of the system on a daily basis would be retrieving information from the data base by means of stored programs which generate reports and listings in pre-determined formats. The operator interaction in this case would be minimal in comparison to the manual system. The operator in this case would merely have to command the computer system to retrieve the proper program from secondary storage and then execute it. The desired reports would be printed automatically on the selected output device. This method of generating reports could be used for virtually all of the reports generated by NC1. The limiting factor here would be the cost of programming each report (and maintaining the software as report content changes over time). Other uses of pre-programmed software would be: to update the data base, including data such as total service and Sea Duty; to output names, addresses, letters and alerts for the tickler and suspense files; and to handle the procedure of dumping excess records to magnetic tape.

G. PERSONNEL REQUIREMENTS/RESPONSIBILITIES

Personnel requirements for a system of this size would fall into three general categories. They are: data base administration, implementation, and operation.

1. Data Base Administration (Data Base Administrator, DBA)

The personnel involved with data base administration would be concerned with ten basic functions:

a. Data Base Definition/Redefinition

The DBA should identify and define common data elements and define the relationships between data elements and other components such as programs, files, and systems. The definition of the data elements and the data relationships should be based on a clear understanding of each participating user community's requirements, as well as the overall organization's needs. Where possible, the DBA would use a data definition language to define the structure of the data base. It would also be within the DBA's purview to define, review and monitor data standards. If the need arises for changing and restructuring the data base, the DBA should initiate this activity, and redefine the database, or any part of it to meet changing requirements.

b. Selection and Procurement

The DBA should participate in the process of evaluation, selection, and procurement of hardware, software, and services related to data base administration.

c. Data Base Design/Redesign

The main design activity would be the design and structuring of the entire data base, taking into consideration the differing needs of the entire user community. This includes design of the data structure as seen by the application community, the storage structure, mapping and search strategies, and access methods, as well as design of support software for creating, maintaining and reorganizing the data base.

d. Data Base Creation

Under this function are included such activities as data collection, data base loading and testing and implementing data definitions and other data base support software.

e. Data Base Security/Integrity

The data base security function is intended to guard against unauthorized access to the data base, and unauthorized update, copying, removal or destruction of any part of the data base. This may be achieved through the use of security locks and keys, etc. Data base integrity is related to the DBA's responsibility for the correctness and accuracy of the data. It can be achieved through the use of validation checks, loggings, dumps, backup and recovery procedures, and auditing procedures. The DBA's responsibility in this area includes access control and security of the data base through the use of measures like password issuance.

f. Data Base Maintenance/Management

The DBA should be responsible for the continued well being of the data base environment. As such, it is his responsibility to maintain and update data base definitions,

data base documentation and data base support software. The DBA should interpret and administer high level management policies related to the data base, and define rules of use and access constraints for the data base.

g. Data Base Performance Monitoring and Evaluation

Responsibilities should include reviewing, testing and evaluting the performance of automated as well as procedural activities; initiation of system improvements when indicated; assessment of the impact of changes; and maintenance of state-of-the-art awareness.

h. Data Base Enforcement

Enforcement activities include determination of compliance with established standard usages and development of data base content, organization, and storage control procedures.

i. Liaison

The DBA should maintain liaison with users, with systems and application analysts, and with organizational management to provide information, assistance and guidance on the use of data base facilities, to detect and correct user problems, and to notify users of changes in system status.

j. Training

The DBA should be responsible for the coordinated training of users, staff and management to develop awareness of data base concepts, and available resources.[27:4,5]

The Data Base Administrator in theory should be involved in virtually all aspects of the data base environment including planning, design, development implementation, testing, documentation, operation, and maintenance. His role

should be characterized as both technical and administrative. There would also be a promotional dimension since he would represent the data base administration concepts and procedures to all participants, coordinate all data base activities among managers, analysts, systems and application programmers, and users. It should be kept in mind that although the tasks in data base administration are performed by more than one person, there should be one person who is charged with the responsibility for coordinating, controlling and directing activities in the data base environment.[27:6]

2. Implementation Personnel

The task of preparing the personnel data for entry into the computer would be an extremely important and tedious task. The appropriate data items must be retrieved from the present manual system for each officer. The data must be placed in a form and format that would allow input into the DBMS. The exact method of entering the data into the system would depend on the hardware and software.

The personnel involved in preparing the data for input into the computer system would most likely be temporary personnel with little knowledge of the personnel system in general. Because of this lack of knowledge and their temporary status, it would be necessary to supervise the people very closely. It would be extremely important that this information be gathered as accurately as possible, and this fact should be constantly stressed to all people involved.

Computerized handling of erroneous information would be worse than having a manual system.

3. Operating Personnel

The personnel (users) required to operate this system could be divided into four main types: parametric user, the non-programmer, the applications programmer, and the data base administrator.

The parametric user would need to know the least about the system. This individual would access the system through a terminal using a set of parameters to invoke a procedure. For example, he might request a current printout of the Sea/Shore/Mobile printout.

The next user in the knowledge hierarchy would be the non-programmer. The term non-programmer does not mean that the individual does not know how to program but that he does no programming in his use of the data base. An example of this user would be an individual who uses the data manipulation language to input or retrieve data from the system. A sample query might be:

LIST OFFICER NAME WHERE RANK = CAPTAIN

In addition, if a required procedure did not exist, the non-programmer should have the capability to design one to meet his needs.

The next user type would be the application programmer/analyst. This individual would manipulate the data base through a high level language, such as COBOL, FORTRAN, etc.

This user should have knowledge of the data structure to properly prepare the programs. He would not necessarily be an employee in the personnel office as this could be contracted out, but it would be beneficial if the person doing the programming had some knowledge of the personnel system.

The final user would be the data base administrator. Because of his responsibility, he should be able to access all parts of the data base.[25:18-19]

H. FURTHER DESIGN CONSIDERATIONS

1. Privacy Act

The Privacy Act of 1974 would have to be taken into account in the final design of this system. The general intent of this legislation is to protect the American people from unauthorized collection, use and dissemination of personal information. In more specific terms this means that institutions can collect only authorized information. The people concerned must have access to knowledge of the records and to the records themselves. Access to and use of those records must be limited to people with a need to know. The data must be accurate. The people must be allowed to correct inaccuracies in that data. Institutions must obtain prior permission from the people concerned before disclosing data to someone without an authorized need to know, and institutions must keep detailed records on the number of disputes and disclosures involved with each individual.

Research on this topic disclosed three general areas that would have to be considered in the design and installation of this automated system:[1] Public notification of a new file, security of data from unauthorized access, and aid in handling Privacy Act administrative procedures.

a. Public Notification

Public notice must be given (in the Federal Register) (1) of any new system of records; (2) of any new routine uses for existing systems of records; and (3) annually for all systems of records.[30:23] Appendix I contains a listing of the types of information needed for public notification. A significant change in the number, type or categories of individuals in the system, or the potential for access to existing records, can trigger the requirement for a new system of records notice.[30:23] Two records systems, NOAA-4 applicants for the NOAA Corps and NOAA-7 Commissioned Officer Official Personnel Folders, would possibly be affected by this requirement. There would be some question as to whether it would be necessary to describe the automated system as a new system or to merely update the information published in the Federal Register describing each system. Initial contact with the NOAA Privacy Act Coordinator indicated that it would be possible to do the latter.[35] Any new systems or changes to old systems should be published before the system is physically started. Approval would have to be

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[1]References 30 through 34 contain a detailed description of the Privacy Act of 1974 and the implications of automation. For the sake of brevity this background information was not presented in detail here.

obtained from the Department of Commerce through the NOAA Privacy Act Coordinator in either case.

b. Security/Integrity of Data

The main concern with data security would be unauthorized access to the data base, for whatever reason. With an automated system of this type, size, and nature of information, the risk of unauthorized access to the data should be relatively light. The system would be relatively small with a limited number of users. The data for the most part would be of little value to anyone without a need-to know. Any interest in seeing the data by an unauthorized user would stem primarily from curiosity.

The above description is important in the determination of how much security would be needed to comply with the intent of the Privacy Act. Privacy act language is intentionally vague in this area leaving the determination of how much is enough to the organization involved. The perceived threat of unauthorized access to the data base would be a big part of that determination.[31]

The intent of the Privay Act has been described as:

> Agencies must maintain and use their personal information records in a manner that ensures fairness to the individuals in question. They must take reasonable precautions against misuse of information, and against use of incorrect or out-of-date information. In particular, they must provide training for employees in the requirements of the Act if those employees will be handling personnel information.... Furthermore, agencies must ensure the confidentiality and security of personal records by <u>establishing appropriate administrative, technical, and physical safeguards against any anticipated breach of confidence or physical integrity</u>. Agencies would also be wise to consult legal counsel regarding certain issues of records use, such as whether the copying of all or

portions of a system of records for internal agency disclosure constitutes itself the creation of a new system of records.[30:21]

In this automated system, therefore, it would be necessary to have a system of physical security measures and controlled accessibility that will adequately protect the data base from accidental or deliberate destruction, disclosure, or modification.

Physical security measures would be relatively straightforward. The computer facility could be located in a safe, limited access location and the data base itself could be periodically dumped to tape or paper and stored in a site separate from the computer facility.

Security measures involving controlled accessibility would be a little more complicated. Controlled access to the computer terminals could be the first step to discourage the unauthorized user. Terminal access control is the procedure for identifying users at both remote and local terminals. These controls include passwords and code numbers, electronically detected identification cards, fingerprints and voice recognition. All of these involve user and terminal identification to the system and then some form of user authentification. By far the most common and easiest to implement would be a password authentication system. It would be available in some form on virtually every on-line system available.

The next step could be directed at the legitimate user who attempts to browse through data outside of his need-to-know. Many DBMS's have the inherent capabilities of

restricting access by an identified user through the data description language used to describe the data base initially. In this way different users are only shown different "pictures" of the data base. This attribute is known as <u>file access control</u>. It can be applied to different levels of data within the file down to access control of individual data elements. File access control can also be used to restrict what a user can do with a file such as read-only, change, purge, and create.[25:63]

The most important step in controlling accessibility, given that terminal and file access control are being used, would be controlling access to the information needed to satisfy these control features. For example it would be useless to restrict different identification numbers to access to only parts of the data base and then allow free access to all identification number information. This step would involve the integrity of the people using the system.

