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A PERFORMANCE MEASUREMENT-BASED COMPANY OFFICER MANAGEMENT INFORMATION SYSTEM PROTOTYPE FOR THE UNITED STATES NAVAL ACADEMY

by

Michael J. Boone,
Terry D. Hagen,
and
William T. Utroska

September 1999

Thesis Co-Advisor:	Walter E. Owen
Thesis Co-Advisor:	Douglas E. Brinkley
Thesis Associate Advisor:	Daniel R. Dolk

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A company officer at the United States Naval Academy (USNA) is tasked with developing midshipmen morally, mentally, physically, and to imbue them with the highest ideals of duty, honor, and loyalty. This task requires increased knowledge on performance measurement and the right tool that will enhance their ability to develop midshipmen into the 21st century. A performance-measurement-based management information system will greatly enhance the company officer's ability to develop, maintain, and use information technology for purposes of performance measurement.

Based on user requirements, this research identifies the key result areas and key indicators, designs, and develops a prototype. The Company Officer Management Information System (COMIS) prototype is developed using Microsoft Access 97, an approved Department of the Navy IT-21 compliant software application.

The findings in this research strongly support the use of the COMIS prototype at the USNA and indicate that future research and future application development will significantly enhance the development of midshipmen well into the 21st century.

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A PERFORMANCE MEASUREMENT-BASED COMPANY OFFICER MANAGEMENT INFORMATION SYSTEM PROTOTYPE FOR THE UNITED STATES NAVAL ACADEMY

Terry D. Hagen
Captain, United States Marine Corps
B.S., United States Naval Academy, 1993

William T. Utroska
Major, United States Army
B.S., University of Puerto Rico, 1989

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

Michael J. Boone
Lieutenant, United States Navy
B.S., United States Naval Academy, 1993

Submitted in partial fulfillment of the
requirements for the degree of

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Authors: Michael J. Boone, Terry D. Hagen, William T. Utroska

Approved by: Douglas E. Brinkley, Thesis Co-Advisor; Walter E. Owen, Thesis Co-Advisor; Daniel R. Dolk, Thesis Associate Advisor

Dan C. Boger, Chairman
Information Systems Academic Group

Reuben T. Harris, Chairman
Department of Systems Management

ABSTRACT

A company officer at the United States Naval Academy (USNA) is tasked with developing midshipmen morally, mentally, physically, and to imbue them with the highest ideals of duty, honor, and loyalty. This task requires increased knowledge on performance measurement and the right tool that will enhance their ability to develop midshipmen into the 21st century. A performance-measurement-based management information system will greatly enhance the company officer's ability to develop, maintain, and use information technology for purposes of performance measurement.

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I. INTRODUCTION

A. BACKGROUND

In 1993 the Government Performance and Results Act (GPRA) was signed by President William Jefferson Clinton as an effort to improve the American public's confidence in the federal government. The GPRA created a long-term goal-setting process to improve federal program effectiveness and public accountability by promoting a new focus on results, service quality, and customer satisfaction. The GPRA made government and federal agencies responsible for developing performance measurement strategies and improving agency results. Agency improvements were based upon their performance measurement findings in order to provide high-quality products and service to the American people. The GPRA, thus, mandated that performance measures become institutionalized and a part of the every day business practices of federal agencies.

Performance measurement is a key element in any successful organization because it provides focus, direction, and a common understanding to all in the organization (Chang and DeYoung, 1995). Furthermore, Chang and DeYoung (1995) say that performance measures provide knowledge for making better decisions and feedback on organizational improvement efforts. Finally, the Oak Ridge Associated Universities (ORAU) imply that performance measures will result in better management and a subsequent improvement in the product (Why Should We Measure Performance, 1999). These ideas are directly applicable to the United States Naval Academy, a federal agency under the Department of Navy.

The Naval Academy's mission focuses on the mental, physical, and moral development of midshipmen.

> NAVAL ACADEMY MISSION STATEMENT: To develop midshipmen morally, mentally, physically and to imbue them with the highest ideals of duty, honor, and loyalty in order to provide graduates who are dedicated to a career of naval service and have potential for future development in mind and character to assume the highest responsibilities of command, citizenship, and government.

While the Naval Academy does not provide a direct service or product that the American taxpayer uses, they do provide an indirect service that benefits and concerns each citizen - national defense. The Naval Academy graduate is a direct input into the Fleet Navy and Marine Corps, thus, the quality of the commissioned officer received by the respective service will impact the ability of our military to conduct its mission.

In an environment where military resources are scarce the officers of our military forces must be better prepared for the complex challenges they face. Currently, no extensive performance measurement tool exists for company officers at USNA as they prepare our nation's future officer corps. Each midshipman is measured subjectively based upon class ranking, quality point rating, the observations of peers, senior enlisted personnel, and company officers.

The company officer at the United States Naval Academy (USNA) is tasked with the development of midshipmen into Naval and Marine Corps officers by providing leadership and guidance. The process is dynamic, complex, unique, and extremely difficult to measure because each midshipman stands at a different stage of development and varying maturity. A standard performance tool with measurements and benchmarks that can be tailored by company officers will provide a more consistent manner in which

to gauge midshipmen development. A performance measurement tool will allow company officers the opportunity to objectively assess the development of midshipmen instead of resorting to crisis management or chance. A standardized tool of user friendly measurements should enhance objectivity in the evaluation of midshipmen and the company overall. Furthermore, it should facilitate continual improvements. This tool will help company officers track important trends in midshipmen and company level performance.

Currently, many databases exist within the current Naval Academy Data Network and the newly established Midshipmen Information Data System (MIDS). These databases provide significant opportunity to centrally locate much of the important data used to measure midshipmen performance. A needs assessment will also provide additional performance measurements that may be used to increase midshipmen performance. The needs assessment will follow the Richard Chang Measurement Linkage model by identifying key result areas and key indicators that are important to company officers.

While conducting introductory interviews to determine the feasibility and need for a performance measurement tool, we ascertained that the current tool is inefficient. No performance measures are consistently used by company officers despite the existence of a current tool. Each midshipman is potentially measured on varying standards with no consistency. A standard performance measurement tool that could consolidate midshipmen data into useful performance information would enhance the company officer's impact on the mental, physical, professional, and moral development of midshipmen.

B. PURPOSE

The purpose of this thesis is to design a Company Officer Management Information System (COMIS) prototype using databases that currently exist in conjunction with a flexible tool for specific company officer analysis in Microsoft Access 97. The main focus of this research is to analyze performance measurements used at the Naval Academy and incorporate these performance measures into a user-friendly performance measurement tool called COMIS. Furthermore, the development of the COMIS prototype will use the latest computer IT-21 compliant technology available at the USNA. This research will entail conducting:

1) a thorough company level needs assessment
2) a requirements analysis
3) the design, development, and testing of the COMIS prototype

The results of this analysis will identify the critical performance measures that company officers need to successfully evaluate midshipmen and the company. These performance measures will serve as the foundation to design, develop, and test the COMIS prototype that will be utilized by the USNA company officer.

C. RESEARCH QUESTIONS

This section identifies the primary research questions.

1. Performance Measurement

Before determining what specific performance measurements are required at the Naval Academy it is imperative that all aspects of performance measurement be

understood. The following questions address performance measurement and are posed along with subsidiary questions specific to the Naval Academy.

- What is performance measurement?
- How do company officers at the USNA conduct performance measurement?
- What are the specific performance measures that are crucial to the company officer?
- What are the specific performance measurements available at the USNA?
- What additional performance measures need to be created at the company officer level?
- How should performance measure features be defined to assist in identifying potential problems or improvements?

2. COMIS Prototype and MIDS

The COMIS prototype will be designed to interface with the MIDS. Before beginning the design phase the following research questions are posed in order to determine interface requirements between the COMIS prototype and MIDS.

- What is the Midshipmen Information Data System (MIDS)?
- What are the current capabilities of the MIDS company officer module?
- What data will be needed from MIDS to design and develop the COMIS prototype?
- What additional data is needed to design and develop the COMIS prototype?
- How will the MIDS data be imported to COMIS prototype?

3. Design Phase

These research questions relate to the design phase of the COMIS prototype. The research questions are posed to identify user interface and data requirements.

- What are the software and hardware requirements?
- What statistics and calculations do the company officer need the COMIS prototype to provide?
- What views, menus, forms and reports will COMIS provide?
- What flexibility is necessary in the COMIS performance measurement tool to allow company level tailoring?
- What documentation and maintenance are necessary?

D. BENEFITS OF STUDY

This study provides a unique opportunity to mesh the knowledge of two different academic fields. First, it provides an opportunity for a systems management student to directly apply performance measurement theory and practice to an existing leadership problem at the Naval Academy. Next, this study allows the chance for two information technology management students to apply IT-21 technology tools resulting in the development of a useful performance measurement system. Ultimately, this study provides an opportunity for the Naval Postgraduate School to have a direct impact on the development of future graduates from the Naval Academy by improving the leadership tools available to company officers.

A good performance measurement tool should facilitate GPRA compliance and continual improvements. This tool will help company officers track important trends in midshipmen and company level performance. The company officer will be proactive in leading and guiding midshipmen on the proper course. Finally, this tool will enhance the company officer's ability to drive continued performance improvement while reducing information overload.

E. SCOPE AND METHODOLOGY

1. Scope

The scope of this thesis is broken down into five phases. The first phase includes a needs assessment utilizing Chang and DeYoung's (1995) Measurement Linkage Model to ascertain performance measures used and needed by company officers at the USNA. This is the first phase in the systems development life cycle. It is known as the problem recognition/preliminary investigation phase and helps define and investigate the current problem.

The second phase consists of a review and analysis of the Midshipmen Information Data System (MIDS) company officer modules current capabilities. This phase is necessary to understand the current system in use along with new system's requirement. This phase is known as the requirement determination phase in the systems development life cycle.

The third phase consists of a review of system requirements/analysis of implementing the COMIS prototype. This is the third phase of the systems development life cycle in which system requirements are translated into design specifications.

The fourth phase entails the logical and physical designs of the COMIS prototype and the translation of these designs into a working prototype. During this phase the actual hardware, software, and programs are generated.

The fifth and final phase consists of the implementation, testing and maintenance of the COMIS prototype. This is the final phase of the systems development life cycle.

In this phase, the prototype is in service, evaluated for effectiveness, and continuously improved.

The end product of the research is a user-friendly prototype that will satisfy the needs of the USNA company officer for evaluating midshipmen. Follow on thesis research will be conducted to maintain and enhance the functionality of the COMIS tool.

2. Methodology

The methodology used in this thesis research consists of the following steps.

- Conduct a literature search of books, magazine articles, CD-ROM systems, and other library information resources on organizational performance measures.
- Conduct a needs assessment to determine key result areas and key indicators for company officers at the USNA using the Richard Chang Measurement Linkage Model.
- Conduct a review of the current capabilities of the MIDS company officer module and examine the physical and software components that comprise the system.
- Prepare a baseline assessment to document hardware components, software components, and functionality of the current MIDS.
- Conduct a visit to the USNA to observe operation and discuss management issues, maintenance issues, equipment requirements, implementation and maintenance costs, and lessons learned.
- Based on needs assessment, determine the critical database information required.
- Determine any additional functionality required for the prototype.
- Identify all potential hardware, software, and compatibility issues.
- Design and develop the COMIS prototype.
- Test and gather user feedback on the COMIS prototype.
- Modify COMIS prototype based on user feedback.

- Identify training requirements for use and maintenance of the COMIS prototype.

F. ORGANIZATION OF STUDY

This study consists of eight chapters describing the steps, actions, and theoretical framework necessary for the development of the COMIS prototype. In Chapter II, a literature review is conducted to establish the framework for the performance measurement analysis conducted using Chang and DeYoung's Measurement Linkage Model. Chapter III specifically lays out the Key Result Area's (KRA's) and their respective key indicators necessary for company officers to properly evaluate the performance of their company. Chapter IV presents a system requirements/analysis of the Midshipmen Information Data System (MIDS), the process models, and the platform considerations that led to the development of the COMIS prototype. Chapters V and VI present the logical and physical designs of the COMIS prototype. Chapter VII presents the implementation and application testing of the COMIS prototype. Finally, Chapter VIII presents the conclusion of this research along with lessons learned. Further recommendations for future research are also enumerated.

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II. LITERATURE REVIEW

A. INTRODUCTION

There are many concepts and ideas related to organizational performance measurement. Most successful organizations have a performance measurement system in place to monitor their performance. The creation of the Government Performance and Results Act established performance measurement as a normal method of conducting business in federal agencies. This section reviews the Government Performance and Results Act while also explaining the importance of performance measurement. Various performance measurement models are introduced and the benefits of each provided. Finally, the role of information technology in performance measurement is discussed.

B. THE GOVERNMENT PERFORMANCE AND RESULT ACT OF 1993

The 103rd Congress enacted the 1993 Government Performance and Result Act (GPRA) and President William Jefferson Clinton signed it into law. The GPRA served to institutionalize performance measures in government agencies. The GPRA requires all Federal agencies to establish strategic plans, and measure the performance of their mission (Arveson, Improving Government Business Processes, 1998, p.1). According to the National Performance Review (Serving the American Public: Best Practices, 1997) the GPRA represents the Federal government's commitment to performance measurement and improved agencies.

The text of the GPRA (The Government and Performance Act of 1993) specifies six purposes for the Act. First, the GPRA is to improve the American people's confidence in the capability of the Federal Government, by systematically holding

Federal agencies accountable for achieving program results (p.1). Second, the GPRA is to initiate program performance reform with a series of pilot projects in setting program goals, measuring program performance against those goals, and reporting publicly on their progress (p.2). Third, the Act is to improve Federal program effectiveness and public accountability by promoting a new focus on results, service quality, and customer service (p.2). Fourth, the Act is to help Federal managers improve service delivery, by requiring that they plan for meeting program objectives and by providing them with information about program results and service quality (p.2). Fifth, the GPRA is to improve congressional decision-making by providing more objective information on achieving statutory objectives, and on the relative effectiveness and efficiency of Federal programs and spending (p.2). Finally, the GPRA will improve internal management of the Federal Government (p.2)

The National Performance Review (Serving the American Public: Best Practices, 1997) establishes the starting point for Federal agencies strategic plans. First, agencies should establish top-level agency goals and objectives. Next, the agency must define how it intends to achieve those goals. Finally, the NPR says the agency must demonstrate how it will measure agency and program performance in achieving its goals.

The NPR (Serving the American Public: Best Practices, 1997) further purports that the GPRA may mean a dramatic shift in the focus and approach of most agencies. The agencies must now focus on outcomes rather than inputs and outputs. Furthermore, the GPRA holds managers accountable for reaching identified goals. These are fundamental shifts in the way that government has typically operated meaning that many agencies will be required to rearrange their paradigms for success in the future.

Specifically, the GPRA (Government Performance and Results Act of 1993, 1993) requires Federal agencies to submit a strategic plan to the Director of the Office of Management and Budget and to the Congress. Strategic plans must consist of several elements expressed by law. First, a comprehensive mission statement covering major functions and operations of the agency is required. Second, the GPRA requires general goals and objectives, including outcome-related goals and objectives, for the major functions and operations of the agency. Third, a description of how the performance goals included in the plan required by law relate to the general goals and objectives in the strategic plan. Fourth, the GPRA requires the identification of those key external factors beyond the agency's control that could significantly affect the achievement of the general goals and objectives. Fifth, a description of the program evaluations used in establishing or revising general goals and objectives, with a schedule for future program evaluations, is required.

The GPRA also requires Federal agencies to develop performance plans with several required elements. First, a program activity's performance level should be established by performance goals. Second, plans should express such goals in an objective, quantifiable, and measurable form unless authorized to be in an alternative form. Next, the plans should briefly describe the operational processes, skills and technology, and the human, capital, information, or other resources required in meeting the performance goals. Fourth, performance indicators to be used in measuring or assessing the relevant outputs, service levels, and outcomes of each program activity must be established. Fifth, the performance plans must provide a basis for comparing

actual program results with the established performance goals. Finally, the plans must describe the means to be used to verify and validate measured values.