In actuality, there is no such thing as a completely secure computerized information system. The key to the security problem would be the integrity of the overall system. If the hardware, software, and personnel are reliable and secure, the security problem would vanish. Past computer systems have show that hardware is the most reliable and secure of these three since it is the easiest to test. System integrity in any case would be a team effort. If any one of the three would be insecure, the security of the system would be open to failure.[25:66]

It is the opinion of the author that site access, terminal access, and file access controls would provide security for this system that fulfills the intent of the Privacy Act of 1974 given the stated, limited threat of unauthorized access.

c. Privacy Act Administrative Requirements

Full compliance with the Privacy Act of 1974 involves conformance with a substantial number of administrative requirements which can be grouped under five main functional headings:[30:4]

- Collection of information
- Maintenance and use of information (by the maintaining agency)
- Personnel access to and amendment of information
- Non-routine-use and disclosure of information
- Public notice requirements

A DBMS, because of its many data handling characteristics, could be used to aid in performing the many administrative details involved with these requirements.[30] The question that would have to be answered before using the DBMS would be: "Would the additional effort needed to include these procedures in the automated system be greater than the time saved to perform those procedures manually?" The answer to that question would require a detailed analysis of the two types of systems--automated vs manual--and as such could be the subject of another thesis.

2. Complexity of the DBMS

The level of education and training of the personnel who would be operating the system on a day to day basis is of significant importance. The personnel who would be operating this system, with the exception of the data base administrator, would have very little exposure to computer systems in general. They would be the same people who were operating the manual system prior to the appearance of the computer. They could be termed parametric and non-programmer users as described in the personnel requirements section of this chapter. With this in mind it would be necessary to select a DBMS with a data manipulation language and a query logic that is as English-like as possible. As the complexity of the system increases, the probability of the system falling into disuse and failing increases drastically.

3. Accuracy

The automation of this system would increase the opportunity for errors to enter the data base. This would be caused by an increase in the number of times that the data is handled by humans. The possibility would also exist that the data handling hardware and software could introduce errors. At the same time it would be more difficult to detect data errors once they entered the system because automating a system reduces the number of times that operators have visual contact with the data. In light of this situation it would be necessary to place emphasis on preventing errors

from entering the data base and detecting them once they did enter the data base.

There are a wide variety of methods that could be used on various systems to prevent and detect errors.[41] To help prevent gross errors due to mistakes of the terminal operator during input or alteration of data, software could be used to check the input data against predefined limits for each data item. The computer would refuse to accept the data if it exceeded those limits. It would also be advisable to limit the number of users who could input or alter data to a few well-trained individuals. These personnel should be well briefed on the importance of controlling input errors.

Detecting errors when they do creep into the system would be the responsibility of the users of output products of the system, including the officer personnel themselves. Any errors noticed in the system output by these users would be forwarded to the personnel office for immediate correction. The most effective method of detecting errors would be to periodically send to each officer in the system a printout of his entire automated file. Each officer would then be requested to send any necessary corrections to NC1.

4. Current Data

The problem of keeping the data base information current would also be a major consideration in using an automated system such as this. The fact that the errors in this case would be the result of lack of action instead of incorrect action would necessitate some different procedures

to prevent the errors. To help ensure that records are kept as current as possible, a tickler system could be used to keep track of what data is due into the system. A suspense file could be used to keep track of when actions should take place that would require a change to the data base. For the many standard actions that occur with relative frequency, such as transfers and promotions, standard procedures could be established describing which data items should be changed for each action. These lists could be similar to the change submittal forms for the PERC system. Another method of helping maintain current data would be to divide the responsibility of monitoring the data items among the employees. Each employee in the office could be given responsibility for monitoring a predefined set of data items and initiating any updates necessary. The items assigned to each individual would be related to the information that that person would be working with and would be familiar with. Data items which change quite frequently or are relatively important would be given extra consideration. The methods of detecting errors discussed in section three above would also be applicable to detecting outdated data items.

VII. EVALUATION OF ALTERNATIVES

The objective of this chapter is to identify, discuss, and evaluate the decision-maker's alternatives before acquiring an automated personnel system.

A. ALTERNATIVES

In attempting to identify alternative systems by considering different mixes of hardware, software and ownership characteristics, it quickly became apparent that the number of combinations of these characteristics was limitless. It became necessary to consider only general system descriptions for evaluation. Following the general evaluation and selection, it was then possible to consider more detailed evaluation criteria within the winning system. The systems identified for evaluation were as follows:

1. Purchase computer time from a government owned and operated installation;
2. Purchase computer time from a privately owned and operated installation;
3. Purchase and operate entire system;
4. Lease and operate computer and DBMS and operating system software.

B. EVALUATION METHODOLOGY

The evaluation of the generalized alternatives was performed by rating each alternative with respect to six criteria.[44]

Each alternative could be given a possible ten points for each criteria. A high score indicated that the characteristics of that alternative were desirable. The criteria were then grouped into three main categories: cost, effectiveness and disruption. The scores for each category were totaled and multiplied by a weighting factor to reflect the relative importance of each category. These products were then totaled for each alternative to give a score of relative desirability. The highest score was considered the most desirable.

With one exception--telecommunications capability of a micro-computer system in alternatives three and four--it was possible to assume that the capabilities of all four systems were equal.

The weighting factors applied to the category totals represent the author's subjective determination of the relative importance of each category.

C. EVALUATION CRITERIA

In evaluating these four alternative systems, the objective was to consider them in a setting as close to the real world as possible. With this objective in mind the evaluation criteria were selected as follows:

1. Initial Cost of the System

This criterion represented the approximate costs to the user that would be needed to put the hardware and software in place. It was not meant to consider miscellaneous

start-up costs. It was meant to provide a reference point and a relative ordering of the alternatives.

2. Operational and Maintenance Cost of the System

This criterion was needed to provide an idea of what the additional cost to the user would be to operate and maintain the system once installed. The combination of this criterion with criterion one represented the relative costs that would show up as budget expenditures.

3. System Effectiveness

The main purpose of this criterion was to represent the amount of time needed to get the desired information from the system. The rating was a combination of the time and effort needed to get the system on line and the time needed to retrieve the desired information from it once on line. A weighting factor of two was used to increase the effect of this criterion because the overall effectiveness of the system will greatly influence the attitudes and morale of the users and ultimately determine its usefulness and fate.

4. Acquisition Environment

The acquisition environment is directly related to the selection of any government system. The public sector labors under the constraints of well-controlled acquisition regulations. To ignore then would be to leave the real world.

5. Installation and Startup Effort

The beginning of a new system is very important, somewhat like first impressions. It sets the attitudes of the users toward the new system. A transition from old system to new that is complicated and lengthy will also disrupt the effectiveness of personnel system during that time.

6. Operational and Maintenance Effort

The importance of this criterion should not be underestimated. It was included to represent the overall time needed by the office personnel to operate and maintain the system. Large amounts of time could negate any benefits attributable to automating the system.

D. DISCUSSION OF CRITERIA/ALTERNATIVES

1. Initial Cost of System

a. Purchase Time from Other Government Agencies

This effort would require initial outlays for two to five terminals at $2.5K each, one printer for NC1 at $3K,[37] and applications software for five to ten different reports at $15K.[42] Other costs might include additional phone lines for the terminals. All prices are approximate, and vary with the quality and capability of the system. The bottom line was approximately $23K to $30.5K. On a relative basis this alternative is the least expensive and was rated at 10 points.

b. Purchase Time from Private Installation

This alternative was essentially identical to alternative one--10 points.

c. Purchase and Operate Entire System

In collecting the cost data for purchasing an adequate system it became reasonable, because of the rapid rate of advancement of technology in this area, to fix the technology six months in the future and identify the least expensive system. The computer industry is rushing to develop the capabilities of microcomputers and the near future will see extremely versatile, high capacity systems that will be readily available at prices that would seem ridiculously low only one year ago. The software industry is currently developing the necessary software. These systems are well suited for relatively small file management operations such as needed in this case.

There is, however, one small cloud in this optimistic outlook that involves the time sharing, and therefore the telecommunications capabilities, of microcomputer systems. Microcomputers have relatively limited main memory capacity. The main memory storage space needed to accommodate the complex operating system software capable of providing a time sharing function would be excessive and as such would limit the use of a microcomputer system to an in-house, single user mode.

Minicomputer systems, on the other hand, are not as limited by main memory capacity. "Mini's" have been on the market much longer than micros and have been developed

to the point that time sharing is well within their capabilities. They are, however, more sophisticated and more costly.

The following costs are approximate and represent an attempt at identifying the least expensive systems capable of handling a DBMS. The systems would require the terminal, printer and software suite previously described at $23K to $30.5K, a micro or minicomputer system at $13K[1] to $50K[2], a DBMS at $13.5K (TOTAL) to $132K (ADABAS)[3],[45] a tapedrive at $3-5K, and setup costs(+) in excess of alternative one and two for a total of $52.5K to $217.5K+. This alternative was by far the most expensive and as such was rated at 0.

d. Lease and Operate Computer and DBMS + OS Software

This alternative requires the basic suite at $23K to $30.5K, a tape drive at $3-5K, and setup costs in excess of alternatives one and two for a total of $26K to $35.5K+. This alternative was rated at 8 points.[4]

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[1]System includes rack, 74 megabyte disk, dual floppy discs, 48K of RAM, OS65U operating system and one CRT terminal--under $13K. Also, multiple terminal systems with printer and applications software are available in the mid $20K's.[36] The $13K system is predicted to drop to $8K by six months.[37]

[2]Mini-system includes 128KB cpu, cartridge, console, AMLC, OS, FORTRAN & BASIC, 64KB Virtual Memory, hardware memory mgmt, multiuser, multiprogramming; Manufacturer - Prime Computer; major application - time sharing; Make - Prime 300.[39:123]

[3]Complicated software for microcomputers is presently quite limited but there is a lot in the making. The cost of the software would be dependent on what is compatible with the computer and operating system selected, and what capabilities are desired.[38]

[4]This microcomputer option in this aternative is subject to the same limitations as in c. above.

2. Operational and Maintenance Cost of the System

a. Purchase Time from Other Government Agencies

The monthly time cost figure for this alternative was estimated using the figure from alternative b. below. That figure was from a similar type of system contracted to private industry. This figure was established as "relatively higher" than alternative two because of a comment from a government computer system financial manager who said that their computer services and government computer services as a whole were not competitive with commercial systems. The rating of this alternative is complicated when different user perspectives are taken into account. From the perspective of the NOAA Corps, assuming no budgetary increase for ADP services, the funds for purchasing computer time from a NOAA or other government machine would require the use of resources previously used for other purposes. In this case the expenses could be considered as costs and the alternative would be rated at 0 points.

From the prespective of NOAA, assuming that the time is purchased from an existing NOAA machine, the new costs would be zero. The computer rental rates are set to cover the operating costs of the computer center and any increase in revenues from NOAA Corps would be offset by reduced rates to all users. In this case the expenses of the NOAA Corps could not be considered costs and the alternative would be rated at 10 points.

From the perspective of the Federal government, assuming that time is purchased from any existing government

machine, the logic of the NOAA perspective can be used to justify a 10 point rating.

b. Purchase Time from Private Institution

The monthly time cost figure for an application similar to this one was $1300 per month for one port or computer access line.[1] On a relative basis this alternative was given 2 points.

c. Purchase and Operate Entire System

The monthly costs for this alternative were limited to routine maintenance on hardware at approximately $200 per month plus the cost of paper supplies and possibly additional phone lines. This alternative should be by far the least expensive to operate, assuming that the hardware and software is reliable--10 points.

d. Lease and Operate Computer and DBMS & OS Software

Leasing costs for this alternative were estimated because the system exists six months in the future. On a relative basis it should be less expensive than buying main frame CPU time but more expensive than alternative three--7 points.

3. System Effectiveness

a. Purchase Time from Other Government Agencies

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[1] A multiuser contract managed by the NOAA Office of Management and Computer Systems. Uses 1022 DBMS. Does not include telephone rates which could be substantial if used over long distance on commercial lines.

This alternative on a relative basis was given the lowest rating. Unless it would be possible to keep the terminals on line to the computer at all times during the day it would be necessary to re-establish communications each time the automated system is needed. This time would vary considerably. At the very least it would be the time necessary to dial a phone, receive an answer from the computer, and log onto the system (passwords). If the workload on the system is heavy, the time required to receive an answer can be considerable. If the system is down or running a large job for another user, the wait could be indefinite. The average wait time on any particular computer system will depend on the size of the average workload, the number of users with large programs that monopolize the computer's time, and the reliability of the system.

Another effectiveness factor concerns the response time of the system to terminal commands, i.e. how long it takes the computer system to provide the desired results. This time also depends on the current workload of the system. When the computer workload is near capacity the response time can be considerable.

When all of these time delays are considered together, the amount of time wasted trying to communicate with the system can negate much of the time savings realized by implementing a computerized system--5 points.

This would be the only alternative that would have the capability of direct interfacing with the PERC system through a common machine. This would only be the case

if the time were purchased from the same NOAA machine that supports PERC. As stated before this would not necessarily benefit the NC1 office. The benefit would be realized in the PERC office. The level of effort in the NC1 office would have to increase if this interface were attempted, however, this might result in lower total effort for NOAA.

b. Purchase Time from Private Installation

Many of the time delays stated in alternative one above could occur in this case. However, private firms have much greater incentive to provide systems with reasonable hookup and response time. Private firms need the business to survive and as such are more willing to put extra effort into providing a good service to the user--7 points.

c. Purchase and Operate Entire System

In this case the system could be on-line continuously. There would be only one user. The hookup times would be non-existent and the response times because of only one user would be reasonable--10 points.

d. Lease and Operate Computer and DBMS & OS Software

Same as alternative c--10 points.

4. Acquisition Environment

a. Purchase Time from Other Government Agencies

Current policy in NOAA is that use of government owned and operated facilities for a government computer application is highly desirable if the facilities are adequate and available.[40] Current indications are that adequate time

would be available from the Sperry Univac 1100/42 System currently being installed for NOAA--10 points.

b. Purchase Time from Private Installation

Current policy in NOAA is that purchase of time from a private firm is desirable only if government facilities are not adequate and available.[40] The amount of effort needed to purchase time from a private firm if a new contract must be let would be extensive--4 points. It if were possible to add this application to an existing contract such as the one currently administered by the Office of Management and Computer Systems with First Data Corporation, the effort would be minimal--10 points.

c. Purchase and Operate Entire System

Government procurement regulations for ADP equipment are extensive and complicated. Justification for the purchase of the required equipment would have to be submitted through channels to the Office of Management and Budget for approval. The chances of this approval coming in light of discussions under a. and b. above would be very slim--0 points.

d. Lease and Operate Computer and DBMS & OS Software

Same as alternative c. above--0 points.

5. Installation and Startup Effort

a. Purchase Time from Other Government Agency

The installation and startup efforts of this alternative would include buying and installing the peripherals needed to provide input to and out from the system, training

personnel, establishing a working relationship with the computer center personnel, acquiring application software, loading data base and debugging the system--8 points.

b. Purchase Time from Private Installation

This alternative would involve much the same effort as alternative a. above. It would be expected that this situation, however, would result in quicker installation with less effort because of the effect of the competitive environment on the actions of the private firm--10 points.

c. Buy and Operate Entire System

The effort required in this situation would be considerably greater than alternatives a. and b. The additional effort would be needed to buy, install, load and debug the computer and software with limited help from the outside--2 points.

d. Lease and Operate Computer and DBMS & OS Software

This situation would be similar to alternative c. except for increased aid from the firms that leased the hardware and software--4 points.

6. Operational and Maintenance Effort

a. Purchase Time from Other Government Agency

The operational and maintenance effort required for this alternative would be relatively light. The computer system would be operated and maintained by the other agency. The NC1 office would merely have to maintain the application software and the peripheral equipment in the NC1 office--10 points.

b. Purchase Time from Private Installation

The effort in this alternative would be similar to a. above except for the necessity to periodically renew the contract which means substantial procurement effort and a good possibility that a different contractor will be lowest bidder. This would require the additional effort to restart the system with another computer--6 points.

c. Buy and Operate Entire System

The effort needed for this alternative would include maintaining the standard suite of input/output equipment, and operating and maintaining the computer hardware and software. This effort could become considerable, especially if the system has a few problems of a technical nature--2 points.

d. Lease and Operate Computer and DBMS & OS Software

This alternative would be the same as alternative c. above except that the hardware and software should be maintained by the company leasing them--4 points.

The results of this analysis are presented in Tables III and IV. It should be noted that these results were very sensitive to the choice of the evaluation criteria and the weighting factors chosen. For this set of factors and weights the two alternatives that involved purchasing time from large systems had the highest desirability figure. The selection of the most desirable of these two would depend on the perspective used to determine the operating costs for alternative one and on the method of getting a contract for alternative two. The reason that these two stood out from the others is the relative importance placed on the disruption category. If more emphasis

TABLE III

Alternative Evaluation Results

	Alternatives 1	2	3	4
Cost Category				
Initial Cost	10	10	0	8
Ops. & Main. Cost	0-10	2	10	7
Subtotal x1 (weight)	10-20	12	10	15
Effectiveness Category				
System Effectivness	5	7	10	10
Subtotal x2 (weight)	10	14	20	20
Disruption Category				
Acquisition Environment	10	4-10	0	0
Installation & Startup Effort	8	10	2	4
Ops. & Main. Effort	10	6	2	4
Subtotal x1 (weight)	28	20-26	4	8
TOTAL SCORE	48-58	46-52	34	43

TABLE IV

Rank Order of Alternatives

Rank	Alternative	
1.	Purchase Time from Government (1)	48-58
2.	Purchase Time from Private Firm (2)	46-52
3.	Lease and Operate (4)	43
4.	Buy and Operate (3)	34

had been placed on the effectiveness category, alternatives three and four would stand out as most desirable. If it were on initial costs, one and two again would be desirable, and if on operating and maintenance costs, alternative three and possibly alternative one would be the likely choice.

It would be important, therefore, if another individual were to make this decision, that the evaluation criteria, scores and weighting factors, be updated to reflect the priorities in the environment within which that individual works. The evaluation criteria scores should also be updated to reflect changes in computer use policy, procurement regulations and technology.

Having made the selection of the general type of automated system to use for this application the task of selecting a specific system with which to proceed would remain. This discussion assumes that there would be a choice of specific systems and that other circumstances would not dictate which one is to be selected.

In selecting a specific automated system the majority of the effort would be placed on the selection of a DBMS that could provide the services required. The selection of the hardware would be dependent on which DBMS was selected. For alternatives one and two, it would be necessary to consider both of these together, but for alternatives three and four they could be considered separately.

The fact that the number of DBMS's available would be many with numerous and diverse characteristics would again suggest the use of a set of evaluation criteria

in making the selection. Many of these criteria would be technical in nature and of importance only to the Data Base Administrator and the application programmers. A fairly detailed set of these criteria are presented in Appendix J.

VIII. IMPLEMENTATION

The implementation phase of the automated system would not involve complex technical problems. The last of those problems should have been solved in the system design and development phases. The implementation phase would be a time consuming, costly process that would require a high degree of coordination and constant attention to detail. This need for coordination and attention could be aided quite effectively by use of the Critical Path Method (CPM) or Gant Chart Method of project scheduling. The flowchart and lists of estimated task duration and completion times that make up these methods could keep the DBA constantly informed on the progress of the many tasks that would be proceeding at one time. The remainder of this chapter is devoted to the discussion of those implementation tasks.

Because of the relatively small size of this system and limited personnel resources available, it was assumed that the project officer for implementing the system and the Data Base Administrator would be the same individual.

The initial portion of the implementation phase would consist of five major tasks. These tasks would all be under the responsibility of the DBA and could be performed concurrently.

A. Procurement and Installation of Hardware and Software

B. General User Training

C. System Documentation

D. Data Preparation

E. Application Programming

The procurement and installation of hardware and software would require that the DBA have a well-defined set of technical and performance specifications, a working knowledge of Federal procurement policy and regulations, a strong technical background in computer hardware and software and a propensity to work overtime. The efficiency with which the desired system would be purchased and installed would be very sensitive to a shortcoming in any of these areas.

General user training would prepare the office personnel for the conversion to the automated system. With a properly selected DBMS the users should not require a great deal of training on how to use the equipment and the software. This training should also include instruction on the data handling procedures for the manual and automated systems during and after implementation.

Data preparation would involve extracting large volumes of data from the manual files. It would be a tedious job, but a very important one. The individuals involved with preparing this data in a specific format for the computer would most likely be temporary employees who are unfamiliar with the data and the personnel system. If this is the case they should be controlled very carefully.

There would be a time between the beginning of the data preparation task and the changeover to the automated system

during which the concurrent maintenance of both systems would require the use of three separate files. The first file would contain the records of individuals whose requisite data had been transferred to the automated data base coding sheets. The second file would consist of all documents containing data which represents changes to the previously processed records. The third file would be the portion of the manual records that had not yet been processed. Files two and three would be kept current while the data in file number one would be current only to the day it was processed. When all of the records had been processed and the data collected, only two files would exist. File one would represent the data base at a fixed point in the past and file two would contain all of the changes necessary to make that data base current. Because of the volume of data processed daily it would be prudent to keep the time between the beginning of the data preparation task and the changeover to the automated system to a minimum.

When the automated system is brought on line, the data base would be entered into the computer followed by the changes in file two.

The application programming tasks would most likely be contracted to a private firm through the Office of Management and Computer Systems. This would require that the contractors be supplied with detailed descriptions of the software desired and access to the necessary information concerning the DBMS software.