The Oak Ridge Associated Universities (ORAU) (Why Should We Measure Performance?, 1999) reiterates that the GPRA promotes quality service and customer satisfaction while improving executive and congressional decision-making. Arveson (Improving Government Business Processes, 1998) stresses the GPRA will improve government mission and processes. Performance measurements will be used for budget decisions resulting in improved management. Furthermore, Arveson (Improving Government Business Practices, 1998), believes that the GPRA established a proven best practice in the business world which will result in increased mission effectiveness, customer satisfaction, and improved agency image and reputation. Finally, Arveson (Three Basis Categories of Performance Metrics, 1999, p.2) says that the focus of the GPRA is on effectiveness and efficiency in an agency's authorized work. Ultimately, the GPRA requires federal agencies to evaluate how well they are accomplishing their mission.

The GPRA has resulted in improvements in many Federal agencies. The NPR reports that the Coast Guard, the National Weather Service, and the National Cemetery System, for example, have shown improvements due the implementation of performance measurement systems required by the GPRA.

C. PERFORMANCE MEASUREMENT

Determining what performance measurement means to a specific organization is paramount because this provides the foundation for how the organization will implement

a performance measurement strategy. Performance measurement may have different meanings at various levels of an organization, therefore, what they measure and how they use results vary. Thus, an organization must ensure that each level of their organization understands how their respective performance measurement system relates to their strategic objectives, mission, or vision.

1. What is Performance Measurement?

Performance measurement is the process of assessing progress toward organizational goals, including the efficiency with which resources are changed into outputs, the quality of the output, outcomes achieved, and the overall effective of the organization's efforts toward their mission (Serving the American Public: Best Practices, 1997). Performance measurement starts with determining what to measure, identifying collection methods, and then consolidating collected data (Why Should We Measure Performance?, 1999).

Chang and DeYoung (1995) explain performance measurement as the manner in which organizations continually improve upon their process or products. Lynch and Cross (1995) agree that continued improvement results when performance measures are used. However, they specify that continual improvement occurs because organizational behavior is influenced by the desire to improve.

Others describe performance measurement in terms of mathematical equations. For example, Kaydos (1999) describes a performance measurement system as a mathematical model of a company or process that uses data produced by real activities (p. 153), while performance measurement is described by Harbour (1997) as the process of

measuring work accomplishments and output, as well as in-process parameters that affect work output and accomplishments. Harbour (1997) further asserts that performance measures can be used for a variety of purposes including determining current performance levels, predicting future ones or controlling existing processes.

Performance management is the use of performance measurement information to help set agreed-upon performance goals, allocate and prioritize resources, make decisions about current policy and change directions to meet specified goals (Serving the American Public: Best Practices, 1997). Harbour (1997) specifies that a performance measurement system involves the collection, synthesis, delivery, and display of information related to the measurement of work output and accomplishments, as well as the in-process parameters that affect work output and accomplishments (p.7).

There are several characteristics of a performance measurement system that are likely to result in success. First, Brown (1996) specifies that fewer performance measures are better. The key to having a successful set of metrics is paring down your database to the vital few key metrics that are linked to your success (Brown, p.4). Second, the performance measures must be linked to organization values, mission, and key success factors. Lynch and Cross (1995) support this claim by specifying that measures must link operation to strategic goals (p.6).

Performance measures must also look to the future while also looking at the past and present. Brown (1996) further specifies that performance metrics must be linked with customers, stakeholders, and employees while Lynch and Cross (1995) purport that a measurement system's true worth lies in its ability to focus all activities on a customer's requirement. Finally, performance measurements need to have targets, or goals based on

research. This will ensure that goals are achievable, challenging, and not arbitrary. In other words, an agency must choose the correct measures to have an accurate picture of how it is doing or where it is going.

2. Specific Performance Measures

A key step in building any performance measurement model is determining which specific performance measures to choose. Performance measurements tell an organization something important about their processes. Performance measures are the answers to the question - How are we doing? Performance measures are also known as performance indicators or performance metrics. Walters (1998) defines outcome indicators as the specific measures that allow an organization to assess its success (p. 52). The performance indicators, thus, are related to the organizational mission because they inform organization's how well they are carrying out objectives.

Specifically, a performance measure is composed of a number and some unit of measure. Multidimensional units can be used if needed. Examples of performance measures that may be applicable at the United States Naval Academy are listed below:

- Percent of plebes who leave during the first year
- Number of sexual or racial discrimination grievances filed per semester
- Conduct violations per year
- Percent of classes missed
- Percent increases in grade point average
- Percent absenteeism
- Result of peer reviews

Performance measures can be classified in different ways. The Oak Ridge Associated Universities (What Are Performance Measures?, 1999) suggest that performance measures can be grouped into six categories: effectiveness, efficiency, quality, timeliness, productivity, and safety. Lynch and Cross (1995), on the other hand, identify two types of performance measures: global measures which provide top management a view of how their organization is achieving their strategic objectives and specific workflow measures, which are used by floor managers and workers on a day-to-day basis to determine how well they are carrying out their duties.

Harbour (1997) says that performance measures can be used in five different ways:

1) Baseline performance measurements can be used to determine where an organization is currently. Essentially, baseline performance measurements create reference points from which to gauge following performance.

2) Trending performance measures can be used to determine how performance is varying over a time based upon a previously established baseline.

3) Control performance measures are used to establish boundaries. They ensure that performance remains within some predetermined boundaries and are typically associated with quick feedback measures (Harbour, 1997).

4) Diagnostic performance measures can assist in determining where specific problems are occurring.

5) Planning performance measures are predictive (Harbour, p.18) which provide insight when plans about the future are being considered.

D. PERFORMANCE MEASUREMENT MODELS

There are numerous performance measurement models. This section addresses various performance measurement models including the Measurement Linkage Model, the Balanced Scorecard, Mark Graham Brown's Strategic Measurement Model, and the

Oak Ridge Associated Universities Performance Measurement System. The descriptions provide differences and common features between the various models.

1. Measurement Linkage Model

The Measurement Linkage Model was designed by Chang and DeYoung (1995) to a help a work group (a section, department, or division of a larger organization) start their own performance measurement system. The Measurement Linkage Model consists of eight steps in which the work group attempts to link their performance measurement system with that of the large organization through key result areas and key indicators.

a. STEP 1: Develop Organization-Wide KRA's, KI's, and Performance Targets

The first step in the Measurement Linkage Model is the development of organization-wide key result areas, key indicators, and performance targets. Key result areas are defined by Chang and DeYoung (1995) as critical, "must achieve," "make or break," performance categories. Key indicators are the specific measures that help determine how well you are performing in reference to a key result area. Performance targets are the tangible goals an organization attempts to meet to determine whether or not it is improving.

The primary purpose of the first step is to ensure that the work group is aligned properly with organizational wide goals and priorities. Chang and DeYoung (1995) specify that an organization must be concerned with the common good - doing whatever is necessary to make the organization successful. Individualism can cause the

organization to fall even if one department or section is successful but their operating standards are counter to the organizational culture and norms.

Another key element of the first step is the identification of performance targets. Organizations need to know where they are going, and whether or not they've reached the destination (Chang and DeYoung, 1995, p. 32). The performance targets provide direction by defining important performance objectives.

Performance targets according to Chang and DeYoung (1995) should accomplish four objectives:

1) They should be descriptive. Performance targets be directive but not specific in nature.
2) The performance targets should focus on the organizations key result areas.
3) Performance targets must be high level targets that reflect the organizations key indicators of success.
4) Performance targets must be challenging but set within realistic boundaries.

b. STEP 2: Select Organization-Wide KRA's and KI's Linked to Your Work Group

Step two of the Measurement Linkage Model involves the selection of organizational wide key result areas and key indications that are linked to specific work groups. Chang and DeYoung (1995) identify three processes that are required to complete step two. The work group must understand the organization's vision and mission. The work group must then identify how it functions within the organization. Finally, the functions of the work group must be linked to organizational wide key result areas and key indicators.

c. STEP 3: Develop Work Group KRA's

Work group Key Result Areas are critical performance outcomes essential for work group success and for which the work group alone is held accountable. Most work group KRAs will be linked with the organizational KRAs; however, some areas crucial for the work group may not be associated with the organization. The essential focus of work group KRA development should center on those elements that make success possible in the work group.

Chang and DeYoung (1995) identify several characteristics of work group KRAs.

- Business result areas that contribute to achieve an organization's or work group's strategic goals.
- They are aligned with the organization's strategic business goals.
- They are defined in terms of outputs, not inputs.
- They are defined as results, not processes, activities, or resources.

A work group should list all potential key result areas then discuss and clarify the list. This process will modify some KRAs while eliminating redundancy and improving upon clarity and specificity (Chang and DeYoung, 1995). A work group typically has four to seven KRAs.

d. STEP 4: Develop Work Group KI's

Recall that Key Indicators measure how well a work group is doing in KRAs. The purpose of this step is to identify and develop those KIs of the previously developed KRAs. The work group should attempt to answer, (1) What concrete measure could be used to show how your work group is doing on each KRA? And (2) What

would you point to if your boss asked you how you are doing in each KRA (Chang and DeYoung, 1995, p. 63)?

Chang and DeYoung (1995) list the following characteristics that are important in effective KI's:

- Provides critical/important data.
- Easily understood.
- Controllable by your actions.
- Tracks actual performance change.
- Aligns with existing data or can be 'clearly' established.
- Measures efficiency and/or effectiveness.

The process by which the work group develops the KI's is similar to that used to develop the KRA's.

e. STEP 5: Determine Data Collection, Tracking, and Feedback Methods

This step is crucial to the success of any performance measurement system. If data cannot be collected, tracked, and put to use then it serves no purpose and the performance measurement system will flounder. Chang and DeYoung (1995) pose the following issues before determining how performance measurement data is going to be collected:

- Who will collect it?
- How will it be collected?
- Where will the data be stored and posted so that employees can monitor their performance?

- When will it be collected and posted?

f. STEP 6: Gather Baseline Data and Set Performance Targets

Before performance targets can be established it is important for the work group to determine how they are currently doing. Gathering baseline data will allow the work group to establish realistic targets. Chang and DeYoung (1995) specify that a performance target should be based on knowledge of the capabilities of your processes or systems (p.80).

Established performance targets may not actually result in improved performance. Performance levels may not show drastic improvement because the system is flawed. When performance does not improve leaders must determine if the current system or process needs adjustments before improvements are made. Thus, establishing performance targets can lead to improved performance by indirectly causing the system or process to be analyzed.

g. STEP 7: Establish Work Group Objectives and Tactics

Once the work group has established its KRA's, KI's, and performance targets it is necessary to determine the manner in which the group will actually reach its desired objectives. The direction the group takes should be consistent with the nature of its objectives such as process improvements, special projects, and the normal ways of conducting business (Chang and DeYoung, 1995).

h. STEP 8: Implement Plans, Monitor Performance, and Provide Feedback

Monitoring the performance of the work group is an essential ingredient for success. Leaders must continually provide feedback so group members know where they stand in regard to performance targets. Providing feedback will allow subordinates to take action to upgrade their performance level.

Once the performance measurement system is in place it must continually be examined and updated. This will allow the work group to change so that it remains successful. Goals and work group functions often change requiring that performance measures change in order to remain linked with the current organization mission and vision.

2. The Balanced Scorecard

Robert Kaplan and David Norton (1999) developed the Balanced Scorecard performance measurement philosophy. The Balanced Scorecard relies upon four perspectives to which performance measures are linked. Kaplan and Norton (1999) specify that the Balanced Scorecard translates an organization's mission and strategy into performance measurements that provide a framework for future decisions related to strategy and management.

Arveson (The Balanced Scorecard, 1998) identifies the four perspectives as (1) Learning and Growth, (2) Business Process, (3) Customer, and (4) Financial. These four perspectives in turn define a company's strategy (Gendron, 1997). The Balanced Scorecard approach assists organizations in identifying problems with the potential of heading off troubling situations before they become too severe. The goal of the Balance

Scorecard or any measurement system is to permit managers to see their organizations clearly, hence, long-term decisions and strategy are more coherent and sound (Arveson, The Balanced Scorecard, 1998).

The Balanced Scorecard Model specifies that four questions must be asked concerning the four perspectives and their relationship with the organizations vision and strategy (Arveson, The Balanced Scorecard, 1998).

a. Financial Perspective

To succeed financially, how should we appear to our shareholders? This question concerns issues of cash flow and cost reduction for example.

b. Internal Business Processes Perspective

To satisfy our shareholders and customers, what business processes must we excel at? Business processes refer to the issues of actual production schedule versus plans.

c. Customer Perspective

To achieve our vision, how should we appear to our customers? Customer service involves issues of percentage of new sales from new customers and customer satisfaction.

d. Learning and Growth Perspective

To achieve our vision, how will we sustain our ability to change and improve? Technical innovation and how long it takes the organization to develop new product lines are the central issues surrounding this perspective.

The Balanced Scorecard suggests that organizations view themselves using these four perspectives then create metrics, collect data, and analyze it relative to the particular perspective (Arveson, 1998).

3. Oak Ridge Associated Universities Integrated Performance Management System

Oak Ridge Associated Universities has developed a performance management philosophy called the Integrated Performance Management System. The approach uses the term integrated because it aspires to establish a connection between participants in an activity and what is expected of them in regards to the performance measures they are responsible for.

ORAU's Performance-Based Management Handbook (1999) established several steps necessary for successful implementation of a performance management system. The critical components are: (1) outputs of the strategic planning process, (2) an analysis of key processes, (3) an analysis of stakeholder needs, (4) involvement of senior management, (5) a balance set of measures (6) selection of a critical few set of measures (7) accountability for measures, (8) vertical integration of measures, and (9) horizontal integration of measures.

a. The Strategic Plan

Strategic planning is imperative for organizations to have success over long periods of time. The strategic plan guides an organization is the accomplishment of its mission and objectives. Performance measurement systems must be closely linked

with strategic principles or they risk undermining an organization's strategic mission by causing shortsighted practices (Performance- Based Management Handbook, 1999).

ORAU identifies six common themes consistent in successful strategic plans:

1) The organization's mission must be well established so members know why the organization exists and what its purpose is.

2) The organization must have a strong situational awareness and understand where it stands in regard to its environmental setting.

3) Vision, strategic goals, and objectives must be understood so that the organization knows when it is achieving its goals. Performance indicators are a key element of this theme.

4) A strategic issue is the next theme consistent in solid strategic plans. Strategic issues deals with overcoming obstacles from where an organization currently is to where they are going.

5) Strategies, which set a course of direction for an organization, are paramount.

6) Program planning is necessary so that strategies can become action.

Performance measures must be linked with strategic plans. The objective of this stage is to find out specifically what measures are currently monitored and who owns the data. This step will allow the organization to determine whether a strategy is currently measured while also identifying those current measurements that have no relationship to strategies.

b. Key Business Processes

Key business processes are the means to achieve the desired outcomes of an organization. The ORAU's Performance-Based Management Handbook (1999) specifies that one of the key ingredients to an integrated performance measurement

system is to clearly identify all the key business processes that impact whether or not strategic initiatives are accomplished. Before organizations attempt to define key performance measures a thorough understanding of its key business processes is necessary (Performance-Based Management Handbook, 1999).

c. Stakeholders

A stakeholder refers to those people who actually have or are perceived to have an interest in the outcomes of an organization. Stakeholders should have input in the performance measurement process because they are affected by the output (Performance-Based Management Handbook, 1999). Stakeholders are significant because they are likely to determine what success is for an organization.

d. Senior Management

Senior management is necessary in performance measurement because they establish the proper environment for success. Leadership must promote performance measurement initiatives for them to be successful (Performance-Based Management Handbook, 1999).

ORAU's Performance-Based Management Handbook specifies four ways that senior leadership has positive impacts on the implementation of performance measurement systems. First, leaders must champion the cause and lead by example. If subordinates do not think the boss finds the performance measures serious then neither will they. Second, senior leadership must delegate responsibilities. Third, good communications processes are required. A sound communications effort will link strategic initiatives with tasks that ordinary employees perform. Last, leaders must

always seek feedback. Feedback will allow leadership an opportunity to assess whether or not employees are onboard with current strategic plans.

e. Balanced Set of Measures

The identification of different categories of data is essential for a performance measurement system. It is important that the categories of data selected represent a balance between the needs and requirements of respective groups (Performance-Based Management Handbook, 1999, p. 15). Furthermore, the categories of data selected should be indicative of the organization's purpose and key success factors.