The documentation of the automated system would be a continuing process throughout the entire implementation phase.

The accurate documentation of this system would become very important when the implementation personnel, in particular the DBA, are transferred or otherwise leave the organization. The documentation would include: a management overview and general system description; hardware technical manuals and operating procedures; software source code, operating procedures, and data base description; and system descriptions such as data input procedures, output products and schedules, data flow charts, personnel responsibilities, security features, and backup and restart procedures.

The second portion of the implementation phase would involve the actual conversion from the manual to the automated system. This phase would begin with bringing the hardware and software functions on line and insuring their correct operation. It would then be possible to load a block of test data to test the system for the desired data handling characteristics i.e. errorfree data storage, processing and output. This would also give the users an opportunity to get some hands on training on the system without subjecting the real data base to unnecessary risk.

Subsequent to the system and user testing the next step would be to actually load the data base into the computer system. The method of doing this could vary, depending on the system, from typing everything in via a terminal to placing the data on punched cards or magnetic tape and entering it all at once. Having done this it would again be prudent to test the system for accurate data storage, processing and output.

Assuming that the data base was loaded accurately or that all problems had been resolved, the next step would be to update the data base by entering all of the corrections to the data from file number two. Concurrent with this updating would be the initiation of the data handling procedure for the automated system. These data handling procedures are the methods developed to ensure that all data items in the data base are kept current on a daily basis.

To correct the database for errors that could have entered the system during the data preparation and loading functions or that pre-existed in the manual system, a computer printout of each officer's automated file would be sent to him for auditing. All discrepancies would be checked and the data base updated accordingly. At this stage, the office personnel could convert from the manual to the automated system. This change in state of the system in real terms means that the automated system is current, accurate and ready for access by users. Before dismantling the procedures for updating the manually prepared records and listings careful evaluation of the automated system should be performed to check again the adequacy of the new system in keeping track of all necessary data items. Security procedures for preventing unauthorized access to the data base and for preventing accidental damage to the data base should also be evaluated carefully.

The final step of the second portion of the implementation phase would be to train and incorporate the remote users (Marine Centers, Liaison Officers, Recruiters) into the system.

This second portion of the implementation phase would have the potential for much confusion and wasted effort. A well-scheduled and well-controlled plan of events would be a tremendous asset in accomplishing these tasks efficiently and quickly.

The last portion of the implementation phase would be a continuous one. It would involve the periodic re-evaluation of the entire information system to: locate new information needs that can be supplied by accessing the computerized data base; to identify and remove data items from the computerized system that are no longer needed; and to correct data handling procedures to ensure that the data items are current and accurate.

The implementation of a DBMS can be a long and arduous task, with many problems along the way. Government data base administrators were surveyed with regards to the problems encountered when implementing DBMS's in the public sector.[27] The problems were divided into non-technical and technical categories. The non-technical problems centered around topics such as lack of management commitment, jurisdictional questions, data ownership disputes, power struggles, poor communication, inadequate training, and high costs. The technical problems tended to be specific to each organization.[27:26] A more detailed listing of these problems is presented in Appendix K.

IX. SUMMARY AND CONCLUSIONS

The NOAA Corps personnel system is a small, relatively complex system that exists separate from, but interfaces with, the much larger, civil service oriented NOAA personnel system. Recent increases in the size and responsibilities of the NOAA Corps coupled with a fixed number of employees in the NOAA Corps personnel office have strained that office's ability to function at peak effectiveness.

Research was performed to evaluate the feasibility of converting some aspects of manual data handling procedures to computerized handling with the objective of aiding the office personnel in handling the increasing demands for information and increasing the overall effectiveness of the system. Five specific objectives of implementing an automated system were identified. They were: reduce time needed for data retrieval and information preparation; aid in monitoring suspense dates; increase currency of data; improve data communications; and eliminate maintenance of hard copy records where possible. A search for an automated system that could accomplish these objectives pointed toward the need for a computer system capable of handling a data base management system software package.

The data flow and storage requirements of the manual system were analyzed to identify the data items that could make up an automated data base. The data structure for a

general data base was defined using those data items. The hardware and software characteristics of a general system capable of fulfilling the objectives were defined. A method of operation of the new system was discussed including possible output products, personnel requirements, Privacy Act considerations, complexity, accuracy, and currency.

Having defined what capabilities were needed in a general system, four alternative methods of acquiring those capabilities were chosen and evaluated in relation to six criteria selected by the author. The results of the evaluation indicated a most desirable alternative but emphasis was placed on the fact that other decisionmakers with different priorities might select weighting factors that would produce different results. A separate set of evaluation criteria were provided for use in the selection of a specific data base management system for use as part of the selected alternative. An implementation plan was described for use in getting the system on line.

As a result of the preparation of this study, it is apparent that the automation of the NOAA Corps personnel files is indeed feasible. The technology exists and is available at ever decreasing costs. Strong potential exists for the accomplishment of the five stated objectives in automating the system. Automation of the files would not reduce costs because of increase in workload and services. The only decision variable involving costs would be concerned with how much costs would increase. The possibility of increasing the efficiency of data transfer to the NOAA PERC system by

use of an automated system in the NOAA Corps personnel division would be limited. Time savings realized by the use of a computer to store and process information would be consumed by the effort needed to manipulate the automated system and the new demands for information that would result.

X. RECOMMENDATIONS

As stated in the introduction, the objectives of this thesis were to study the feasibility or desirability of automating some aspects of the NOAA Corps personnel system and to provide the initial planning information for the development of an automated system if the decision were made to automate.

In light of those objectives and the conclusions presented in the previous chapter, it is recommended that serious consideration be given to proceeding with the final design and implementation of an automated system.

If the decision is made to proceed, it is further recommended that an individual with the requisite background be selected as the data base administrator for the final design and implementation of the system. Previous government experience and prudent management theory strongly suggest that if implementation of the new system is to be effective, commitment and support must be given by the highest level management to the data base administrator.[27:31] This commitment and support should be expressed as follows:

> "Authority: The DBA must be given the authority to make decisions and the power to implement any required changes. One of the ways in which this authority could be ensured is to place the DBA very high organizationally."

"Definition of Responsibilities: The DBA's responsibilities must be clearly defined, preferably in a formal document such as a charter. This is essential if later jurisdictional disputes are to be avoided.

Compliance Power: The DBA must be given the power to enforce the rules and regulations associated with the implementation of data base administration concepts.

Resources: The DBA must be given the necessary resources to carry out his function, including staff, time, money, and equipment."[27:31]

Lastly, it is recommended that the final design of the system include a vigorous review of the data items proposed for the automated data base with emphasis on identifying and discarding items which would be used infrequently but would require considerable effort to maintain as current in the automated system. The final design should be sensitive to input from the personnel who will be the users of the system. It is important also that the final design include details of the procedures that would be used to insure that the data input is current and accurate, and that the data output products are timely and conform to the user needs.

APPENDIX A

Representative Inquiry Information

Champus Information - Dependents

Name, Type of Dependent, Date of Birth, SSN, Ethnic Origin, Sex, Address, Whether Member of Other Service, Expiration Date of I.D.Card, Entitlements (Commissary, PX, etc.), Status as Dependent or Survivor.

FHA Mortgage Insurance

Name, SSN, FHA Mortgage, FHA Mortgage Insurance Premium.

Survivor Benefit Election

Name, SSN, Beneficiaries/Percent, Base Amount.

New G.I. Bill Educational Program

Name, SSN, Sex, Original Appointment Date - EOD, Date of Birth, Grade, Marital Status, Education, Service Completion Date, G.I. Bill Witholding and Beginning Date.

APPENDIX B

Contents of Periodic Listings and Reports

Retired List

Name, Grade, Type of Retirement, Date of Retirement, Total Service (years, months, days)(Rank at Retirement), *Federal Employee Group Life Insurance Coverage, *Total Service for retirement pay.

Roster

Name, Lineal Number, Rank, Original Appointment Date - EOD, Date of Rank, Control Date Promotion, Control Date - Pay Purposes, Control Date - Active Service

Location Roster

Name, Lineal Number, Routing Code, Present Assignment Reporting Date, Date of Last Organization Code Change, Pending Report Date, Present Assignment Duties, Pending Assignment, Present Assignment Schedule Report Date.

Sea/Shore/Mobile

Name, Rank, Lineal Number, Sea Duty, Shore Duty, Mobile Duty, Education (Bachelors, Masters, Doctor - Discipline), Routing Code, Present Assignment, Present Assignment Reporting Date Pending Assignment, Pending Detachment Date, Assignment Review Date, Professional Licenses (Discipline, Sea, Flight), Present Duty Type (Sea, Shore, Mobile), Training Class.

OPB Report

Name, Rank, Type of Action (Commendation, disciplinary), Date of Action, Source of Action, Promotion Control Date Adjustment-Direction, Promotion Control Date Adjustment-Amount.

Promotion Zone Report

Name, Lineal Number, Rank, Control Date - Promotion, Promotion Zone.

*Not Published
Data items underlined were used in more than one report.

APPENDIX B (con't)

Approved Assignment Changes
Name, Rank, Present Assignment, Pending Assignment, Pending Reporting Date.

Change of Location Roster
Name, Rank, Past Assignment, Present Assignment, Present Assignment Reporting Date.

Man Day Count
Name, Rank, First Day of Duty FYXX, Last Day of Duty FYXX, Number of days onboard.

Resignation/Retirement/Separation Report
Name, SSN, Grade, Pay Step, Date of Rank, Present Assignment, Present MLC, Routing Code, Present Organization Code, Original Appointment Date - EOD, Home of Record, Total Service (Years, Months, Days), Education (Bachelor, Masters, Doctor - Discipline), Training, Publications, Track Record, SGLI Election.

APPENDIX C

Data Item Usage Rates In Present NC1 Listings and Reports

	Date Item	Usage Rate
1.	Name	10
2.	Rank	7
3.	Lineal Number	4
4.	Grade	2
5.	Total Service (years, months, days)	2
6.	Original Appointment Date	2
7.	Date of Rank	2
8.	Control Date - Promotion	2
9.	Routing Code	3
10.	Present Assignment Reporting Date	3
11.	Pending Assignment	3
12.	Pending Report Date	2
13.	Education	2

APPENDIX D

New Reports - Data Items

1. Flight Board Report

Name, Lineal Number, Rank, Education Professional Licenses,.Control Date - Active Service, Aviation Service Date for ACIP, Present ACIP Gate, Present Assignment.

2. Recruiter Reprt

Name, Rank, Routing Code, Present Assignment, Education, Present MLC, Present Phone Number - Work.

3. Liason Officer Report (Including Marine Centers)

Name, SSN, Employee Number, Rank, Pay Step, Date of Next Longevity Increase, Promotion Eligibility Date, Present Assignment, Present Organization Code, Date of Last Organization Code Change, Assignment Review Date, Pending Detachment Date.

4. Officer Personnel Record Report

This Report would consist of a printout of all data held in a computerized Data Base.

5. Service Index Report

Name, Rank,*Competence Quotient, *Cumulative Fitness Report Average, *Bias Correction, Undergraduate Degree, (Latest) Grade Point Average, Graduate Degree (Latest) Grade Point Average, *Experience Credit, *Awards Credit, *Service Credit, *Sea Duty, *Shore Duty, *Mobile Duty, Months of Prior Active Duty Commissioned Service, Months of Prior Active Duty Enlisted Service, Number of DOC,Gold Medals, Number of DOC Silver Medals/Colbert Awards, Number of DOC Bronze Medals/Karo Awards, Number of USC & GS Meritorious Service Awards and/or USC & GS Commendation Medals, Number of NOAA Special Achievement Awards and/or ACO Annual Awards, Number of Unit Citations Shared, Months of NOAA/USC & GS Active Duty Service, Months of Advanced Standing Granted to Date, *Service Index.

*Data items that are underlined are redundant with items already stored in personnel listings and reports

APPENDIX E

SERVICE INDEX - MEASURE OF GROWTH POTENTIAL FOR NOAA CORPS OFFICERS

9 September 1977 - Revised 20 September 1977

Commander John D. Bossler, NOAA

1. Background:

Commissioned officers of the NOAA Corps serving in the grades O-1 through O-6 occupy positions on a lineal list according to their grade and seniority. The number of officers in each grade is limited to a specific percentage of the total authorized NOAA Corps strength (NOAA Directive 56-40). When vacancies occur, qualified officers are selected for promotion to the next higher grade from a promotion zone which embraces a specific number of the most senior officers in each grade (NOAA Directive 56-46). For promotion purposes, seniority is defined by the officer's position on the lineal list.

Officers are initially placed on the lineal list according to any advanced standing (months of service credit) which they may have been granted at the discretion of the Officer Personnel Board (OPB) upon their appointment. Officers who are not eligible for advanced standing are added at the end of the lineal list in the order of their class standing upon graduation from the Officer Training Center.

Each officer's performance is reviewed annually by the OPB for the purpose of granting additional advanced standing (progression on the lineal list) to those officers who have been identified as exceptionally well qualified and exceptionally well motivated, as well as to impose "loss of lineal numbers" (regression on the lineal list) in the case of those officers whose performance is deemed to be unsatisfactory. The review is accomplished within each grade-group by comparing every officer's performance to that of his peers. The purpose of the service index described herein is to provide a quantitative indicator of an officer's growth potential - in terms of both his competence and his performance - to be used as an initial guide in this review process.

2. The Service Index:

The service index (SI) is a numerical indicator of an officer's growth potential computed as the product of two factors - one reflecting the officer's level of competence and the other his level of performance:

$$SI = \text{Service Index} = (\text{Competence Factor})(\text{Peformance Factor}) = CQ(FR + BC)$$

The performance factor FR+BC consists of the familiar cumulative fitness report average (FR) to which a subjective bias correction (BC) may be applied by the OPB. This bias correction is intended to remove obvious rater bias in the case of those individual officers who possess only a small number of fitness reports, all or most of which having been rendered by a rater or raters known to the OPB to be either excessively lenient or excessively strict in their rating styles. In the normal case (when no rater bias is evident), the bias correction is zero.

Experience will show whether or not the use of this bias correction is necessary and meaningful. In any case, a bias correction should be applied on a one-time basis only; i.e., in subsequent annual reviews, a different bias correction (preferably BC=0.00) should be assigned at the discretion of the OPB.

3. The Competence Quotient:

The use of a factor reflecting competence is a new concept which will require a detailed explanation. The quantity selected for this purpose is the competence quotient (CQ) which is analogous in principle to the well-known intelligence quotient (IQ) and has a similar numerical range (typically 0.5 to 1.5). The intelligence quotient is a measure of intelligence (mental age) divided by a normalizing quantity (chronological age). Similarly, the competence quotient is a measure of competence divided by a normalizing quantity:

$$CQ = \text{Competence Quotient} = \frac{\text{Measure of Competence}}{\text{Normalizing Quantity}} = \frac{ED + EX + AW}{SC + 6.00}$$

Let us first examine the normalizing quantity SC+6.00. It consists of the service credit (SC) in years (total NOAA/USC&GS active-duty service plus all advanced standing granted to date) augmented by six units - this increment is necessary because a fully-qualified officer with N years of service credit is expected to possess at least N+6 units of competence.

For the measure of competence, the sum of three numerical quantities was chosen. They are, respectively, the education credit (ED) reflecting the officer's academic achievement, the experience credit (EX) reflecting the officer's relevant service experience, and the awards credit (AW) reflecting the officer's professional achievement as recognized by the receipt of certain specific awards. These three contributors to an officer's measure of competence will be considered separately in sections 4, 5, and 6.

4. Education Credit:

Academic achievement at the undergraduate level is reflected by the undergraduate degree grade-point average (UD) which may vary from 2.00 to 4.00. Academic achievement at the graduate level is reflected by the graduate degree grade-point average (GD) which may vary from 3.00 to 4.00 (note, however, that GD=0.00 for officers with no graduate degree). Education credit is given at the rate of 1 to 1 for (the latest) undergraduate degree and at the rate of ½ to 1 for (the latest) graduate degree. The units of education credit are points. In terms of a formula:

$$\begin{aligned} ED = \text{Education Credit} &= 1.0(\text{Undergraduate Degree Grade-Point Average}) \\ &+ 0.5(\text{Graduate Degree Grade-Point Average}) \\ &= UD + GD/2.00 \end{aligned}$$

5. Experience Credit:

The experience credit consists of credit given for certain specific types of NOAA/USC&GS active-duty service and for prior active-duty service in other uniformed services. The units of experience credit are years. Officers accrue experience credit at the rate of 2 to 1 for NOAA/USC&GS sea duty (1/6 unit for each month), at the rate of 1½ to 1 for NOAA/USC&GS mobile shore duty (1/8 unit for each month), at the rate of 1 to 1 for NOAA/USC&GS fixed shore duty and for prior active-duty commissioned service (1/12 unit for each month), and at the rate of ½ to 1 for prior active-duty enlisted service (1/24 unit for each month). In terms of a formula:

EX = Experience Credit = (Months of NOAA/USC&GS Sea Duty)/6
+ (Months of NOAA/USC&GS Mobile Shore Duty)/8
+ (Months of NOAA/USC&GS Fixed Shore Duty)/12
+ (Months of Prior Act-Duty Commis'd Service)/12
+ (Months of Prior Act-Duty Enlisted Service)/24

$$= (2.0M_{sd}+1.5M_{ms}+M_{fs}+M_{pc}+0.5M_{pe})/12$$

6. Awards Credit:

The awards credit consists of credit given for the receipt of certain specific awards in recognition of outstanding achievement. The units of awards credit are points. Officers accrue awards credit at the rate of 2 points for a DOC Gold Medal, 1½ points for a DOC Silver Medal or for a SAME Colbert Award, 1 point for a DOC Bronze Medal, SAME Karo Award, USC&GS Meritorious Service Medal, USC&GS Commendation Medal, NOAA Special Achievement Award, or ACO Annual Award, and ¼ point for a unit citation shared. In terms of a formula:

AW = Awards Credit = 2.0(Number of DOC Gold Medals)
+ 1.5(Number of DOC Silver Medals and/or Colbert Awards)
+ 1.0(Number of DOC Bronze Medals and/or Karo Awards)
+ 1.0(Number of USC&GS Meritorious Service Medals and/or USC&GS Commendation Medals)
+ 1.0(Number of NOAA Special Achievement Awards and/or ACO Annual Awards)
+0.25(Number of Unit Citations Shared)

$$= 2.0N_{gm}+1.5N_{sm}+N_{bm}+N_{mc}+N_{aa}+0.25N_{uc}$$

7. Service Credit:

The quantity called service credit, which appears in the denominator of the competence quotient, has already been defined parenthetically in section 3. To reiterate, service credit is the sum of the total NOAA/USC&GS active-duty service time (commissioned service as well as deck officer and junior engineer service) and of the cumulative advanced standing time granted to date. The units of service credit are years. In terms of a formula:

SC = Service Credit = (Months of NOAA/USC&GS Active-Duty Service)/12
+ (Months of Advanced Standing Granted to Date)/12

$$= (M_{ad}+M_{as})/12$$

8. Use of the Service Index:

The use of the service index presupposes that all the necessary input parameters are available in computer-readable form for all NOAA Corps officers. After the initial data-automation effort, the following actions could take place on an annual basis:

a. Fitness reports and service reports are received at NC1 NLT 31 December.

b. Each officer's records are updated by NC1. Automatically produced summary sheets of service index input parameters are mailed (with appropriate Privacy Act safeguards) to the individual officers NLT 15 January.

c. Reviewed summary sheets are returned to NC1 NLT 15 February.

d. Errors and omissions are validated, corrected, and the corrections are verified by NC1. Preliminary service index listing (a computer run) is provided to OPB NLT 1 March.

e. OPB examines cumulative fitness report averages in each grade group, assigns bias corrections as appropriate, and the final service index listing is produced (one computer run).

f. Within each grade group, officers flagged as having service index higher than the group mean plus standard deviation are considered as candidates for advanced standing, and officers flagged as having service index lower than the group mean minus standard deviation are considered as candidates for adverse action.

The service index is intended to function as a labor-saving device which provides initial guidance in the annual review process. It does not preclude the consideration of any other officer on the lineal list for advanced standing or adverse action at the discretion of the OPB.

9. Formulation Summary:

A comprehensive formulation summary for the computation of the service index is given on the following page.

SERVICE INDEX (SI): $SI = CQ(FR + BC)$

where: CQ = Competence Quotient (see below)
FR = Cumulative Fitness Report Average
BC = Bias Correction (subjective, applied by the Officer Personnel Board in those instances when an officer does not have fitness reports by a sufficient number of raters to average out rater bias - BC = 0.00 when no rater bias is evident).