Performance measures should be developed based upon the types of categorical data is necessary to determine performance. Typical, examples of data categories are financial, operational, customer satisfaction, employee satisfaction, and stakeholder satisfaction.

f. Critical Few

Performance measurement systems must not gather too much data and generate unnecessary and cumbersome measurements. The ORAU's Performance-Based Management Handbook (1999) asserts that too many performance measures can distract senior leadership from measures that are essential for organizational success. The handbook further specifies that successful organizations typically have between three and fifteen critical measurements at particular levels to gauge how well the organization is doing.

g. Accountability

The success of an integrated performance measurement system is highly related to accountability (Performance-Based Management Handbook, 1999). Managers and employees must be responsible for the performance measures associated with their functions. When instilling accountability employees need to feel ownership for performance measures. Furthermore, they must know how they will be held accountable and employees must be rewarded when good performance results.

h. Vertical Integration

Once an organization's strategic plan and performance measures are established the performance measurement system must be implemented. The vertical integration effort must ensure that each level of the organization falls under the strategic agenda when it develops its own measures so that the overall performance measurement framework is followed (Performance-Based Management Handbook, 1999).

i. Horizontal Integration

Horizontal integration works to optimize workflow ensuring that work boundaries do not impede performance measures. These performance measures typically focus on customers in an effort to continually provide value from the customer's perspective.

3. Mark Graham Brown Strategic Model

Brown (1996) establishes a strategic measurement model that he believes links measures to what is critical within an organization. Brown's strategic measurement

model has five phases that must be completed. The first phase is defining an organization's mission, vision, and values. Second, key success factors and business fundamentals must be determined. Third, performance metrics must be established. Fourth, goals and objectives are identified for each measure. Finally, strategies used to implement and achieve goals are founded.

Brown (1996) employs a six-step process for carrying out the strategic measurement model.

1) Prepare guiding documents.
2) Conduct a situation analysis.
3) Define key success factors and business fundamentals.
4) Identify macro performance measures.
5) Establish the measurement plan.
6) Design the data collection instruments and procedures.

a. Prepare Guiding Documents

Brown (1996) assesses that an organization must first define what it does and then determine its vision for the future. Equally important, an organization must establish what it stands for. An organization must therefore establish a mission, vision, or values statement that establishes an overall climate.

A mission statement defines what the organization is all about - its reason for existing. Brown (1996) asserts that the mission statement should not be vague and must only apply to a single organization.

An organization's vision statement determines where the organization is going in the future. Vision statements should establish direction and make clear to all in the company how the organization is going to get where it is going (Brown, 1996).

Brown (1995) establishes that a values statement outlines what an organization believes in and considers important. The values statement is important because it will aid in determining the key success factors for the organization.

Brown (1996) asserts that for mission, vision, and values statements to be effective they must be followed with consistent messages from upper level leadership. This does not mean newsletters and posters with the mission or vision statement should be posted throughout an organization. Instead it means that leadership must take an active role in developing performance measures for the organization and espouse the vision in daily language and action.

> They make speeches about the mission and vision, and how important they are, and then they go out and ask for short-term financial results (Brown, 1996, p. 161).

Leadership by example is paramount if upper-level executives want their organizations to grasp and use vision, mission, and value statements.

b. Situation Analysis

Situation analysis involves researching an organization's own strengths and weaknesses and those of the major competitors (Brown, 1996, p. 147). The situation analysis also attempts to identify any trends that could potentially impact the industry or organization within five to seven years. The situation analysis may identify some factors that could assist or hinder the organization from achieving its vision.

c. Defining Key Success Factors

Brown (1996) asserts that defining key success factors is the most critical step in designing a performance measurement system.

> If you do a poor job defining key success factors, your measurement system is doomed to failure, and perhaps so is your organization (Brown, 1996, p. 148).

Key success factors are those elements that separate or differentiate your organization from all others. Identification of these traits is critical to success.

d. Identifying Macro Performance Measures

Brown (1996) identifies three steps that must be accomplished to complete this step. First, identify measurement categories. The purpose of this step is to sort the measures and to make sure that important measures are not left out. Brown (1996) asserts that measurement categories must contain both short and long-term measures.

Second, brainstorm measures from within each category. The group that is identifying the macro performance measures should list all possible metrics for each category. The most important measures should be chosen while ensuring that they linked to key success factors. However, not all performance measurements need to be directly linked with a key success factor (Brown, 1995) to be included.

Finally, limit or narrow the measurements to the vital few. Each category should have no more than about four measures. Although many of the brainstormed measurements are applicable they cannot all be successfully measured. Thus, the purpose of this step is to identify only those measurements that must be managed for a successful organization to operate.

e. Develop a Measurement Plan

The measurement plan should consist of four elements:

1) Identify the data collection method for the measurement.
2) Specify the frequency with which the data will be collected.
3) Establish responsibility or ownership for the particular measure.
4) Establish which key success factor the metric is linked.

What is important is that the key success factors all have at least one measure (Brown, 1996, p. 156).

f. Design Data Collection Instruments and Procedures

The purpose of this step is to identify data collection instruments and methods. The team developing the performance measures should determine whether collection methods are more easily collected within the organization or if someone from the outside should collect the data. Thus, the team must establish whether the data to support a metric currently exists, whether to use the data as is, and whether or not to make the procedures for collection or to buy services elsewhere. Finally, a project manager for the particular measure should be established who will design the specifics of the project.

E. BENEFITS OF PERFORMANCE MEASUREMENT

There are many benefits for implementing a performance measurement system. Of most importance, a performance measurement system shows how an organization is performing in regard to its established objectives and purpose. There are other indirect benefits as well, which affect an organization.

A performance measurement system ensures that decisions are based upon fact instead of subjective opinions or emotion. A performance measurement system further establishes visibility, which leads to accountability, because people know where they stand in relation to organizational strategic objectives. As a result, incentives that exist are based upon strong objective data instead of subjective judgements and anecdotal evidence (Top Ten Reasons for a Performance Measurement System, 1999).

Other benefits mentioned by ORAU are related to improvements. Performance measurements show where improvements need to be made and subsequently show if improvements are actually occurring after identification of problems. Problems covered up by bias, emotion, or longevity may also be revealed because it has always been assumed that things are going well. Without a measurement system there is no way to know (What are the Benefits of Performance Measurement, 1999).

Kaydos (1999) mentions that performance measures are good for both managers and employees in an organization. Performance measures result in more control for managers because they have better feedback about processes they oversee which allows them to make more informed, better, and quicker decisions. Performance measures also establish clear responsibilities for results. This leads to everyone knowing what he or she is supposed to accomplish while at the same time knowing how well they are accomplishing their objective.

According to Kaydos (1999) a performance measurement system is one of the strongest ways to communicate strategic objectives throughout an organization. If performance measures are aligned properly with strategic initiatives then the organization

is measuring what it values most. This results in everyone working toward the same objectives and not going off in different directions (Kaydos, 1999, p. 2).

Performance measures also result in managers having a better understanding of organizational processes. Kaydos (1999) asserts that if a performance measurement system is not in place then managers typically do not understand how things actually work. Knowing processes results in a true understanding of a system's capability that leads to better solutions when problems occur.

One special benefit of a performance measurement system according to Kaydos (1999) is the gained freedom of managers to delegate. Managers may be tempted to avoid delegating authority or tasks for fear of losing control. However, a performance measurement system will ensure that manager's stay informed allowing them the opportunity to avoid micro managing.

A performance measurement system is likely to save time. Brown (1996) asserts that a properly implemented performance measurement system eliminates up to an hour each day spent by managers reviewing and attempting to interpret unimportant data (p. 13).

Employees are benefactors of a performance measurement system as well. Performance measurements allow accomplishments to be observed resulting in more recognition for employees. This can result in better performance because employees feel appreciated and confident about their performance. Kaydos (1999) believes that performance measurement systems also result in employee empowerment because organizational focus is now on outcomes instead of the exact details of accomplishment.

This, correspondingly, leads to more freedom and creativity for employees as they carry out their tasks.

F. INFORMATION TECHNOLOGY AND PERFORMANCE MEASUREMENT

Today's world is an information world. Much of the industrialized world now functions in the Information Age; an age in which the majority of workers are involved in the creation, distribution, and application of information (Senn, 1998, p. 7). Decision-makers desire faster access to data with quicker manipulation a necessity. The advent of computers, databases, and networks has greatly enhanced organizational abilities to develop, maintain, and use information technology for purposes of performance measurement. Increases in computing capacity allow large amounts of data to be managed, reported, and subsequently acted upon.

1. Management Information System

Performance measurement systems fall under the category of management information systems (MIS). Management information systems are designed to provide information needed for successful management within an organization. Thus, the central purpose of this project is the development of a management information system for company officers at USNA.

Senn (1998) identifies five characteristics of management information systems that are important:

1) The MIS must use data that is captured and stored.
2) Data and information is reported rather than the details of a process.

3) The MIS assists in monitoring situations, evaluating conditions, and determining what actions need to be taken.

4) The system will support recurring decisions.

5) The MIS provides information in pre-specified report formats, either in print or on-screen.

Lynch and Cross (1995) identify four areas that are important when considering technology for performance measurement systems. Technology provides the opportunity to increase the speed at which processing occurs. Technology also provides the opportunity to greatly increase performance measure capability because tasks and processes are performed consistently. Information capacity is increasing, enabling organizations to gather information in real time, which can either provide value or detract from a manager's attention. A manager must have the ability to capture the meaningful data when deluged with massive amounts of information to be successful.

Information technology skills are necessary in the modern era. Organizations are depending upon management information systems to a greater extent. Arveson (Enabling Technologies, 1998) says information technology skills along with management skills and measurement skills are essential for success in performance measurement based organizations. Information technology according to Bryson (1995) will continue to drive major changes within organizations and the ability to adapt to the rapid changes will impact success.

2. Displaying Information

One of the most important aspects of a management information system is the manner in which information is displayed. Performance measurement displays should

provide relevant and meaningful information that can be quickly and easily assimilated and understood by the intended user (Harbour, 1997, p. 55). Thus, the design of the display has a major impact on the success of the management information system.

Harbour (1997) specifies several types of displays that should be considered. Dashboard types of displays are often the most valuable. Information can be scanned quickly while not having to be converted. In a dashboard type display measurements have associated meaning.

> Always attempt to provide specific meaning to performance metrics by associating them with a desired performance goal (perhaps a simple dashed line) or a color-coded performance range (green for normal, yellow for caution, and red for a problem) (Harbour, 1997, p. 57).

Finally, fixed positions for indications are necessary so that quick references to the display are not confusing.

Graphical displays also provide value in management information systems. Harbour (1997) asserts that graphs should not be too busy and that standard types of graphs (pie graphs, bar charts, etc.) should be utilized. Fonts and graph sizes must be large enough so that readers can easily grasp the content. Brown (1996) agrees that graphs are better than tables at presenting data. Graphs are better at providing information on trends, levels, and variability than tables.

Finally, Harbour (1997) specifies that the most important or core measures should be displayed centrally while attempting to always link together pertinent information. This ensures that they are located in the most dominant or proximal location.

F. CHAPTER SUMMARY

This chapter reviewed 1993's GPRA, its requirements, and its subsequent impact on Federal agencies. The importance of defining performance measurement in relationship to an organization's strategic objectives and how performance measurement will be used at a specific location within an organization was discussed as well. Next, specific performance measures and the benefits of a performance measurement system to an organization were addressed. Four performance measurement models were explained to provide both differences and commonalties between various models used to create performance measures. Finally, the role of information technology in performance measurement was discussed.

The ultimate purpose of this research is the merging of performance measurement theory with information technology to provide a company officer management information system at the United States Naval Academy. The theoretical models and discussion presented in the literature review serve as the foundation for the management information system.

Chang and DeYoung's Measurement Linkage Model serves as the primary model used to determine the specific performance measures placed in the company officer management information system. The next chapter addresses the specific key result areas and key indicators used by company officers to measure midshipmen performance at the United States Naval Academy found as result of the Measurement Linkage Model. The remaining chapters will further explain how performance measurement theory and information technologies are meshed to create the final prototype.

III. USNA COMPANY KEY RESULT AREAS

A. INTRODUCTION

For any organization to progress it must first determine in what areas that success is required for the organization to meet its objectives. Otherwise, it is unlikely to obtain key objectives unless they occur by happen chance. The United States Naval Academy uses its mission statement as its beacon for developing young junior officers for today's military. The mission statement provides the foundation for the key result areas necessary for success at the Naval Academy.

This chapter addresses the key result areas and key indicators necessary for a USNA company officer to monitor and track midshipmen development. Chang and DeYoung's (1995) Measurement Linkage Model was used to develop and determine the key result areas and respective key indicators. A key result area is a "make or break" performance category for an organization. The key indicators define the key result area by illustrating how well an organization is accomplishing its objectives in relation to key result areas.

A Naval Academy company comprises approximately 140 midshipmen divided equally amongst all the respective classes. A company officer and a senior enlisted advisor oversee the development of the midshipmen on a daily basis by providing guidance, discipline, and leadership. Company key result areas and key indicators are derived primarily from the Naval Academy Mission Statement that provides the direction for the leadership provided by company officers. This links company key result areas with organizational wide key result areas as specified by the Measurement Linkage

Model (Chang and DeYoung, 1995). The key result areas for an USNA company are (1) Mental Development, (2) Physical Development, (3) Moral Development, and (4) Professionalism.

B. KRA1: MENTAL DEVELOPMENT OF MIDSHIPMEN

Midshipmen mental development occurs primarily in the academic arena of the Naval Academy's classrooms. Therefore, maintaining a record of midshipmen academic performance in the classroom is paramount if company officers are to assist in the successful mental development of midshipmen.

A midshipman must maintain at least minimum standards (a 2.0 on a 4.0 grading scale) in order to graduate. A midshipman's academic performance has the largest influence on the service selection that a midshipman may select upon graduation. Thus, mental development affects the Fleet Navy and Marine Corps because there are limited billets in most warfare specialties. Therefore, company officers must ensure that a midshipman obtains the best academic standing possible.

1. Mental Development Key Indicators

There are several indicators of mental development that measure midshipmen and a company's mental development including (1) grades, (2) honors students, (3) academic extracurricular activities, (4) academic boards and probationary students, and (5) hours studied.

a. KI1: Academic Grades

Academic grades are perhaps the most influential factor used to measure

midshipmen performance at the Naval Academy. Academic performance is widely used as the sole or primary unit of measure to determine the development, success, and maturity level of midshipmen.

Grade point average data will be maintained for semester and cumulative averages. Grade point averages are maintained throughout the course of a single semester at the sixth, twelfth, and sixteenth week marking periods which are also known as measurement gates. These measurement gates allow midshipmen in academic trouble to be identified as soon as possible. Identifying midshipmen in academic peril allows possible intervention by the company officer to assist the student in gaining some additional help before major academic trouble begins. Midshipmen with a semester or cumulative average below 2.0 or a failing grade in any class are sent to academic boards. Academic boards determine whether a midshipman will remain academically eligible during a probationary period or be dismissed from the Academy. Thus, the measurement gates allow a company officer to intervene prior to an academic board potentially preventing an academic board by raising a midshipman's grades using some of the many study tools available to midshipmen at the Naval Academy.

b. KI2: Number of Honor Students

The number of honors students in a company may be a good indication that the company is performing well as a unit. This measurement is important because honors students gain additional privileges because of their outstanding academic performance. Honors students excel in their respective curriculum indicating that their mental development is superior to the average student.

c. *KI3: Academic ECA's*

Academic extracurricular activities provide additional opportunities for midshipmen to be exposed to additional concepts and ideas beyond their normal classroom environments. These midshipmen may therefore have a propensity toward a higher level of mental development than other midshipmen not exposed to addition ideas. Academically oriented ECA participation will be measured to provide additional feedback on the mental development of a midshipman.

d. *KI4: Academic Boards, Probation, and UNSATs*

Academic boards, academic probation, and unsatisfactory academic performance reflect on those midshipmen who are struggling to uphold the academic standards at the Naval Academy. The number of academic boards, probationary students, and unsatisfactory students gives an indication of individual academic performance and provides a measure of academic performance of an entire company. Poor academic performance as a group may indicate an environment that is not conducive for studying.

e. *KI5: Study Hours*

Study hours are logged for those individuals on academic probation. Study hours logged may provide a measurement of the amount of effort put forth as well as identifying potential prioritization problems that can lead to academic trouble.