COMPETENCE QUOTIENT (CQ): $CQ = (UD + GD/2.00 + EX + AW)/(SC + 6.00)$

where: UD = Undergraduate Degree (latest) Grade-Point Average (GPA)
GD = Graduate Degree (latest) Grade-Point Average (GPA)
EX = Experience Credit (see below)
AW = Awards Credit (see below)
SC = Service Credit (see below)

EXPERIENCE CREDIT (EX) $EX = (2.0M_{sd}+1.5M_{ms}+M_{fs}+M_{pc}+0.5M_{pe})/12.00$

where: M_{sd}= Months of NOAA/USC&GS Sea Duty . . . . . . (Weight 2.0)
M_{ms}= Months of NOAA/USC&GS Mobile Shore Duty . (Weight 1.5)
M_{fs}= Months of NOAA/USC&GS Fixed Shore Duty . . (Weight 1.0)
M_{pc}= Months of Prior Act-Duty Commis'd Service (Weight 1.0)
M_{pe}= Months of Prior Act-Duty Enlisted Service (Weight 0.5)

AWARDS CREDIT (AW) $AW = 2.0N_{gm}+1.5N_{sm}+N_{bm}+N_{mc}+N_{aa}+0.5N_{uc}$

where: N_{gm}= Number of DOC Gold Medals . . . . (Weight 2.0)
N_{sm}= Number of DOC Silver Medals/Colbert Awards (Weight 1.5)
N_{bm}= Number of DOC Bronze Medals/Karo Awards . (Weight 1.0)
N_{mc}= Number of USC&GS Meritorious Service Medals and/or USC&GS Commendation Medals . . . (Weight 1.0)
N_{aa}= Number of NOAA Special Achievement Awards and/or ACO Annual Awards . . . . (Weight 1.0)
N_{uc}= Number of Unit Citations Shared . . . . . (Weight 0.5)

SERVICE CREDIT (SC): $SC = (M_{ad}+M_{as})/12.00$

where: M_{ad}= Months of NOAA/USC&GS Active-Duty Service
M_{as}= Months of Advanced Standing Granted to Date

APPENDIX F

PERC System

APPENDIX F

PERC System

The first section of this appendix is a direct comparison of the PERC and NC1 data bases to determine to what extent the data items were redundant. A high rate of redundancy would seem to indicate that a separate automated system for NC1 was not justifiable. On the other hand, a low rate of redundancy indicates that the automation of NC1 files would be of little help in enhancing the communication of that data from NC1 to PERC. Of the 81 relevant items extracted from the PERC data source document (NOAA form 52-52) only 26 were present in some form or another in NC1 records. An amazing total of 50 of the items were constant for NOAA Corps officers. These items, for the most part, did not change during an officer's career and they were the same values for all officers.

The second section is an analysis of the data items required to submit changes to the PERC data base. This analysis was performed to develop a picture of the data items required for each change submittal and to identify the sources of the data to be used.

There were fifteen formal change submittals (NOA Codes) that were made periodically from NC1. Each submittal required different data items to be provided. The codes used most often were 17011 - Excepted Appointment, 72101 - Reassignment, 89700 - Pay Adjustment, and 99999 - Item Change. Approximately 30 to 45 of the change submittals were transmitted from NC1 to the PERC office each month.[10]

As can be seen from the PERC Data Submittals Summary Sheet, an average of 39 percent of the data items on the PERC data change submittals were constant, 31 percent were available from the NC1 records and 30 percent had to be supplied by the individual generating the change submittal. These figures seemed to indicate that automation of the NC1 data base files would result in relatively little time savings in retrieving data from NC1 files for submittal to PERC.

The coding of PERC submittals was accomplished by an individual in the PERC office from source documents transmitted from NC1. The coded sheets were then transferred to cards and the changes made in the batch mode. This procedure involved individuals in the NC1 office who generated the changes, an individual in the PERC office who coded the change, an individual in the PERC office who key punched the changes, and an individual to process the cards on the computer. This entire process was tedious and time consuming for everyone involved.

In the future, if the PERC system input procedures are changed to allow direct input from a terminal, considerable time could be saved in this process. The PERC change submittal could be coded on a terminal in the NC1 office with the help of an NC1 automated system. The submittals could then be transferred electronically to the PERC system, possibly through a PERC system employee for verification and error checking. This would almost require that the two data bases be managed by the same computer.

It is difficult to predict how much overall extra effort would be needed in NC1 if this future system were to be installed. Personnel in NC1 would be required to make similar additional changes to the NC1 computerized data base. NC1 would also have to take over the task of coding the change submittals which was formerly being performed by the PERC office. The main benefactor of the new system would be the PERC office.

APPENDIX F

PERC - NC1 DATA COMPARISON

NOAA FORM 52-52 Data Field Number & Nomenclature	NC1 Data Base Nomenclature
4 - Social Security No.	SSN
5 - Sequence Number	
6 - Type of Action	
7 - Name (Last, First, Middle)	Name (Last, First, Middle)
8 - Sex Male Female	Sex
9 - Date of Birth	Date of Birth
10a - (1) Departmental (2) Field	Constant
10b - (1) Sensitive (2) Non-Sensitive	Constant
10c - (1) None (2) Critical (3) Non-Critical	Constant
10d - Schedule (1) None (2) A (3) B (4) C	Constant
10e - (1) Competitive (2) Excepted	Constant
11 - Organization Code	Present Org Code
12 - Position Control No..	
13 - Submitting Office No.	Constant
14 - Action (1) Exempt (2) Non-exempt	Constant
15 - Tenure (1) None (2) Tenure Group 1 (3) Tenure Group 2 (4) Tenure Group 3	Constant
25 - Position Number	Constant
26 - Position Title	Rank
27 - Func. Class	

APPENDIX F (con't)

Data Field Number & Nomenclature	Nomenclature
28 - Schedule	Constant
29 - Classification Series	Constant
30 - Grade	Grade
31 - Step	Step
32 - Pay Basis	
33 - Salary Dollars Cents	Salary
34 - Comp Level	Constant
37 - Authorities Code	Constant
38 - Remarks Code	Constant
39 - Effective Date	
40 - Authentication Date	
41 - Placement Follow Up (1) None (2) 3-months (3) 6-months (4) 9-months (5) College Recruit (6) 4-months	Constant
42 - Citizenship (1) Citizen (2) Non-Citizen (3) Foreign National	Constant
43 - Handicap Code	Constant
44 - Veterans Preference (1) None (2) 5-points (3) 10-points comp. (4) 10-points other	Constant
Retired Military (1) Yes (2) No	Constant
45 - FEGLI (1) Regular (2) Ineligible (3) Waved (4) Regular and Optional (5) SEGLI (15,000) (6) SEGLI (10,000) (7) SEGLI (5,000)	

APPENDIX F (con't)

Data Field Number & Nomenclature	Nomenclature
46 - Retirement Coverage (1) CSC (2) FICA (3) FS (4) None (5) Other (6) Non-Gov.	Constant
47 - Health Plan Code	Constant
48 - Legal Residence	Address (State)
49 - Reserve Status (0) None (1) Ready (2) Stand By	Constant
50 - Special Pay Features	
Post Differentials (1) Yes (2) No	Constant
COLA (1) Yes (2) No	Constant
Saved Pay Indefinite (1) Yes (2) No	Constant
Saved Pay 2 years (1) Yes (2) No	Constant
51 - Post/COLA Differential Percent	Constant
53 - Dates of Lost equivalent increase	Control Date Pay Purposes
54 - Date of Grade	Date of Rank
56 - Date of Appointment Affadavits	Original Appointment Date
57 - Re-employed Annuitant (1) Yes (2) No	Constant
58 - Pay Status (1) Inpay Status (2) LWOP (3) Military	Constant
59 - Performance Ratings (1) Satisfactory (2) Outstanding (3) Unsatisfactory	Constant

APPENDIX F (con't)

Data Field Number & Nomenclature	Nomenclature
60 - Leave Category (0) None (1) 0 to 3 years (2) 3 to 15 years (3) 15 years or over	Constant
61 - Type of Appointment (1) Career (2) Career conditional (3) Taper (4) Indefinite Term (5) Temporary (6) Permanent (7) Conditional (8) Indefinite (9) Temporary	Constant
LIMITATIONS ON APPOINTMENT 62a -Not to Exceed Date (1) Yes (2) No DATE	Constant
62b -Not to Exceed Days (1) Yes (2) No NUMBER OF DAYS	Constant
62c -Not to Exceed Hours (1) Yes (2) No NUMBER OF HOURS	Constant
62d -Salary Limited (1) Yes AMOUNT (2) No	Constant
63 - Service Computation Date For Leave	Original Appointment Date
64 - Service Computation Date for RIF	Original Appointment Date
65 - Entered on Duty Date	Original Appointment Date
67 - Date Assigned to Present Position	Present Assignment Reporting Date
68 - Apportionment (From - State) (To - State)	Constant
69 - Extent of Duty	Constant
70 - Employee Number	Employee Number

APPENDIX F (con't)

Date Field Number & Nomenclature	Nomenclature
71a - Temporary Promotion Code YES NO	
71b - Temporary Promotion - Not to Exceed Date	
71c - Permanent Position Date Schedule Grade Comp. Level	 Constant Grade Constant
74a - Geographic Location - State	Address - State
74b - Geographic Location - City	Address - City
74c - Geographic Location - County	Address - County
75 - Bureau Code	Constant
78 - Security	Constant
79a - Employee on Detail Code ( ) Yes ( ) No ( ) Yes - reimbursable	Constant
80 - Reason for Leaving	Leaving for Resignation
81 - Agencies Gaining Losing	
82 - Severance Pay Yes No/Amount	
83 - Pay Rate Determinate	Constant
84 - CSC Special Program ID	Constant
85 - Work Schedule ( ) Full Time ( ) Part Time ( ) WAE	Constant
86 - DOC Special Program ID	Constant
87 - NOAA Special Program ID	Constant
88 - Veterans Preference for RIF	Constant
89 - Education Level	Education Record
90 - Year Highest Degree Attained (Yr)	Education Record
91 - Academic Discipline	Education Record

APPENDIX F (con't)

PERC DATA SUBMITTALS

SUMMARY

NOA Code		Total Data Items	1. Constant For Officers	2. From NCl Data Base	3. From Initiator
17011	Excepted Appointment	77	44	18	15
30020	Retirement - Mandatory	11	1	3	7
30120	Retirement - Disability	11	1	3	7
20220	Retirement - Voluntary	10	1	3	6
31720	Resignation	10	1	3	6
35030	Death	11	1	3	7
70201	Promotion	32	17	10	5
70202	Promotion - Permanent	11	3	3	5
70203	Promotion - Temporary	30	13	9	8
71301	Change to Lower Grade	28	11	11	6
72101	Reassignment	26	10	11	5
79200	Change in Duty Station	22	12	6	5
72102	Reassignment - Permanent	9	1	3	5
89400	Pay Adjustment	20	6	10	4
99999	Item Change	Variable			
	TOTAL	308	122	96	91

1. Number of data items in the PERC data submittal that are constant for all NOAA officers.
2. Number of data items in the PERC data submittal that can be provided from the projected NCl data base.
3. Number of data items in the PERC data submittal that are supplied by the initiator of the action.

30-45 submittals are made from NCl to the PERC System per month

APPENDIX G

NOAA Corps Data Base - Record Contents

Officer Record

Data Item		Characteristics*	Characters**
1.	Name	1,4	30
2.	SSN	1	9
3.	Date of Birth	1	6
4.	Home of Record (State)	1,2,4	15
5.	Home of Record (City & State)	1,2,4	40
6.	Place of Appointment (City and State)	4	30
7.	Ethnic Origin		3
8.	Place of Birth (City & State)	4	30
9.	Lineal Number	1,2	4
10.	Employee Number	1	5
11.	Marital Status	1,2	10
12.	Date of Last Physical	2	6
13.	Date of Next Physical	2,5	6
14.	Present Address (State & City)	2,4	40
15.	Present Address (State)	1,2,4	15
16.	Home Phone	2	10
17.	Date of Marriage	2,3	18
18.	Place of Marriage (City, State)	2,3	90
19.	Officer Status Applicant Resigned Surveyed Retired Active Deceased	1,2	10
20.	Training Class		3
21.	Sex	1	5
22.	Grade	1,2	2
23.	Step	1,2	2
24,	Salary	1,2	7
25.	SGLI Election	2	8
26.	Control Date - Pay Purposes	1	6
27.	Date of Next Longevity Increase	2,5	6
28.	Aviation Service Date for ACIP	1	6
29.	Control Date - Active Service/ For ACIP	1	6
30.	Present ACIP Gate	1,2,5	6

Data Item	Characteristics*	Characters**
31. Housing Allowance	2,5	6
32. Subsistence	2,5	6
33. Cost of Living Allowance (COLA)	2	6
34. Incentive Pay - Type/ACIP, DIVE	1,2	6
35. Incentive Pay - Amount	2,5	6
36. G.I. Bill withholding	2	6
37. Date G.I. Bill Withholding Began	2	6
38. FHA Mortgage Amount	2	9
39. FHA Mortgage Premium (NOAA-5%)	2,5	6
40. Original Appointment Date	1	6
41. Date of Rank	1,2	6
42. Control Date - Promotion	1,2	6
43. Promotion Eligibility Date	2,5	6
44. Rank	1,2,4	25
45. Corps Application Number		6
46. Date Application Received		6
47. Recruiting Area	4	10
48. Disposition of Application I - July - 73=Invited for July 1973 OTC I - No - OTC = Invited not to attend OTC W = Withdrawn by Applicant R = Rejected NPQ-= Not Physically Qualified	4	10
49. Date Available for Commissioning		6
50. Interviewer	1,4	30
51. Critical Need Index (CNI)		3
52. Interviewer's Recommendations (IR)	4	100
53. Reference Score (Average-on reference letters)		4
54. Master Mark (MM - Determined by NC1)		4
55. Strong Vocational Interest Blank Score (SVIB)		4
56. Prior Service	4	20
57. Prior Service Serial Number		10
58. Date Prior Service Began		6
59. Date Prior Service Ended		6
60. Prior Service Duration	4	6
61. Prior Service Highest Grade		2
62. Prior Service Leave Balance Paid		2
63. Present Assignment	4	25
64. Present Work Phone	2	10
65. Present Assignment Duties	4	25
66. Present Organization Code	1,2	6
67. Present Routing Code	1,2	6
68. Present Assignment Reporting Date	1,2	6
69. Present Assignment Type	1,2	6

Data Item		Characteristic*	Characters**
70.	Present MLC	1,2,4	10
71.	Last Assignment Detachment Date	1,2	6
72.	Sea Duty	1,2,5	3
73.	Shore Duty	1,2,5	3
74.	Mobile Duty	1,2,5	3
75.	Date of last Org. Code Change	2	6
76.	Assignment Review Date	2	6
77.	Pending Assignment	4	25
78.	Pending Detachment Date	1,2	6
79.	Pending Reporting Date	1,2	6
80.	Date Pending Assignment Approved	2	4
81.	Date Pending PCS Orders Signed	2	4
82.	Date Last PCS Orders Endorsed	2	6
83.	Date of Resignation		6
84.	Reason for Resignation (PERC Code)		2
85.	Leave Balance - Paid by NOAA		2
86.	Comments on Resignation	4	200
87.	Grade at Resignation		2
88.	Highest Grade Held Successfully		2
89.	Date of Retirement		6
90.	Type of Retirement		12
91.	Total Service	5	6
92.	Total Service for Retirement Pay	5	6
93.	Reason for Retirement	4	100
94.	Recalled to Active Duty (From/To/As)	4	85
95.	Interned at (City, State)		30
96.	Service Records Remarks	2,4	1000
97.	Survivor Benefit Election (Beneficiaries - Name, Relation Percent)	2,3,4	120
98.	Survivor Benefit Election (Amount)	2	9
99.	Date of Death		6
100.	Disposition of Officer Personnel Records	2,4	150
101.	Rank at Retirement		25
102.	Federal Employees Group Life Insurance	2	7
103.	Statutory Basis for Retirement	4	50
			2773

APPENDIX G (Cont'd)

Fitness Report Record

Data Item	Characteristic *	Characters **
1. Fitness Report Score	1,2	3
2. Fitness Report Date	1,2	6
3. Rating Officer	1,2,4	30
4. Reporting Officer	1,2,4	30
5. Rank	1,2,4	3
6. Assignment (MLC)	1,2	10
7. Length of Reporting Period	1,2	2
		84

Education Record

1. Education Type	1,2	2
2. Education Discipline	1,2	2
3. Education School	1,2,4	25
4. Education State	1,2,4	15
5. Education Year	1,2	2
6. Education Completed (Yes/No)	1,2	3
7. Education Hours Toward Completion	1,2	3
		52

Training Record

1. Course Code & Description	1,2,4	75
2. Completion Date	1,2	6
3. Direct Cost	1,2	4
4. On Duty Hours	1,2	4
5. Non Duty Hours	1,2	4
		93

Publication Record

1. Publication Title	2	75
2. Publication Date	2	6
3. Publication Type (Book, Mag, Paper)	2	10
4. Name of Publication Medium (i.e. Proceedings, Military Engineer)	2	75
		166

APPENDIX G (Cont'd)

Licenses/Qualification Record

Data Item	Characteristics*	Characters**
1. License Type (Professional Sea, Flight, Diver)	1,2,4	10
2. License Name (EIT, 2nd Mate, Pilot)	1,2,4	15
3. Miscellaneous Data (EIT State, Pilot C130 450 hrs, Master unlimited tonnage)	1,2,4	50
		75

Assignment Preference Record

1. Date of Preference	2	6	
2. Source of Preference Data (Letter, Service Report)	2	15	
3. 1st Preference (Class I)	2	15	
4. 2nd Preference (Field Party)	2	15	
5. 3rd Preference (Research Lab)	2	15	
6. Additional Preference (In order of Preference)	2	45	45
		111	

Dependents Record

1. Dependent's Name	2,4	25
2. Type of Dependent (Wive, Son, Mother)	2,4	10
3. Dependent's Date of Birth	2	6
4. Dependent's SSN	2	9
5. Dependent's Ethnic Origin	2	10
6. Dependent's Sex	2	6
7. Dependent's Address	2,4	30
8. Member of Uniformed Services	2	3
9. Expiration Date of I.D. Card	2	6
10. Privilege Entitlements (Commissary, Champus, PX)	2,4	50
11. Dependency Status (Dependent, Survivor)	2	10
		165

Promotion Record

1. Rank	2	2
2. Date of that Rank	2	6
		8

Track Record

Data Item		Characteristic*	Characters**
1.	Type of Action (Award, Citation, Commendation, Medal, Disciplinary)	2,4	15
2.	Date of Action	2	6
3.	Source of Action	2,4	30
4.	Promotion Control Date (PCD) Adjustment (Yes/No)	2,4	3
5.	PCD Adjustment Direction (Forward/Back)	2,4	10
6.	PCD Adjustment Amount	2	3
			67

Organizations and Societies Record

1.	Organization or Society	2,4	25

Assignment Record History

1.	Assignment (RAINIER)	2,4	15
2.	Permanent Station (PMC)	2,4	15
3.	Date Reported	2	6
4.	Date Detached	2	6
5.	Primary Duty (FOO)	2,4	25
6.	Duty Type (Sea/Shore/Mobile)	2	8
			75

*Describes certain characteristics of each data item
1. Item can be used for more than one report or retrieval
2. Item is active - changes periodically or part of

3. Item can have more than one occurrence
4. Item is variable length - conserves storage space
5. Item could be computed from other data base information

**Length of data item - needed to estimate storage needed

APPENDIX H

Data Base Management System DMS 1100
Query Language Processor (QLP) Package
Used on Sperry Univac 1100 Series Computers [29]

1. QLP Capabilities

The Query Language Processor supports six classes of commands. These classes are:

Database Communication (INVOKE, EXIT, HOLD, ROLLBACK, DESCRIBE, RELEASE)

Inquiry (LIST, COUNT, SORT)

Database Update (CREATE, CHANGE, DELETE)

Control (REPEAT, SAME, EDIT, CALL)

Database Structure Operations (FIND, REMOVE, INSERT)

QLP/User Interface (DEFINE, PURGE, FORMAT, PRINT, OUTPUT, USE, BUILD)

Data Selection Clauses (WHERE)

2. QLP Command Formats

The general format of a QLP command is:

Action clause WHERE clause

The WHERE clause specifies the criteria to be imposed upon the DMS 1100 database for the purpose of the action clause processing. The WHERE clause may or may not appear depending on the type of action clause.

3. Representative QLP Commands

Commands	Description
LIST - -	Provides the user with the values of the data items requested from the portion of the data base established by the WHERE clause.