C. KRA2: PHYSICAL DEVELOPMENT OF MIDSHIPMEN

The physical development of midshipmen is one of the most important aspects of the Naval Academy experience. Physical development is the key result area, which

should be the easiest to measure, and, more importantly, the easiest to hold midshipmen to standards. Early identification of midshipmen struggling to meet the physical standards is important because it will allow remedial action that can upgrade a midshipman's performance before failure occurs.

All midshipmen are required to participate in some athletic endeavor while maintaining high personal fitness standards. The mission statement employs all involved in developing midshipmen to emphasize the physical aspect of development. Physical standards at USNA are higher than the Fleet Navy's. This allows Naval Academy graduates to immediately be among the most fit members of their respective commands upon commissioning.

1. Physical Development Key Indicators

Physical Development key indicators are perhaps the easiest to quantify and most tangible of all indicators because all midshipmen are required to meet the exact same standards with respect to their gender. The key indicators are (1) PRT scores, (2) number of physical education failures, (3) physical education curriculum grades, and (4) body fat measurements.

a. KI1: Physical Readiness Test (PRT)

Each semester each midshipman is required to undergo a physical fitness test to gauge how well he or she is maintaining his or her physical well being. The test includes a 1.5-mile run, a two-minute session of curl ups, and a two-minute session of push-ups. Failure to maintain minimum standards for the PRT can result in expulsion for a midshipman.

The PRT scores and categorical results (i.e. Number of pushups, Number of sit-ups, and time on the 1.5-mile run) are maintained throughout a midshipman's tenure at USNA. This key indicator could potentially warn a company officer when a midshipmen is showing declined physical fitness allowing corrective action before a midshipman is placed before a disciplinary board.

New standards are in place to push midshipmen to maintain their standards high throughout their Naval Academy experience making this a useful indicator. Furthermore, midshipmen who are improving can then be acknowledged for their outstanding efforts.

b. KI2: PE Failures/Marking Office Failures

Any physical fitness failure can result in dismissal from the Academy if not corrected prior to graduation. Repeated physical fitness failure can result in dismissal even if remedial action has occurred. Some examples are failure to jump from the 10-meter platform prior to graduation or failure to complete a mandatory PE class such as wrestling, boxing, or swimming. Midshipmen who show inadequate skill levels in mandatory PE classes are required to attend remedial instruction to upgrade their performance. Thus, it is important to maintain a clear picture of midshipmen performance in all aspects of their physical curriculum so that unnecessary time is not taken from other aspects of their development.

Other issues of physical fitness failure arise and demand monitoring. Marking office failures (an administrative failing grade given by the PE Officer that is not related to a midshipman's actual performance of a PE test) occur when a midshipman

is injured or is unable to attend a mandatory physical education test. For example, if a midshipman is absent from a test they have seven days to make up the test. If a midshipman fails to make up the exam within the prescribed time then they receive a marking office failure. The difference between a true failing grade is minimal in regards to academic standing. Marking office failures may identify an individual who lacks professional discipline and needs extra attention in this area. However, the marking office failure is not necessarily a sound indicator of a person's physical development.

c. KI3: PE Curriculum Grades

PE curriculum grades are maintained to track a midshipman's overall physical development. Maintaining a midshipman's PE curriculum grade is important because it impacts whether a midshipman is eligible for certain awards and positions.

d. KI4: Weight and Body Fat Standards

All midshipmen must maintain weight and body fat percentages within USNA standards at all time. The failure to maintain weight and body fat percentages can result in a midshipman undergoing an extensive remedial program. Midshipmen are classified in five categories based upon their weight and body fat percentages. Category 1 midshipmen are underweight while category 2 midshipmen meet all standards. Category 3 midshipmen are above the standards but receive a waiver because their weight gain is related to a varsity sport such as football. Category 5 midshipmen are overweight and are entered into a remedial program where they must lose weight or body fat or risk dismissal from the Academy. Category 6 midshipmen are currently within

standards but have exceeded standards within the past six months and are serving probationary period.

Monitoring weight and body fat percentages is potentially a good indicator for how a midshipman is maintaining his or her physical fitness. It may also identify other performance problems because a midshipmen is not able to focus enough attention on physical fitness because of other pressures such as academic or ECA related activities.

D. KRA3: MORAL DEVELOPMENT OF MIDSHIPMEN

Midshipmen moral development serves as the bedrock of our Navy and Marine Corps. Leaders must be developed that make decisions morally and with sound ethical reasoning. One of the strongest principles of our military is the 'true faith and confidence' with which each officer is bestowed when commissioned. The 'true faith and confidence' is based upon the honor and integrity that each officer holds. Our military leaders must be dedicated to the Navy's core values of Honor, Courage, and Commitment, thus, moral development is a facet of each midshipman's daily life.

The Naval Academy values character development to such a high degree that a new department was recently established called the Character Development Center. The Character Development Center presents issues of ethics and human relations using monthly character development seminars.

While most agree that moral development is an important aspect of midshipmen development, it is much more difficult to measure the exact level of each midshipman's morality. Interviews with the Performance Officer and several company officers indicated that the Naval Academy assumes a midshipman is moral until proven

otherwise. Thus, midshipmen are judged based upon external behaviors because a true measure of moral development is difficult to measure internally.

1. Moral Development Key Indicators

Key indicators of moral development of midshipmen at the Naval Academy are (1) the number of honor offenses and counseling sessions that occur both individually and within a company, (2) the number of demerits and subsequent conduct grade a midshipman receives, and (3) community service.

a. KI1: The Number of Honor Offenses/Counseling

The number of honor offenses and honor counseling sessions that occur within the company will be measured to gain an overall picture of how well the company is developing morally. A large number of honor violations or counseling session may indicate that past training was insufficient and that additional moral development is needed within the company or that an improper attitude toward integrity and personal ethics exists within the company.

Individual honor offenses and counseling sessions will be recorded to measure a single midshipman's integrity. This does not mean that an individual who has no honor violations is moral. This measure is only an indicator for the individual cited with integrity shortcomings.

b. KI2: The Number of Conduct Offenses and Demerits

Conduct offenses and their severity are crucial in determining how well a midshipman is able to obey USNA regulations. The ability to obey regulations shows a

higher level of moral development because an individual shows the maturity to carry out a superior officer's directives. Midshipmen receive evaluation reports with questions pertaining to their moral development. For example, the following questions are asked in helping to determine fitness report grades:

1) The midshipman understands and follows USNA uniform regulations and maintains a smart and professional appearance.
2) The midshipman demonstrates self -control.
3) The midshipman demonstrates proper behavior while on duty.

The number of conduct offenses and number of demerits assigned will be tabulated to provide an input to the moral development of a midshipman. Subsequently, conduct grades will be assigned based upon demerits awarded for violations committed by midshipmen. This provides a relative scale of the moral development of each midshipman.

c. KI3: The Amount of Community Involvement

Several opportunities are provided to the midshipmen to impact the Annapolis community by volunteer service. Volunteer service and community involvement shows a propensity toward helping out the less fortunate and needy. Community service may create empathy for those who are struggling in some way while at the same time providing leadership opportunities for midshipmen to excel in the community. Thus, a midshipman who volunteers his or her own personal time shows a higher moral development.

E. KRA4: PROFESSIONALISM

Professionalism as a KRA is important at the United States Naval Academy because midshipmen will assume leadership roles in the Fleet Navy and Marine Corps upon graduation. They must understand the professional standards that they must uphold when they become commissioned officers. Much emphasis is placed upon midshipmen professional development with summer cruises, professional courses, lectures, and military training dominating a midshipman's schedule. Measuring a midshipman's professional development is important for two reasons. First, a poor performer can be identified with corrective actions taken. Second, it measures the type of graduate the Naval Academy is sending to the Fleet. The Naval Academy desires to send professionally competent graduates who uphold the traditions of the naval service and are the future leaders of our military. The Naval Academy is in the business of producing professional naval officers; therefore, it is no surprise that this is one of the most important areas of teaching at the USNA.

1. Professionalism Key Indicators

There are five key indicators that will be used to determine a midshipman's professionalism: (1) absences, (2) professional development grades, (3) uniform inspections results, (4) room inspection results, (5) Fourth-class midshipmen professional quiz and board results and (6) performance grades.

a. KI1: Absences/Unauthorized Absences

Professional military officers show great pride in their timeliness. Late arrivals

and tardiness are embarrassing and are not marks of professionalism. An absence from a ship or a unit movement could potentially cause a failure in mission because of a missing member that is crucial to mission accomplishment. Thus, maintaining an accurate indication of midshipmen absences provides a measure of a midshipman's professionalism in regard to attending required events.

Intentional unauthorized absences are treated as major conduct violations at the Naval Academy because they indicative of an unprofessional attitude and a disregard for regulations. Naval officers are tasked with enforcing Navy regulations and thus must be able to hold themselves to a higher standard.

b. KI2: Professional Development Grades

Each Midshipman receives grades for professional courses they take throughout their tenure at the Naval Academy. Midshipmen performance in professionally related courses establishes a midshipman's relative strength in areas related specifically to military skills required by naval officers. Good performance is indicative of someone who is more professionally developed than someone who performs poorly or has little regard for professionally related topics.

c. KI3: Uniform Appearance/Inspection Results

Uniform appearance and inspection results are important because they identify those midshipmen who take great pride in wearing their uniform. Midshipmen who have outstanding uniform appearance understand the importance of wearing the uniform properly because it reflects upon them and the Naval Academy. Thus, excellent

uniform appearance indicates a midshipman who has high professional standards and is dedicated to the service.

d. KI4: Room Inspection Results

Room inspection results are indicative of the level of professionalism that a midshipman maintains. Midshipmen will be tasked to maintain their spaces in ship-shape condition when they report to their first commands after graduation. Those midshipmen who maintain high room standards by keeping their rooms stowed properly and in a clean condition understand the importance of a stow for sea. Their professional attitude toward stowage will lead to safer ships because properly stowed gear will not lead in injury. Daily room inspections and formal room inspection results will be maintained to track midshipmen performance throughout a performance marking period.

e. KI5: 4/C Professional Quiz/Board Results

Fourth class midshipmen are required to undergo a weekly training regimen where they learn about the Naval service through weekly topics on various military subjects. Each week in connection with the weekly topic the fourth class midshipmen take a professional quiz in order to ascertain the level at which they understand the material presented to them. The quiz scores will be maintained to determine the professional development of the fourth class in regards to military topics throughout each semester. Furthermore, maintaining the professional quiz scores will serve as a measurement to determine how well the upperclassmen responsible for training the fourth class are performing. Fourth class performance is indicative of the professional knowledge that upperclassmen are able to pass on to the fourth class.

f. KI6: Performance Grades

Performance grades will be kept to determine how well midshipmen are performing in comparison to their peers. Each semester's performance grade will be maintained to conduct trend analysis to determine how well a midshipman is performing throughout their four years at USNA. Each semester midshipmen receive a grade of A, B, C, D, or F for performance. Grades are assigned by the company officer with input provided by the midshipmen chain-of-command. Continually poor performers who receive a D or F in performance are required to attend a performance board where a senior officer determines if a midshipman should be retained at the Naval Academy. Thus, measuring performance over a period of semesters may allow a midshipman with declining performance to be identified and corrective action taken before the midshipman is involved in performance probation or separation.

F. CHAPTER SUMMARY

This chapter has identified the key result areas and their subsequent key indicators for a company of midshipmen at the United States Naval Academy. The key result areas and indicators were derived using Chang and DeYoung's Measurement Linkage Model. The key result areas for a company of midshipmen are (1) Mental Development, (2) Physical Development, (3) Moral Development, and (4) Physical Development.

Upcoming chapters will explain the design process for an information management system prototype that will be used by company officers. The company officers will use the management information system to determine how well midshipmen

are developing based upon the defined key result areas and key indicators specified in this chapter.

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IV. SYSTEM REQUIREMENTS/ANALYSIS

A. INTRODUCTION

The purpose of this chapter is to thoroughly analyze the current information systems available to the company officer at the USNA, and then determine requirements for a new or an enhanced information system. The analysis then structures those requirements for clarity and consistency, and develops a prototype that best meets user requirements within development constraints. The USNA provided a copy of the Company Officer Module data dictionary with respective relationships as of 1 May 1999. The results of this chapter will provide functional specifications that meet user requirements and are feasible to develop and implement.

B. MIDSHIPMEN INFORMATION DATA SYSTEM (MIDS)

MIDS is a web-based application accessing the USNA enterprise database running on an Oracle platform. MIDS supports user level and group level security so that individuals can only view information for which they have appropriate security permissions. The MIDS database also has extensive backup and fault tolerant capabilities. All information is backed up periodically and the primary database server has automatic failover to a backup machine if it should falter. To support data integrity, all record manipulation and / or editing is audited so that it is easy to determine who made changes and when. The MIDS system was designed as part of the USNA Central Facility Project, the replacement for the Honeywell Mainframe/NATS system. Web modules are the fundamental building blocks of the MIDS system and each web module performs a specific function.

1. Company Officer Module

The Company Officer Module consists of the area within the MIDS program that company officers have access to. The complete web module has a total of 25 data tables with existing relationships. As of June 9th, 1999 there have been no changes to the structure of the Company Officer module with respect the information provided by the USNA.

a. Procedures

Each company officer must first go to the Midshipmen Information System home page as illustrated in Figure 1. From here, the company officer has numerous menu items on where to go and what information to view. One of the options is "Midshipmen" which will take them to the Company Officer Module of MIDS.

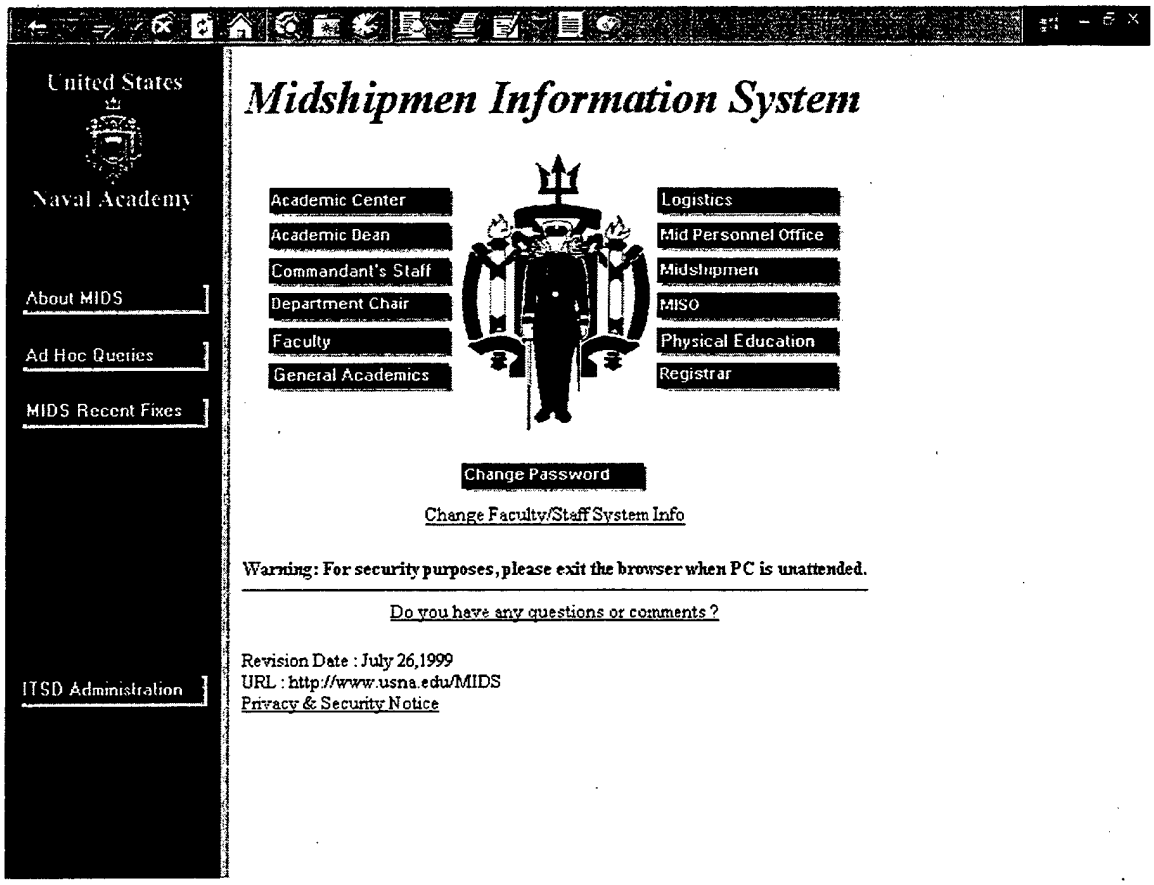

Figure 1: Midshipmen Information System Homepage

After going to the login screen of the Company Officer Module, the company officer inputs his username and password, and is presented with a web page to identify which midshipmen they would like information on as shown in Figure 2.

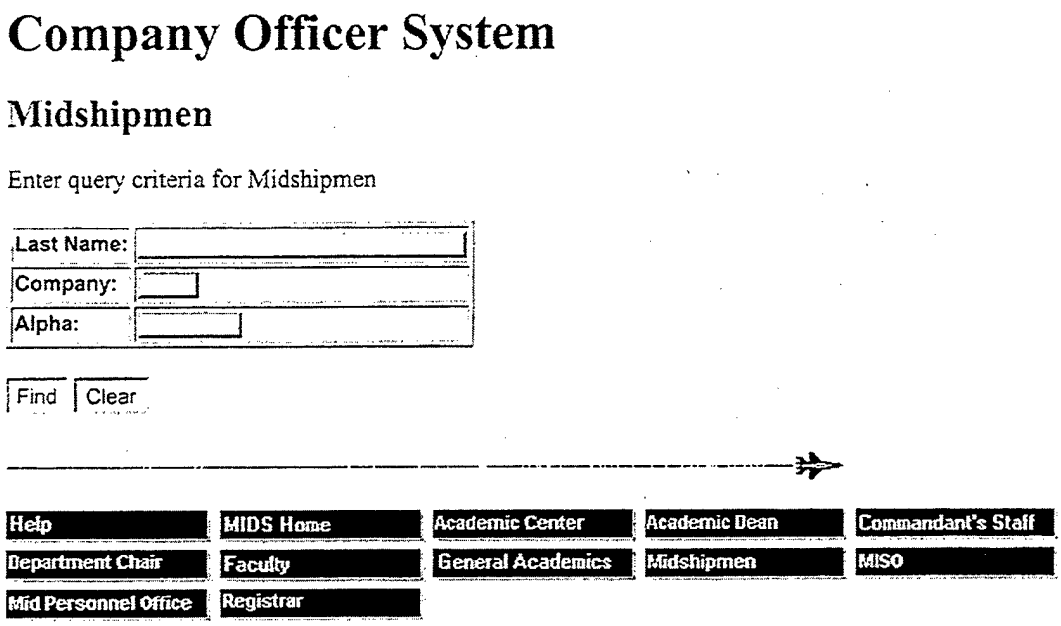

Figure 2: Company Officer System Midshipmen Search Page

Here the company officer can enter the requested information (Last Name, Company, and Alpha code). Upon selecting the find button the company officer is presented with a standard report.

b. Capability

The following figures illustrate the current capabilities for gathering information with the existing midshipmen information system. Together these figures represent the standard report that company officers have available. The report is a text based, static document that only displays one midshipman at a time. When printed, the report is approximately four pages long. For clarity and neatness each page is displayed as a figure. Figure 3 represents page 1 of the Midshipmen information output.

Find by Alpha | Find by Company | Find by Last Name | View Brigade

[redacted] **005610 Co: 11 Class: 00**

Alpha: 005610
Name: [redacted]
SSN: [redacted]
Status: ACTIVE
Date of Birth: 09-MAY-1978
Upward Mobility Code: NONE
High SAT V: 620
High SAT M: 710
Advisor: BODEN D G
Room Number:

Company: 11
Home Of Record: THURMONT
State: MD
Former Alpha:
Former Military:
Gain Code: Civil Life, No Prior Service
Proj Grad Date: 24-MAY-2000
Service Assign:
Major: AEROSPACE ENGR (ASTRO)

Update | Reset

Spring 1999 Grades

Course	Section	6 wks	12 wks	16 wks	Final Grade
A302					B
EA307	1001	B	D		D
EA322	3111	F	C		C
EA364	6001	F	F		D
EA365	4321	D	C		C
EE331	2121	C	C		C
NL302	5034	A	B		B
PE338	0641				A
X302					A

Ac Yr Ending	Sem	SQPR	Proj CQPR	CQPR
1999	SPRING	1.78	2.3	2.30

Schedule

No Records returned

Total Credits: 0

Free Periods: M 1234567 TU 1234567 W 1234567 TH 1234567 F 1234567 S 1234567

Figure 3: Page 1 Midshipmen Information Output

As depicted, page 1 displays the midshipman's pertinent personal information and only allows updating of the room number. It also displays the current semester grades for the respective marking period. Finally, if on record, the midshipman's schedule is displayed

to include total credits and free periods. Figure 4 presents page 2 of the Midshipmen information output.

Absences and Excuses

No Records returned

Absent: 0
Tardy: 0
Left Early: 0

Military Grades/Status

Ac Yr Ending	Sem	Conduct	PE	Perf	Academic Status
1997	FALL	A	B	B	
1997	SPRING	A	B	C	
1998	FALL	B	B	B	
1998	SPRING	A	B	A	
1999	FALL	A	B	A	
1999	SPRING	A	A	B	
2000	FALL				

Records 1 to 7 of 7

QPRs and Standings

Ac Yr Ending	Sem	Class	SQPR	CQPR	Sem MQPR	Cum MQPR	Overall Stnd	Acad Stnd	Milit Stnd	Status
1997	FALL	4/C	2.67	2.67	3.41	3.41	555	560	350	
1997	SPRING	4/C	2.17	2.39	2.26	2.73	689	665	740	
1998	FALL	3/C	2.48	2.43	3.00	2.84	667	689	672	
1998	SPRING	3/C	2.50	2.45	3.31	2.94	643	722	565	
1999	FALL	2/C	2.22	2.40	3.64	3.07	645	755	485	
1999	SPRING	2/C	1.78	2.30	3.31	3.11	706	822	462	
2000	FALL	1/C								

Records 1 to 7 of 7

Status Codes:
S = Superintendent's List, C = Commandant's List, D = Dean's List, P = Academic Probation
The following codes refer to Academic Boards:
A = Retained on Appeal, W = Waived, B = Reviewed, PE = Pending

Figure 4: Page 2 Midshipmen Information Output

Page 2 displays absences and excuses, military grades and status, and the midshipman's Quality Point Ratings (QPRs) and standing. A list of status codes also appears. Figure 5 represents page 3 of the Midshipmen information output.

Final Course Grades

Ac Yr Ending	Sem	Courses and Grades
1997	FALL	SM131 B HH104 C NL102 A PE101 B HE111 B SC111 C A101 B X101 A
1997	SPRING	HE112 B FP130 C PE102 B SM122 B SC112 D NS100 C A102 C X102 A
1998	FALL	EA202 B SP211E C SM221 C NE203 B NN200 B PE201 B EM211 C A201 B X201 B
1998	SPRING	HE222 B EM214 C SP212 D PE212 B SM212 A HH205 B EM232 C X202 A A202 A
1999	FALL	EA305 C EA362 C EM319 B EM217 D HH206 B PE301 B NS310 B A301 A X301 A
1999	SPRING	PE338 A EA364 D EA365 C EA307 D EA322 C EE331 C NL302 B A302 B X302 A
2000	FALL	EA461 EA467 EA465 EE332 ES300 NL400 PE420

Records 1 to 7 of 7

MAPRs

Course	Course Title	Section	Marking Period	Purpose	Created By	Creation Date
EA322	AEROSPACE STRUCTURES I	3111	6 WEEK	6WK/12WK/END OF TERM	MACKNEY	26-FEB-99
EA365	ROCKET PROPULSION	4321	6 WEEK	6WK/12WK/END OF TERM	KARPOUZI	24-FEB-99
EA364	SPACECRAFT ATTITUDE DYNAMICS AND CONTROL	6001	6 WEEK	6WK/12WK/END OF TERM	BRSMITH	25-FEB-99
EA364	SPACECRAFT ATTITUDE DYNAMICS AND CONTROL	6001	12 WEEK	6WK/12WK/END OF TERM	BRSMITH	09-APR-99
EA307	ENGINEERING ANALYSIS	1001	12 WEEK	6WK/12WK/END OF TERM	NIEWOEHN	08-APR-99
EA307	ENGINEERING ANALYSIS	1001	END OF TERM	6WK/12WK/END OF TERM	NIEWOEHN	10-MAY-99

Records 1 to 6 of 6

Special MAPRs

No Records returned

Figure 5: Page 3 Midshipmen Information Output

Page 3 displays the midshipman's final course grades at the USNA. It also presents the Midshipman Academic Performance Report (MAPR) and any special MAPRs if on record. Figure 6, represents the fourth and final page of the Midshipmen information output.

Parents

Addressee	Emerg Cont	Relationship	Addr Line 1	Addr Line 2	City	State	Zip	Country	Phone	Ac Disclose	Mil Disclose
[redacted]	YES	PARENTS	RT 3 BOX 175B		SILOAM SPRINGS	AR	72761		[redacted]	YES	NO

Record 1 of 1

Leave Periods for COMRATS

No Records returned

Record Leave for COMRATS

Leave Addresses

No Records returned

Record Leave Addresses

Personal Note

No Records returned

Add new Personal Note record

Help | MIDS Home | Academic Center | Academic Dean | Commandant's Staff
Department Chair | Faculty | General Academics | Midshipmen | MISO
Mid Personnel Office | Registrar

Figure 6: Page 4 Midshipmen Information Output

Page 4 displays the midshipman's relative/emergency contact information; information on the leave dates/periods and the midshipman's location during leave. Page 4 allows the

company officer to enter leave periods for COMRATS, leave addresses, and to add a personal note on a specific midshipman.

This is the only report the company officer is able to generate from MIDS. Each report is specific to an individual midshipman. There are no consolidated company-wide views. If company officer's would like to access more information, they must use the AD HOC query option of the MIDS program. Inside the AD HOC query option, they can request a query to provide other pertinent information. For the purposes of this research, access to enter the AD HOC query section of the MIDS program was denied. By only providing one report, the Company Officer Module lacks flexibility and is limited in its capability to provide the company officer with any comparative analysis at this point in time.

C. DATA REQUIREMENTS/ANALYSIS

The user's information needs were gained through extensive interviews with company officers and is documented in Chapter III. To satisfy the data needs that drive the COMIS prototype, three areas were examined:

- USNA Company Key Result Areas (Chapter III)
- Current MIDS Company Officer Module
- Former in-house database tool "Brigread Plus" created by Chief Petty Officer Canfield in Paradox 7.

During the course of this research, the MIDS Company Officer Module was just coming online. The COMIS prototype is being developed as an enhancement tool for the MIDS Company Officer Module. At this point in time the MIDS application is limited in its

ability to provide certain functionality and flexibility to the company officers. The COMIS prototype provides the desired functionality and flexibility as per the performance measures laid out in Chapter III.

The current MIDS Company Officer Module has a 25-table data model with existing relationships. In order to make the prototype as compatible as possible to the MIDS program, the exact same model is used. The database tool "Brigread Plus" created by Chief Petty Officer Canfield coupled with a personal visit to USNA in March 1999, provides insight on company officers' desires for displayed information. Finally, an in-depth comparison is conducted between the data desires of company officers and the existing MIDS company officer module data. The result of the analysis is the COMIS data model. The COMIS data model consists of 30 tables (25 MIDS tables and 5 new tables). The five new tables reflect data required and tracked internally by company officers not currently provided the MIDS application. The five tables are populated via keyboard input by company officers. The complete model will be described in detail in Chapter V. Figure 7 graphically depicts the COMIS model analysis process.

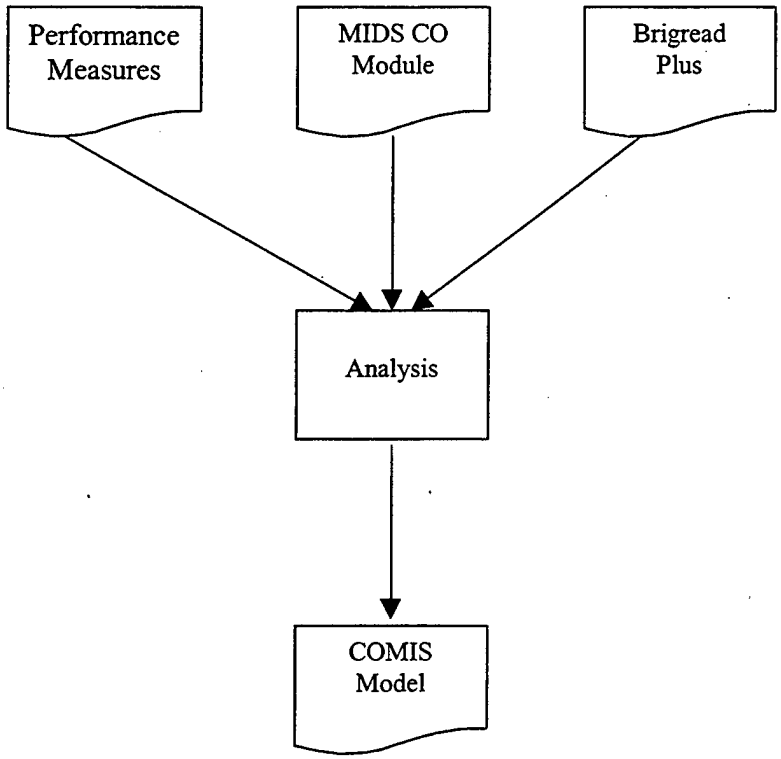

Figure 7: COMIS Analysis Process

The final model was created after two iterations of comparative analysis. During the first iteration, a comparison is conducted between the MIDS Company Officer Module and the performance measures in Chapter III to determine what information is already in the module and what information will be added. Finally, the results of the first iteration were compared with the "Brigread Plus" tool to determine if any further information could be used to enhance the COMIS model. The CASE tool "Salsa for the Desktop" from Wall Data, Inc. is used to create the tables and relationships. The generate database utility within Salsa is used to convert the COMIS model to Access 97.

D. PROCESS MODELING

1. Context Level Diagram

The context diagram of Figure 8 gives an overview of the system and shows the system boundary, external entities (Company Officers and MIDS) that interact with the COMIS prototype, and major information flows between the entities and the COMIS prototype.

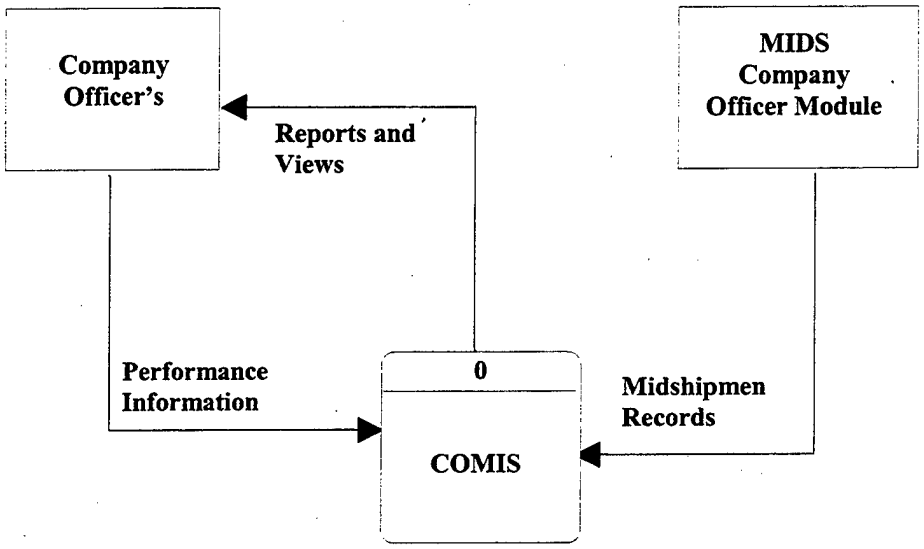

Figure 8: COMIS Context Level Diagram

As depicted in Figure 8, the COMIS prototype receives all MIDS midshipmen records. The company officers can enter or update all midshipman performance information. The company officers will have the option to view any report via monitor or printout. The COMIS prototype in this research does not cover how the midshipmen records will be imported to the COMIS prototype. This task would entail the writing of an extraction program that would properly format the data into an Access 97 ".mdb" file.