Commands	Description
	LIST OFFICERS WHERE ORG CODE = A32000 AND RANK = LIEUTENANT COMMANDER AND SEX = FEMALE AND RATING OFFICER = JOHN AND FIT REP>90.
COUNT - -	Tallies the number of occurrences of the data items specified in the count command action clause. COUNT OFFICERS WHERE FIT REP AVG > 95 AND RANK = LTJG AND MLC = NMFS.
SORT - -	Causes output for a LIST or BUILD command to be ordered in a sorted fashion. The items outputted may be sorted in ascending or descending order. ...SORTED ON LINEAL NUMBER
CREATE - -	Introduces a new record into the database at the point of organization determined by the WHERE clause. CREATE FITNESS REPORT RECORD WITH FIT REP SCORE = 80 WHERE OFFICER; EQUALS JOHN SMITH
CHANGE - -	Modifies as specified the data items listed in the action clause in those records established by the WHERE clause. CHANGE MARRIED EQUALS YES WHERE OFFICER = ALAN PICKRELL
DELETE - -	Removes a specific record from the data base. The data removed is established by the WHERE clause. DELETE ASSIGNMENT PREFERENCE WHERE OFFICER = JOHN DOE AND DATE OF PREFERENCE = 040474
REPEAT - -	Executes the previous action clause with a new WHERE clause, thus establishing a different selection criteria for the previous processing command. REPEAT WHERE OFFICER = JOHN DOE AND DATE OF PREFERENCE = 080274
SAME - -	Used to signify, following the WHERE conditional conjunction, that the data selection criteria specified on the previous command is to be applied to the current command. LIST FIT REP SCORE WHERE SAME

Commands	Description
EDIT - -	Causes the previously issued command to be modified in the manner specified. EDIT FIT REP SCORE TO REPORTING OFFICER
OUTPUT - -	Defines the output for subsequent queries as either a demand terminal or an onsite printer. OUTPUT TO PRINTER
BUILD - -	Causes a file of data items to be built from the portion of the database established by the WHERE clause. BUILD COBOL FILE SESHMO ON DISC FROM NAME RANK LINEAL NUMBER SEA DUTY SHORE DUTY MOBILE DUTY PRESENT ASSIGNMENT SORTED ON LINEAL NUMBER WHERE MLC = NOS
FORMAT - -	Establishes a tabular output format for later use in a LIST or BUILD command. FORMAT SESHMO NAME NAME 2 RANK RANK 30 LINEAL NUMBER NUMBER 35 SEA DUTY SEA 39 SHORT DUTY SHORE 44 MOBILE DUTY MOBILE 49 PRESENT ASSIGNMENT ASSIGNMENT 54 Numbers 2, 30, 35, 39, 44, 49, and 54 refer to beginning column position of data in Table.
DEFINE - -	Temporarily saves a QLP command for later use. DEFINE TICKLER LIST OFFICER WHERE FIT REP DTE = 78
SAVE - -	Permanently saves formats or procedures previously established through a DEFINE or FORMAT COMMAND. SAVE TICKLER
PURGE - -	Removes from the QLP system or user catalog a QLP command previously saved there through the save command. PURGE TICKLER
PRINT - -	Returns to the user a display of a QLP command previously established through a DEFINE or SAVE command.

Commands	Description
USE - -	Directs the QLP to save commands in a file specified and established by the user rather than the QLP system save file. USE QLP - COMMANDS FOR SAVE FILE[29]

APPENDIX I[35]

Public Notice Requirements
Privacy Act of 1974
COMMERCE/NOAA

SYSTEM NAME:

SYSTEM LOCATION:

CATEGORIES OF INDIVIDUALS COVERED BY THE SYSTEM:

CATEGORIES OF RECORDS IN THE SYSTEM:

ROUTINE USES OF RECORDS MAINTAINED IN THE SYSTEM, INCLUDING CATEGORIES OF USERS AND THE PURPOSES OF SUCH USES:

POLICIES AND PRACTICES FOR STORING, RETRIEVING, ACCESSING, RETAINING AND DISPOSING OF RECORDS IN THE SYSTEM:

STORAGE:

RETRIEVABILITY:

SAFEGUARDS:

RETENTION AND DISPOSAL:

SYSTEM MANAGER(S) AND ADDRESS:

NOTIFICATION PROCEDURE:

RECORD ACCESS PROCEDURES:

CONTESTING RECORD PROCEDURES:

RECORD SOURCE CATEGORIES:

APPENDIX J

DATA BASE MANAGEMENT SYSTEM
EVALUATION CRITERIA

CRITERIA	DESCRIPTION	WEIGHT
1. FUNCTIONAL CAPABILITIES		
DATA DEFINITION		
Data Relationships	Ability of the data definition language to describe the logical business relationships among data.	
Data Characteristics	Attributes of data being described. (i.e., information about the data's identification, security requirements, physical characteristics, validation rules).	
Data Description Reports	Type and usefulness of reports produced by data description facility.	
Data Dictionary Interface	Data dictionary system that will automatically generate information needed by the DBMS from the description on dictionary.	
Ease of Use - Data Definition Language	User-oriented syntax.	
Multiple Paths Into Data	Multiple keys of retrieval and ordering.	
STORAGE AND RETRIEVAL		
Variable Length Records	Does DBMS support them.	
Data Compaction	Compress out null fields, leading zeros, trailing blanks.	

CRITERIA	DESCRIPTION	WEIGHT
FUNCTIONAL CAPABILITIES (Continued)		
STORAGE AND RETRIEVAL (Continued)		
User Processes	User written programs defined in the data definition language to which the DBMS gives both control and data to: 1) Before the application program receives control (when retrieving) and 2) After the application program has modified data.	
Access Techniques	Different file structures and retrieval techniques. User control over physical aspects of techniques	
Physical Structuring Flexibility	Ability of data administrator to control, through DDL, physical placement of data.	
Usage Statistics	Statistics generated by DBMS that allow data administration to monitor and fine tune DBMS performance.	
Hardware Resources	Hardware required to efficiently operate DBMS.	
Physical Device Support	Does DBMS support data bases on tape, disk, drum, terminals.	
Utility Support (load, inload, reorganization)		

CRITERIA	DESCRIPTION	WEIGHT
FUNCTIONAL CAPABILITIES (Continued)		
STORAGE AND RETRIEVAL (Continued)		
Non-Data Base Support	Can standard (non-database) files be accessed?	
INTEGRITY		
Central Version	• Does the DBMS have a central version that can service requests from multiple programs or does each program run with its own copy of the DBMS. • Is central version single or multi-thread.	
Isolation of Control Info from User	Control info needed by DBMS should not be accessible by user.	
Concurrent Update	• What protection is there against programs trying to modify the same record concurrently. • What level of data base is locked out.	
Deadly Embrace	User A has Rec 1 and wants Rec 2, while User B has Rec 2 and wants Rec 1. Automatically detected?	
Audit	• Characteristics of the audit log - Disk only? - Optiona oefore/after images	

DATA BASE MANAGEMENT SYSTEM
EVALUATION CRITERIA

CRITERIA	DESCRIPTION	WEIGHT
FUNCTIONAL CAPABILITIES (Continued)		
INTEGRITY (Continued)		
Audit	- Update images only? - Ability to turn it on and off.	
Recovery	Recovering integrity of data base after failure.	
Reconstruction	Reconstructuring current status of a data base from a backup copy and audit log.	
Restart	Ability to restart program at some non-beginning of job point.	
Consistency-User Program and Data Def.	Insure that description of data in program is synchronized with description in data definition language.	
SECURITY	• Facilities that help insure against unauthorized access to data base.	
USER ACCESS		
TP Interface	Quality of TP monitors that can communicate with DBMS.	
Report Writer	Report writer that will extract and report from the DB files.	
Processing Flexibility	Scope and power of data manipulation language verbs (i.e., host language interface).	
Subschema access	Ease of invocation of the subschema (does it have to be keypunched in its entirety in the program, or can it be brought in by preprocessor?)	

CRITERIA	DESCRIPTION	WEIGHT
FUNCTIONAL CAPABILITIES (Continued)		
USER ACCESS (Continued)		
Host Languages Supported		
Data Independence	• In what ways does this system allow the application program to be independent of the description of data? • Logical DB, elements, not records returned, JCL.	
Inquiry	• Does a "self-contained" on-line inquiry and update system for unstructured inquiry cost.	
Ease of Use	• Are calls easy to form? • Are calls self-documenting? • Any syntax checking done at compile time. • Error processing. • Preprocessor. • User oriented.	
2. DISTRIBUTED PROCESSING CAPABILITY		
3. TRAINING		
Amount Required to Learn DBMS		
Training Available	Both from vendor and from independent sources.	

CRITERIA	DESCRIPTION	WEIGHT
4. SOFTWARE COST		
DBMS TP Monitor Training Installation Maintenance		
5. SUPPORT REQUIREMENT		
Number of Persons		
Availability of Persons	• Availability of persons with experience	
Installation Effort	• New versions • Updates	
6. DOCUMENTATION	Completeness and accuracy (up-to-date).	
7. UPWARD COMPATIBILITY	Are new versions of system upward compatible?	
8. MACHINE PORTABILITY		
Vendor to Vendor	Run on multiple vendor machines.	
Vendor Product Line	Operating systems independence.	
9. CONVERSION		
To DBMS		
From DBMS	How difficult will conversion to future systems be?	

CRITERIA	DESCRIPTION	WEIGHT
10. VENDOR SUPPORT	• Business position of vendor • Historical support level	
11. SUPPORTING SOFTWARE	What is availability of software to support DBMS?	
12. MATURITY	• How long has system been out? • Debugged.	

APPENDIX K

PROBLEMS ENCOUNTERED IMPLEMENTING DBMS'S [27:25]

Non-Technical Problems

*Lack of commitment to database administration concepts at different management levels;

*Management hesitant to commit manpower and money to internally-oriented, non-visible projects;

*Unreasonable management demands;

*Lack of decision-making power for the DBA;

*Lack of enforcement power for the DBA;

*Unresolved jurisdictional problems, especially when different groups perform database administration tasks;

*Unclear definition of responsibilities of DBA's, analysts, users, and management;

*Frequent reorganization causing instability in control of data;

*Undefined ownership and control of data. especially between users and DBA;

*DBA concepts conflict with service center concepts;

*Failure to establish effective communication lines between DBA's, technical staff, and management;

*Insufficient communication between DBA's and users with respect to data errors and availability of help;

*Decision-making management not knowledgeable in technological state-of-the-art;

*Lack of training and understanding of database concepts and DBMS by users and technical staff.

*Lack of experience in database technology;

*Skepticism with respect to the success of database administration practices;

*Resistance of analysts and programmers to DBA interference;

*Excessive procurement constraints on purchase of hardware, software, and services;

*Inadequate cost-benefit analyses regarding implementing DBMS vs. conventional programming, and in evaluating in-house vs. commercial software.

*High cost of hardware, software, services, technical staff, training, and vendor support;

Technical Problems

*Generalized systems sometimes too general for specific applications; tailored systems sometimes too inflexible for changing needs;

*Commercial software sometimes not available for existing hardware;

*Hardware/software limitations and interface problems;

*Absence of shared databases in spite of DBMS usage;

*DBMS used as a file control mechanism rather than a data base administration tool;

*Inability to assure reliability of data;

*Lack of organizational data standards;

*Poor system and software documentation;

*Too much dependence on vendor support;

*Non-availability of commercial software source code.

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