The COMIS prototype presumes midshipmen records have already been imported and focuses on how the data is presented and used by the company officers.

2. Data Flow Diagram

The data flow diagram of Figure 9 shows the inter-relationships among the movement of data between external entities (Company Officers and MIDS) and the processes and data stores within the COMIS prototype.

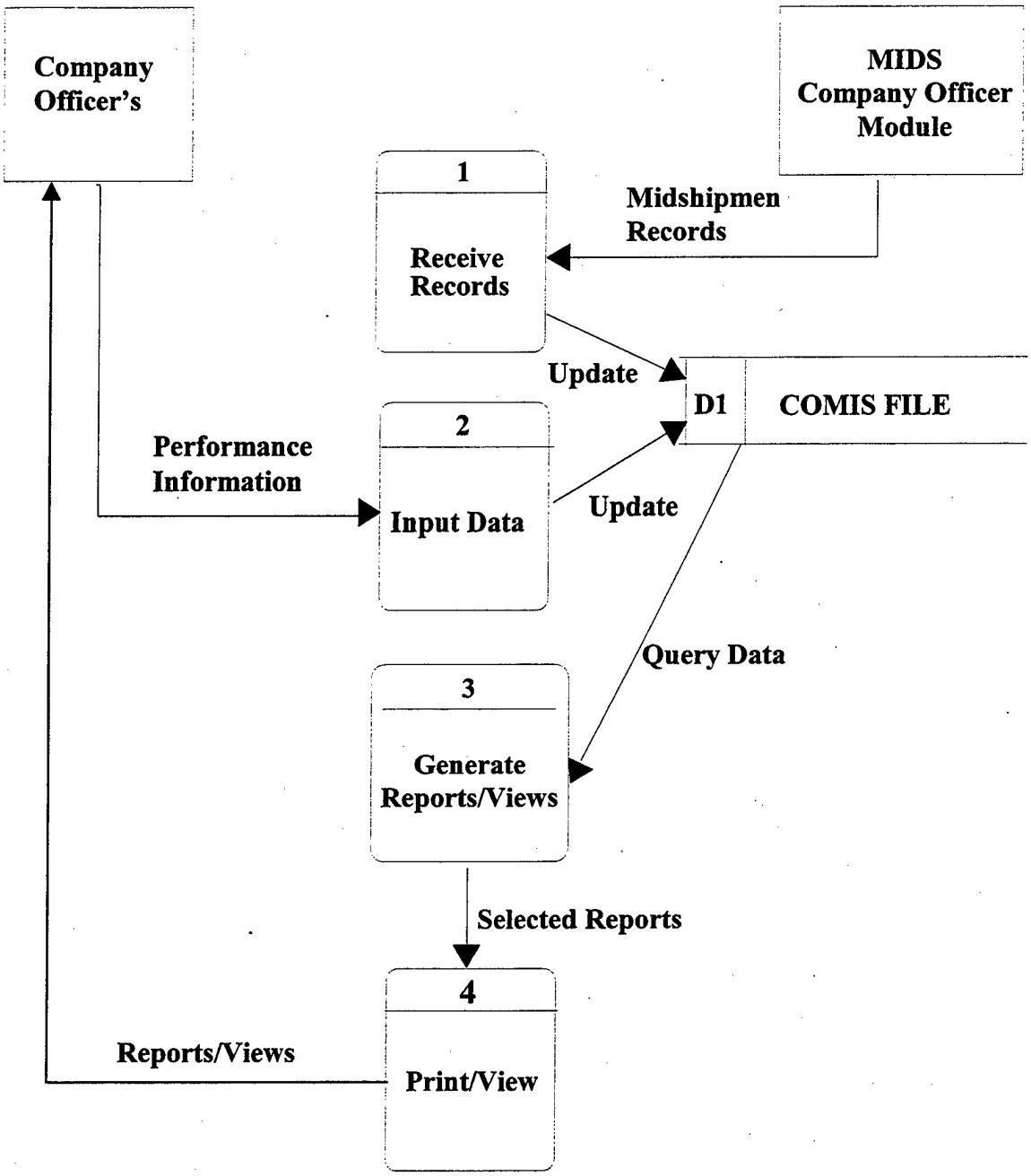

Figure 9: COMIS Data Flow Diagram

As depicted in figure 9, the COMIS prototype operates using four processes. The first process is receiving midshipmen records from the MIDS Company Officer Module. After record receipt, records are saved in the COMIS file. The company officers then input respective performance information on a midshipman and update the COMIS file. The company officer then generates desired reports and selects which medium to view with.

E. PLATFORM CONSIDERATIONS

1. Software Requirements

Minimum software requirements include a Windows 95 or later operating system and Microsoft Access 97. A run-time version of the COMIS prototype is available if company officers do not have access to Microsoft Access 97.

2. Hardware Requirements

Software requirements drive hardware requirements. To use the COMIS prototype, minimum hardware requirements include an IBM (or compatible personal computer) with an 80486SX-33 or higher processor, 12 MB of RAM, VGA monitor, and a mouse or some other pointing device. A printer is optional, but necessary for printing generated reports.

To maximize the full capability of the COMIS prototype, we recommend all hardware should be IT-21 compliant. The IT-21 standards for hardware are:

- 200 MHz Pentium Pro CPU
- 64 MB EDO RAM

- 3.0 GB Hard drive
- 3.5 inch floppy disk drive
- 8X IDE CD-ROM
- Dual PCMCIA/PC Card Reader
- PCI Video with 2MB RAM
- 17 inch monitor with 1280-1024 resolution
- Point device (trackball or mouse) and keyboard
- SoundBlaster (compatible) audio card with speakers
- CPU compatible 100 MBS fast Ethernet NIC

F. CHAPTER SUMMARY

This chapter reviewed the analysis process used to determine COMIS requirements based on the user needs within our development constraints. The next two chapters of this research describe the design phase. Chapter V outlines the logical design of the COMIS prototype.

V. LOGICAL DESIGN

A. INTRODUCTION

Logical design follows the requirements analysis phase and is often the first phase of the systems development life cycle. This chapter focuses on how the COMIS prototype interfaces with the users. The "look and feel" of all system inputs, outputs, and interfaces and dialogues is described. Finally, the data model is developed as a result of the analysis phase. For the purpose of this research, all information gathered from the USNA is as of 1 May 1999 and there have been no changes or additions to the Company Officer Module as of 15 August 1999.

B. FORMS AND REPORTS

Designing the forms and reports for the COMIS prototype was addressed during the analysis phase of this research. A prototyping methodology of iteratively collecting information, constructing a prototype, assessing usability, and making refinements was followed. The benchmark for design came from the in-house database tool "Brigread Plus" developed by Chief Petty Officer Canfield. Coupled with interviews conducted by LT Michael J. Boone, an understanding of company officers' needs and desires for forms and reports was reached.

1. Types of Forms

The COMIS prototype incorporates two versions of forms. One type of form has pre-defined data and includes some areas/fields where additional data will be entered by

the company officer or a designated representative. The second type of form is strictly for data input to populate the database tables.

All reports contain pre-defined data. The reports are passive documents used solely for viewing by computer monitor or reading by hard copy printing. The company officer has the choice of which medium to use when generating reports.

2. Usability

Usability is the overall evaluation of how a system performs in supporting a particular user for a particular task. The three main factors considered in designing the forms and reports for the COMIS prototype are:

- Speed – Can the user complete a form efficiently?
- Accuracy – Does the output or view provide what is expected?
- Satisfaction – Did they like using or viewing the output?

The goal is to provide a user-friendly environment by assisting, rather than hindering, user performance. The COMIS prototype provides a report manager option to generate multiple query type reports. This feature provides more flexibility, functionality and time responsiveness. This feature is a great advantage over the current AD Hoc query list system currently being used.

3. Outcomes and Deliverables

A sample draft design of menus, forms, and reports is provided in Appendix A.

C. INTERFACES AND DIALOGUES

The same prototype methodology used in designing the forms and reports is used to design the interface and dialogues for the COMIS prototype. Again, the intent of the design is to assist and not hinder user performance.

1. Interaction

There are five widely used styles currently deployed to design interaction between user and an information system: command language, natural language, menu, form, and object. The COMIS prototype incorporates the last three styles. These three styles are used to develop a usable and user-friendly interaction between user and information system. The same interaction convention used in Microsoft software applications was used to achieve this user-friendly interface. This format provides the company officer a familiar set of menus, icons, and toolbars with the COMIS prototype. In some cases, a combination of styles is used to enhance interaction.

a. Menu Interaction

A significant amount of interface design research was conducted to stress and enhance the importance of the system's ease of use and understandability. Menu interaction is the means to achieve ease of use and understandability. A menu is simply a list of options; when the user selects an option, a specific command is invoked, or another menu is displayed or activated. The COMIS prototype takes advantage of the combination of two styles of menus. The first one is the Pop-up menu. In a pop-up menu, menus are displayed near the current cursor position so users do not have to move

the position or their eyes to view system options. With respect to the COMIS prototype, a pop-up menu shows a list of commands relevant to the current cursor position (for example: delete, clear, or copy current field). The pop-up menu is invoked by performing a right click on the pointing device. The pop-up menu also provides a list of possible values (from a look-up table) to fill in for the current field. The second menu style is the drop-down menu. In a drop-down menu, menus drop down from the top line of display and give the user certain options (for example: save, save as, and exit). This type of menu provides consistency in menu location for the user and is commonly used in Windows applications.

b. Form Interaction

The premise of form interaction is to allow users to enter new data or update existing data when working with a system. Form interaction is the most effective way for both the input and presentation of single record information. To effectively design the forms, self-explanatory titles and field headings are used. Fields are grouped into logical groupings and default values are provided where practical. Finally, data is displayed in appropriate field lengths, to minimize the need to scroll up and down windows.

c. Object-based Interaction

Object-based interaction is a method of interaction where symbols are used to represent commands or functions. The most common method is through the use of icons. Icons are graphic symbols that look like the processing option they represent. The user selects the operation by "pointing and clicking" on the icon. The primary

advantage of icons is that it takes up little screen space and can quickly be understood by most users. An icon also looks like a button. When the icon is selected or depressed the system takes action relevant to the form. The COMIS prototype uses the standard Windows icon convention in order to enhance understandability.

2. Interfaces

a. Layouts

To minimize user training and data recording, the COMIS prototype uses standard Windows formats. Standard screen navigation flows from left to right and top to bottom similar to paper-based forms. Flexibility and consistency are primary considerations. Users are able to freely move forward and backward or to any desired data entry fields. Users are also able to navigate each form in the same way. Additionally, data is saved only when explicitly requested by the user. This allows the user to abandon a data entry screen, backup, or move forward without impacting the contents of the permanent data. Consistency is achieved by using a known layout (Windows format) throughout the entire system.

b. Structuring Data Entry

To minimize data entry errors and user frustration, the COMIS system never requires the user to enter information that is already available within the system or that the system can easily compute. Field formatting and data entry prompts will make it provide clear guidance on the type of data required. A caption, a combo box, or drop down list is adjacent to the respective data field. When the data is entered, it is

automatically justified in the standard format (e.g., date, time, telephone number, etc...). The use of radio buttons or check boxes are used to allow users to choose standard textual responses.

c. Controlling Data Input

The overall objective of the interface is to reduce data entry errors. As data is entered into the COMIS system, Microsoft Access 97 validates the entry to ensure the user is entering the correct datatype for the specified field. The majority of data errors occur from appending extra data onto a field, truncating characters off a field, transcripting the wrong characters into a field, or transposing one or more characters within a field. The COMIS prototype takes advantage of Access 97 by utilizing its validation test for each field. The prototype sends a message to the user announcing the error and allows for correction. Also, the combination of reviewing forms and reports before permanently saving them will assist in resolving errors in data input.

3. User Access

The final step in designing the interface is to decide which forms of user access controls are necessary and select the mechanisms, which maximize application security. The COMIS prototype incorporates two user access techniques, views and authorization rules, and also complies with existing and future USNA organizational procedures. The USNA Database Administrator (DBA), issues passwords in accordance with existing USNA organizational procedures.

a. Views

A view is a subset of the database presented to the user. As long as the user has access to a particular area of the prototype, system support to that area is provided. Users of the COMIS prototype only have access to the forms and reports. No access is permitted to the table structure/data structure, queries, macros, or modules. Only the USNA Database Administrator (DBA) will have access to these views. Any requested changes or creating of new data must be requested through the DBA or within current USNA organizational procedures.

b. Authorization Rules

Authorization rules are controls incorporated in an application or system software that restrict access to data and also restrict the actions that a user can take when data are accessed. The COMIS prototype authorization rules are outlined in Figure 10.

COMIS Authorization Rules			
	USNA DBA	**Company Officer**	**Legend**
Records:			
MIDS Tables	**R W M D G**	**R**	**R = Read**
Mental	**R W M D G**	**R W M D**	**W = Write**
Moral	**R W M D G**	**R W M D**	**M = Modify**
Physical	**R W M D G**	**R W M D**	**D = Delete**
Professional	**R W M D G**	**R W M D**	**G = Grant**
Weekend	**R W M D G**	**R W M D**	
Forms Design	**R W M D G**	**None**	
Forms Query	**R W M D G**	**R**	
Reports	**R W M D G**	**R**	
Reports Design/Queries	**R W M D G**	**None**	

Figure 10: COMIS Authorization Rules

The company officer has read-only authorization on the 25 MIDS tables and read, write, modify, and delete on the five performance-measurement-based tables added to the model. With respect to forms and reports, the company officer has read-only authorization. Any modifications as stated above must be requested through the USNA DBA.

D. DATA MODELING

1. Entities/Tables

The collections of fields that share common properties or characteristics are called tables. The COMIS prototype has 30 tables. The following 25 tables and descriptions correspond to the tables obtained from the MIDS Company officer module:

- **tblAC_BOARD_CASES** - This table will hold all academic board case information.
- **tblAC_DEFICIENCIES** - This table stores the academic deficiencies for midshipmen each semester.
- **tblADV_ASSIGNS** - This table indicates an area an individual is assigned to provide guidance.
- **tblCONFIDENTIAL_COMMENTS** - This table stores comments about a specific midshipman.
- **tblCOUNTRIES** - This table stores the country of a person's birth or citizenship to include U.S. territories.
- **tblCOURSES** - This table holds the unit of instruction offered over time at the USNA.
- **tblCOURSE_OFFERINGS** - This table stores the courses offered for a specific academic year and semester.
- **tblKINS** - This table stores addresses and telephone numbers of midshipmen's relatives

- **tblLEAVE_ADDRESSES** - This table stores leave addresses for a specific midshipman when on authorized leave.

- **tblLEAVE_PERIODS** - This table stores specific leave date(s) recorded by a midshipman.

- **tblMAJORS** - This table stores the areas of study and knowledge in which a midshipmen may specialize.

- **tblMAPRS** - This table stores data from the Midshipmen Academic Performance Report.

- **tblMIDSHIPMEN** - This table stores all the personal data of a person who is attending the USNA

- **tblMID_EXCUSES** - This table stores any midshipmen's excuse for an absence from a section for a date and period, including tardys and early departures.

- **tblMID_GRDS** - This table stores the grades a midshipman receives for a marking period and course for a semester. Academic, military, and validated courses are included.

- **tblMID_MAJ** - This table stores the major(s) a midshipman has indicated preference for or has been assigned.

- **tblMID_SEMS** - This table stores information pertaining to a midshipman for a specific academic year and semester.

- **tblNON_MIDS** - This tables stores the personal information of a person who is or has been employed at the USNA including faculty, staff, and volunteers.

- **tblSCHEDS** - This table stores the courses assigned to or selected by a midshipmen form the list of offered courses and the sections preferred by or assigned to a midshipmen during a specific academic year and semester.

- **tblSECT_ABSENCES** - This table stores an absence from a section for one date for one period for one midshipman. Includes tardys and early departures.

- **tblSECT_OFFERS** - This table stores divisions of an available course that will be taught for one or more periods during a semester.

- **tblSECT_TIMES** - This table stores the set of valid meeting times.

- **tblSEM_BLK_DATES** - This table stores the start and stop dates of each block during a semester. Blocks are the time periods each semester is broken into. Fall and spring have one block and summer has three blocks.

- **tblSERV_ASSIGNS** - This table stores the valid community assigned to first class midshipmen during service assignment.

- **tblSTATES** - This tables stores all state names for the United States.

The following five tables and descriptions are developed into the COMIS prototype to capture performance measurement data not provided by the MIDS program.

- **tblMental Development** - This table stores midshipman academic and study related information.

- **tblMoral Development** - This table stores information related to conduct and external midshipman behavior.

- **tblPhysical Development** - This table stores all midshipman physical readiness data.

- **tblPrivileges** - This table stores all midshipman earned and loss privileges information.

- **tblProfessional Development** - This table stores all midshipman professional information and inspection results.

2. Relationships

A relationship between tables is an association between the instances of one or more tables that is of interest to an organization. The COMIS prototype uses the relationships provided by the MIDS Company Officer Module and then further develops relationships to properly relate and integrate the five additional performance-measurement-based tables. The relationships also assist in maintaining referential integrity throughout the model. See Appendix B for all COMIS prototype relationships.

3. Entity-Relationship Diagram (ER Diagram)

An Entity-Relationship diagram is a technique for representing the logical structure of a database in a pictorial manner. The ER diagram facilitates communication to verify data requirements between the database designer and the end-user. Figure 11 depicts the ER diagram with crow's foot showing only primary and foreign keys for the COMIS model.

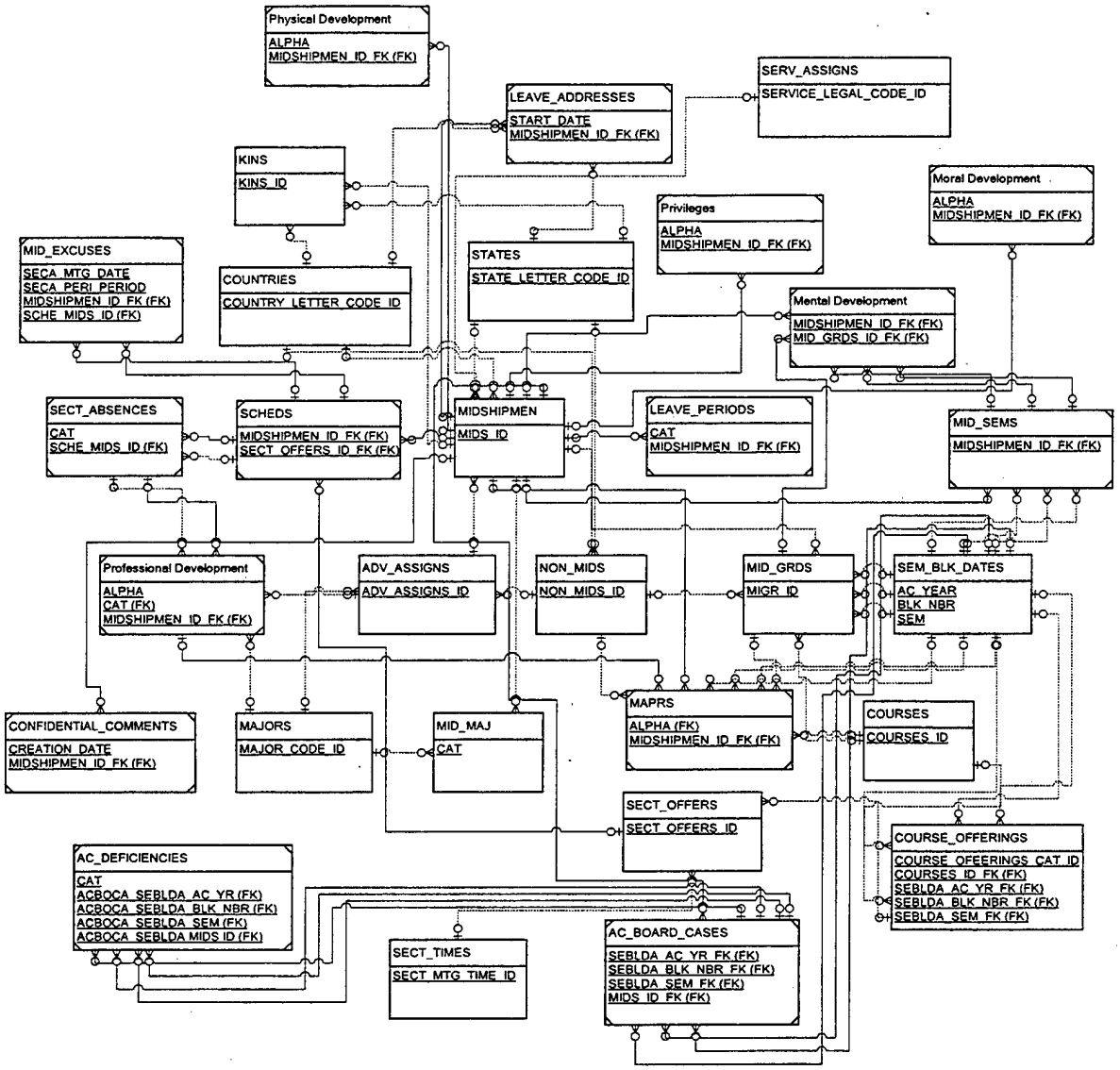

Figure 11: COMIS Entity-Relationship Diagram

Visio Professional 5.0a is the CASE tool used to develop the COMIS ER diagram. This case tool conducts an analysis of the COMIS prototype by mapping the database and generating the diagram from Microsoft Access 97. See Appendix C for the complete COMIS Model ER diagram with crow's foot.

4. Normalization

Normalization is a step-by-step process for analyzing data in relations and redesigning these relations to prevent update anomalies. By normalizing a database optimum structure is achieved. It is built around the concept of normal forms. First normal form (1NF) dictates that all column values must be atomic. This means that one field in a row must contain only one value. Second normal form (2NF) is dictated when 1NF conditions are met and every non-key column is fully dependent on the entire primary key. This means that tables should only be storing data on one thing that's described by the primary key. Third normal form (3NF) is dictated when 2NF conditions are met and if all non-key columns are mutually independent. This means that all non-keys fields must not have inter-field dependencies. They must be fully dependent on the primary key and not each other. Higher normalization exists, but most of the benefits of normalization are realized by normalizing to 3NF. Therefore, the COMIS prototype is normalized to 3NF.

E. CHAPTER SUMMARY

This chapter reviewed the logical design of the COMIS prototype. By effectively designing a good user interface and developing a properly related and normalized data model, the company officers can make better performance decisions on their

midshipmen. The user interface is the key to the successful implementation of the COMIS prototype. Chapter VI outlines the physical design of the COMIS prototype.

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VI. PHYSICAL DESIGN

A. INTRODUCTION

Physical file and database design is the natural, succeeding step after logical data modeling. Physical design produces the technical specifications that will be used during the implementation phase of systems development to create and populate files, file organizations, and databases. The goal of physical design is data processing efficiency. In other words, the prior system development and life cycle stages concentrated on "doing the right things," whereas physical design focuses on "doing the right things right." One goal of good design is to develop a physical system design that will minimize the time required by users to interact with the system. This means shortening data retrieval time and computer job turnaround time. Thus, this chapter concentrates on how to make processing of physical files and databases efficient, with less attention on efficient use of space. As part of the information gathering, the following requirements are needed:

- Normalized relations
- Definitions of each attribute
- Descriptions of where and when data are used; entered, retrieved, deleted, and updated (including frequencies)
- Expectations or requirements for response time and data integrity
- Descriptions of the technologies used for implementing the files and database so that the range of required decisions and choices for each is known

Included in this phase are a number of critical decisions that will affect the integrity and performance of the application system. These key decisions include the following:

1) Choosing the storage format (called data type) for each attribute from the logical data model; the format is chosen to minimize storage space and to maximize data integrity. Data type involves choosing length, coding scheme, number of decimal places, minimum and maximum values, and potentially many other parameters for each attribute.

2) Grouping attributes from the logical data model into physical records (in general, this is called selecting a stored record, or data structure).

3) Arranging related records in secondary memory (hard disks and tapes) so that individual and groups of records can be stored, retrieved, and updated rapidly (called file organizations). Consideration must be given also to protecting data and recovering data after errors are found.

4) Selecting media and structures for storing data to make access more efficient. The choice of media affects the utility of different file organizations. In this case we are using a database management system and the primary structure used is primary and secondary keys.

Many of these requirements and decisions are already made because the COMIS prototype is modeled after the existing MIDS structure. The MIDS tables are normalized, the fields are defined, and all data updates to MIDS are done internally. This will ensure that the COMIS prototype is as compatible as possible with the MIDS system and facilitates future integration. However, for the additional requirements to comply with company officer performance measures that are not part of MIDS, additional tables that matched those requirements were added, as stated on Chapter IV. The Data dictionary for the COMIS prototype is provided in Appendix D.

B. DESIGNING THE FIELDS

Fields are the smallest unit of application data recognized by system software, such as Microsoft Access 97. Several fields may represent an attribute from a logical data model and each field requires a separate definition in the application system. A data type is a detailed coding scheme recognized by system software for representing organizational data. Selecting a data type involves four objectives that are important for the COMIS prototype:

1) Minimize storage space
2) Represent all possible values
3) Improve data integrity
4) Support all data manipulations

The bit pattern of the coding scheme is transparent, but the space to store data and the speed required to access data are of consequence in the physical file and database design.

Using Access 97, all fields in the MIDS company officer module are matched to new fields in COMIS using the same data types. However, with respect to integer values Access 97 provides different integer types such as byte, short, integer, long, and double each type stores different lengths. Therefore, only integer and long integer are used in COMIS. Both types ensure that all MIDS integer values fit each type of numerical code or input in COMIS without wasting extra memory.

In Access 97, there is a data type called *variant* that will allow data of all types to be put inside the field. Using variant data types is considered poor programming and it is not used in COMIS. Each data type is explicitly declared and matched to the original

MIDS company officer module field so that there is the greatest chance for future integration with MIDS.

1. Data Integrity

The use of different data types by themselves helps control data integrity by limiting the possible range of values for a field. There are additional methods that are included in COMIS to make the data integrity as error free and integration capable as possible.

For certain fields, a *default value* is used. This means the assigned value a field will assume unless an explicit value is entered for the field. Assigning a default value to a field can reduce data entry time and helps reduce data entry errors. In addition for any fields with only a certain number of possible values, a drop down list is included to display only the required codes or values for that particular field. This ensures the data is entered correctly as stated in Chapter V.

Input masks are another method of ensuring data integrity. They assist the user in inputting the data in the proper format such as dates and times. For example, text fields are formatted to force all uppercase letters. This ensures that the text fields present a uniform appearance throughout the application. This way if a user inputs upper and lowercase text, only uppercase letters are displayed.

Another powerful feature is validation rules. Validation rules allow the input of data that meet only a certain range of values. If the data inputted does not meet that range, an error message tells the user what are the appropriate values. In addition, control

tip text by the mouse over a field allows the user to see a small "help tip" to better identify what is required for a value.

Referential integrity is a means in a relational database to update information in tables based on one-to-many and many-to-many relationships. It is defined as limiting values for a given attribute to the existing values of another attribute in the data model. The most common example of this is cross-referencing between relations such as updating an ID field between two related tables. Access 97 allows for two types of relational update that use referential integrity, cascade update and cascade delete. With cascade update referential integrity turned on, the ID value is automatically populated to the related table without requiring the user to re-input the same information and potentially making a mistake. Cascade delete is not used or enabled to prevent accidental deletion of records. Referential integrity acts like a dynamic table look-up. Whereas a range control limits a field to those values found in a table defined when the files and databases were created, referential integrity says that a field is limited to those values currently in some field found in the database. Since it is cross referencing between relations that hold a relational database together, it is critical that all possible referential integrity controls be defined in relational databases.

Null values are another means of controlling data integrity. A null value is a special field value, distinct from 0, blank, or any other value, that indicates that the value for the field is missing or otherwise unknown. Usually when you apply a referential integrity restriction in a field, it implies that the field may not be null or empty. When a field may be null, there is a question of how to handle null values in processing data. For the purposes of the COMIS prototype, all data that is coming from the MIDS database

and any missing data will be resolved at that level. The COMIS prototype is not designed to edit or update MIDS data at this time.

C. DESIGNING PHYSICAL RECORDS

A physical record is a group of fields stored in adjacent memory locations and retrieved together as a unit. The design of a physical record involves choosing the sequence and grouping of fields into adjacent storage locations to achieve two goals: efficient use of secondary storage and data processing speed. Access 97 automatically assigns these page faults for optimum use. Additional performance improvement configurations are possible to the computer itself in the registry options, defragging the hard disk, compacting the database, increasing the amount of RAM inside the client computer, and optimizing virtual memory settings.

For COMIS, considering the relatively small amount of records that would be stored on a company officer's computer, as long as the PC meets the recommended hardware requirements outlined in Chapter IV, there should be no problem handling the processing necessary to manipulate the data.

D. DESIGNING THE PHYSICAL FILE

A physical file is a named portion of secondary memory (a hard disk) allocated for the purpose of storing physical records. Some computer operating systems allow a physical file to be split into separate pieces and Access 97 is no different. This is covered in detail in the proposed file design implementation in a multi-user environment later in this chapter. In the meantime, our design has the physical records residing on the local

machine. The next section will review the different types of files that will be in the COMIS prototype

1. Types

Data File (Master File) – The file that contains the business data related to the conceptual and logical data models for application. The file is permanent but the contents change. Data files should be designed for both random and sequential processing speed, storage efficiency, and accommodate changes in size.

Look-Up Table File – A list of reference data used to validate field values in one or more data files. These files are static and are designed for rapid data retrieval of individual entries.

Protection File – Also called a backup file, this file is used to restore other files in case other files are damaged. The COMIS prototype will include a complete backup strategy that will work in conjunction with the existing Naval Academy architecture.

2. Access Methods

All I/O operations are ultimately handled by the data management portion of the computer's operating system. Each operating system supports one or more different algorithms for storing and retrieving data and these algorithms are called access methods. This understanding is fundamental to good design.

There are basically two types of access methods: relative and direct. A relative access method supports accessing data as an offset from the most recently referenced point in secondary memory. A sequential access method is a special case of this type since the "next" record begins the distance of one record from the beginning of the

current record. In general, a relative access method supports finding the *n*th record from the current position or from the beginning of the file. A direct access method uses some calculations to generate the beginning address of a record. The simplest form of a direct method is to tell the access method to go to a particular disk address. Another variation is to provide a record's primary key and the direct access method determines where this record should be located. This access method is discussed under the more inclusive concept of file organizations in the next topic.

3. File Organization

File organization is a technique for physically arranging the records of a file on secondary storage devices. In choosing a file organization for a particular file, we took the following factors into mind:

- Fast data retrieval
- High throughput for processing transactions
- Efficient use of storage space
- Protection from failures or data loss
- Minimizing need for reorganization
- Accommodating growth
- Security from unauthorized use

There are many different types of file organizations and other variations, but for Access 97, the type used is called the indexed file organization. Here the records are stored sequentially or non-sequentially and an index is created that allows the application software to locate individual records. Like a card catalog in a library, an index is a table

that is used to determine the location of rows in a file that satisfy some condition. Each entry matches a key value with one or more records. An index can point to unique records (a primary key index, such as on an ID field) or to potentially more than one record. An index that allows each entry to point to more than one record is called a secondary key index. Secondary key indexes are important for supporting many reporting requirements and for providing rapid ad hoc data retrieval.

The main disadvantages to indexed file organizations are the extra spaces that are required to store the indexes and the extra time required accessing and maintaining indexes. These disadvantages are more than offset by the advantages. Since the indexes are kept in sequential order, both random and sequential processing are practical. More discussion on indexes will follow later in this chapter.

4. Controls

Controls are the mechanisms for protecting the files from corruption and contamination. Field data integrity controls help do this as already discussed and two other procedures are backup and security.

The easiest approach for file backup is to specify that all files will be periodically copied onto a separate electronic medium and stored off site from the current versions. These files can be backed up using the existing file server backup strategy of the Naval Academy. Reloading the tape and overwriting the corrupt data can then accomplish recovery from backup. For each individual file loaded on the company officer's desktops, they can back up their data to a back up file located on their hard drive, or to their secured network folder on the file server.

Application security is another important issue because it prevents users from making design changes to complex objects, having people accessing sensitive information, or any number of other considerations. A benefit of Access 97 is that it provides two main alternatives to help control this problem: share level and user level security. Share level is the most common, but also the least secure. It is not meant for real security. The most powerful and flexible method is called user-level security.

Access 97 is unique in that, unlike most security models of other database systems, the primary form of security is user-level security rather than share-level security. User-level security is the only form of Access 97 security that allows you to establish different levels of permissions to sensitive data and objects. This security model is similar to the security used in most network environments, such as NT Server 4.0. When users start Access 97, they enter a name and password in the Logon dialogue box. The password confirms the users' identity by checking the name and password against data in the workgroup information file. The user, without affecting anyone else on the system, can change the password at any time. When users log on, each user is also identified as a member of one or more groups and each user has permissions to all the objects that the group has permissions for. To implement this level of security is a complex process and it may exceed the Naval Academy's requirements. This security model is workgroup based and a firm understanding of the workgroup administration is required before any attempt should be made to utilize this type of security.

A more appropriate model for the Naval Academy, at this stage of development, is share level security. Access 97 provides alternative methods of share level security that can be used to help give basic protection to the application:

- Using startup options to restrict access to default menus and toolbars, the database window, and special keys.
- Establishing a password to control opening the database.
- Saving the application as an MDE file to remove Visual Basic source code and prevent changes to the design of forms, reports, and modules.

In the Naval Academy environment, the startup options can restrict access to default menus and toolbars, the database window, and special keys. Another easy implementation is adding a database password to prevent unauthorized users from opening the application. This approach is used when one needs to control which users can open the application, but not what they do after providing the correct password. This method is only as good as the security of the password chosen.

Another common and easy way to prevent users from changing the application design is to create a MDE file. A normal Access 97 database is a MDB file. An Access 97 MDE file is a special file type that enables the application to work just like the normal MDB file, however it removes all of the background code and prevents users changing the design of forms and reports in the application. This approach does not require users to log on or require one to create and manage the user accounts and permissions required by user-level security. However, an MDE file does not control how users access the application's tables, queries, and macros. If more control is needed, then user-level security should be established before one saves the database as an MDE file.

The problem with these share level security approaches is that it does not prevent someone from using a disk editor or other utility program to read the data without opening the database. To prevent this, one can encrypt the database. Encryption makes a

database indecipherable, which protects it from unauthorized viewing or use, particularly during electronic transmission or when it's stored on floppy disk, tapes, or compact disc. The User-Level Security Wizard automatically encrypts the database and one can use the Security module in Access 97 to decrypt a database. Encryption is thus available for all methods of security protection.

E. DESIGNING THE DATABASE

Since a database is a collection of logically related data designed to meet the organizational needs of multiple users, a relational database management system (RDBMS) is required for data storage and retrieval. The RDBMS is the software that sits between application programs and the operating system and extends the capabilities of the operating system for organizing data.

1. Architecture

There are different styles of database management systems, each characterized by the way data are defined and structured, called database architectures. Access 97 as mentioned earlier is the database structure selected for the COMIS prototype. Access 97 is the Department of the Navy's IT-21 standard for relational databases. By using Access 97, as the Naval Academy gradually moves to a Microsoft Office suite of products, the COMIS database will already meet those standards.

Access 97 is a relational type database model, which is the most common model for new systems. This model defines simple tables for each relation and many-to-many relationship. Cross-reference keys link the tables together, representing the relationships

between entities and primary and secondary key indexes provide rapid access to data based upon qualifications.

2. Indexes

During this stage of design, fields are designated for use as indexes. Indexes are created for both primary and secondary keys and there is a trade-off between improved performance for retrievals and degrading performance for inserting, deleting, and updating the records in a file. Thus indexes are used extensively in COMIS because the main purpose of this database is data retrieval and there is no heavy updating.

The following guidelines are used for choosing indexes for relational databases:

- Specified a unique index for the primary key of each table, this ensured the uniqueness of the primary key values and speed retrieval based on those values.
- Specified an index for foreign keys used in joining tables. This also speeds processing multiple-table queries.
- Specified an index for nonkey fields that are referred to in qualification, sorting, and grouping commands for the purpose of retrieving data.

Selecting proper indexes is arguably the most important physical database design decision for performance improvement. Good primary keys are needed to enforce referential integrity rules. All primary keys are documented in the data dictionary provided in Appendix D.

F. DESIGNING A DISTRIBUTED SYSTEM

Distributed systems are systems that are spread over two or more locations and create a multi-user environment. This is the case at the Naval Academy where there will

be thirty company officers using this system based upon records pulled from the MIDS system. Because of this environment, there are numerous design issues that need to be considered due to their influence on the reliability, availability, and survivability of the system when it is implemented. Distributed systems also have more components than a single-location system – that is more processors, networks, locations, data, and so on – there are more potential places for a failure to occur. Consequently, various strategies can be used when designing and implementing distributed systems. For example, replicating all data elements across all distributed sites will enhance the reliability that a given piece of information will be available at a given time, and enhance the overall system survivability if a single node has a failure. Yet, replicating all data elements at all sites may not result in the best availability of information.

Thus, numerous trade-offs are considered that will influence reliability, survivability, and availability.

1. File Server Model

One way to manage a multi-user environment is over a local area network (LAN). A LAN is simply an interconnection of computers and other hardware that enable users to share resources. At the Naval Academy, each company has access to the LAN and there are file servers available to put the COMIS database on it so that it can be shared among the company officers. A file server is a computer that manages file operations and is shared by each client PC that is attached to the LAN. In essence, a file server acts as an additional hard disk for a client PC. In this type of environment as illustrated in Figure 12, all data manipulation occurs at the workstations where data are requested.

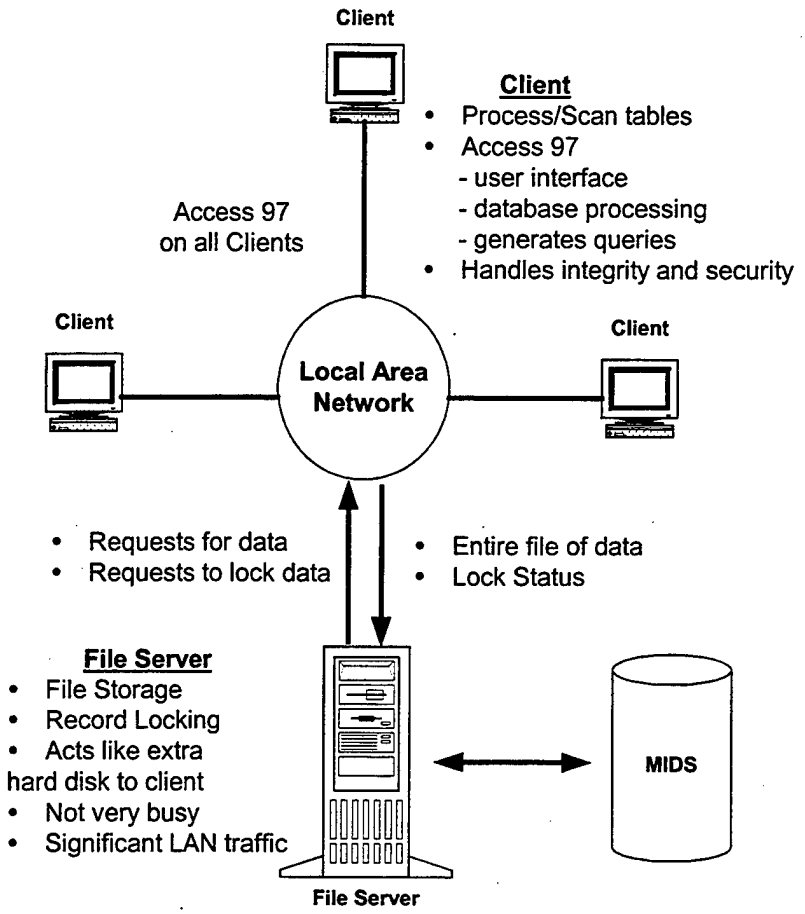

Figure 12: File Server Model

When using a RDBMS, such as Access 97, in this environment, each client PC is authorized to use the RDBMS application program on that PC. Thus, there is one database on the file server and many concurrently running copies of the RDBMS on each active PC. The primary characteristic of a client based LAN is that all data manipulation is performed at the client PC, not at the file server. The file server acts simply as a shared data storage device and is an extension of a typical PC. Software at the file server only queues access requests; it is up to the application program at each client PC, working with the copy of the RDBMS on that PC, to handle all data management functions. This

means that in an application that wants to view a single midshipman record in a database stored on the server, the file containing all midshipman account information will be sent over the network to the PC. Once at the PC, the file will be searched to find the desired record. Additionally, data security checks and file and record locking are done at the client PCs in this environment, making multi-user application development a relatively complex process. Thus the limitations of this environment are the following:

1) Excessive data movement
2) Need for a powerful client workstation
3) Decentralized data control

When using this type of architecture, considerable data movement is generated across the network. The whole table that has to do with whatever query or recordset that is being requested has to be moved across the network so that the client has a local copy on their computer. Thus, the server does very little work, the client is busy with data manipulation, and the network is transferring large blocks of data. Figure 13 illustrates file server architecture.

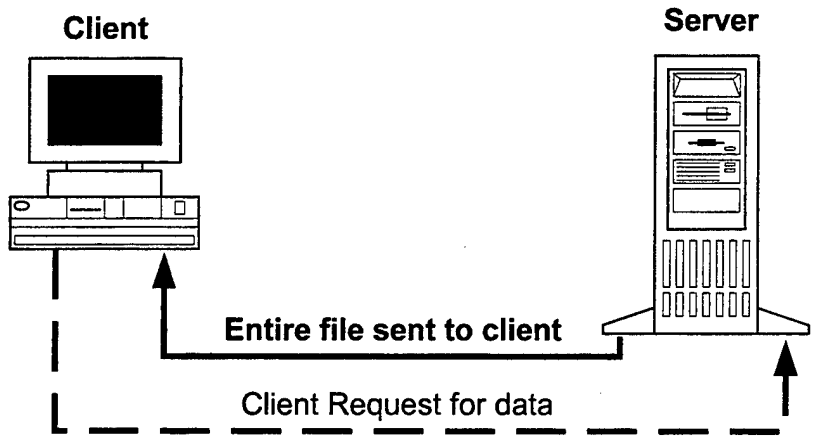

Figure 13: File Server Architecture

Consequently, a client-based LAN places a considerable burden on the client PC to carry out functions that have to be performed on all clients and creates a high network traffic load.

Second, older client workstations will have some difficulty manipulating all of the data because they will have a full version of the RDMBS on the client station. RAM and fast hard drives are important when it comes to processing information and if there are older workstations, then they will have difficulty. In a client-server environment, the server usually has a faster hard drive and more RAM so processing would be better on the server.

Third, the RDBMS must manage the shared database integrity. In addition, each application program must recognize, for example, locks on data and take care to initiate the proper locks. A lock is necessary to stop users from accessing data that are in the process of being updated. Thus, application programmers must be rather sophisticated to understand various subtle conditions that can arise in a multiple-user database

environment. Programming is more complex since one has to program each application with the proper concurrency, recovery, and security controls.

For the Naval Academy, this would mean keeping a main Access 97 COMIS program on a server that contains all of the records inside the database on a shared directory for the company officers to have access to. The company officers could then have a shortcut icon on their desktop and simply double click on it to load the program from the server over the network. The advantage is in its simplicity and ease for updates to COMIS, i.e., there is only one place to make design changes and every time the company officer loads COMIS, he could have the latest changes to COMIS. There are disadvantages to this approach, namely it would be difficult to maintain any confidential comments on the server without other company officers having access to those comments. With share level security it would be a laborious process to create all the different queries necessary to separate the data so that confidential comments are read only by the company officers who created them. This is not a desirable ideal approach.

2. Client/Server Architecture

Another type of system that can be implemented on a LAN is called a client/server architecture in which application processing is divided (not necessarily evenly) between the client and server. The client workstation is responsible for managing the user interface, including presenting data, and the database server is responsible for database storage and access such as query processing. All database recovery, security, and concurrent access management is centralized at the server, whereas this is the

responsibility of each user workstation in a simple LAN. This architecture is illustrated in Figure 14.

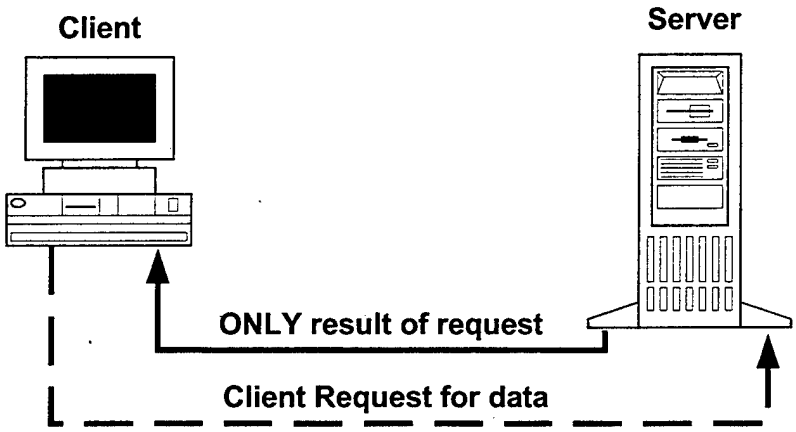

Figure 14: Client/Server Architecture

There are many advantages to this type of environment. Since the client is decoupled from the server, clients can consist of multiple types. As long as the application program can generate Structured Query Language (SQL) commands, then it does not matter what the client application program is running. The database server understands all the commands and sends the appropriate information to the client. Thus, this architecture allows for reduced network traffic and encourages open systems.

This architecture is used in robust network environments. Access 97, by itself, is not designed to work as an SQL server. Usually Access 97 is paired with Microsoft SQL server 7.0 or an Oracle database. Because of this architecture's flexibility, it also makes it very complex to implement. Numerous advanced level considerations for COMIS would need to be addressed before this type of system could be used. Embarking upon this project, the authors knew the importance of data security to the Naval Academy and that having direct access to that data would be prohibited. It would be possible to tie our

COMIS database into the Oracle database using linked tables from Access 97 directly to the Oracle database. However, due to security implications and differences in technology between Microsoft and Oracle we decided that the safest and most feasible approach at this point would be to pull the needed records out of MIDS. Thus, for the purposes of the Naval Academy and COMIS, this client/server architecture would be too difficult to implement at this point.

3. Recommended Solution for COMIS

Based upon these two types of architectures, neither one as presented seems to generate an acceptable solution for COMIS. We therefore settled upon a hybrid solution called replication.

Database replication is the process of copying a database so that two or more copies can exchange updates of data or replicated objects. This exchange is called synchronization. Each copy of the database is called a replica, and each contains a common set of tables, queries, forms, reports, macros, and modules. Each replica can also contain local objects that exist only in that specific replica.

In Access 97, each replica is part of a replica set, which contains the Design Master and the other replicas for a database. The Design Master is the only replica where you can make changes to the database's design and objects. Replicas that belong to the same replica set can synchronize with one another.

With replication the following actions are possible:

- Share data among the company officers in each company area throughout the Naval Academy: Replication creates copies of a database on each local machine. All of these copies are then synchronized with the main replica to

get all of the latest information and design changes. However, local replicas can maintain local tables that contain information not included in the other replicas in the set. This way the company officer can maintain confidential comments on a midshipman only on his local machine so that other company officers do not have access to that sensitive information.

- Make partial replicas: For each company officer, the COMIS application could just replicate only the records that apply to that company officer's midshipmen and thus furthering reducing network traffic. However, since each company officer at this point already has access to information on every midshipman, this probably will not be an option we will go with.

- Makes server data accessible: The COMIS application does need to have immediate updates to data, so network updates can be scheduled that best meets the user requirements and reduce network traffic. Replication requires less centralized administration of the database while offering greater access to centralized data.

- Distribute application updates: When the application in replicated, it automatically replicates not only the data in the tables, but also the application's objects. If changes were made to the design of the database, the changes are transmitted during the next synchronization exchange; therefore we would not have to distribute complete new versions of COMIS to each of the company officers every time there is a change to the program.

- Back up data: At first glance, database replication may appear to be very similar to copying a database. However, while replication initially makes a complete copy of the database, thereafter it simply synchronizes that replica's objects with the original objets at regular intervals thus keeping the network traffic low. This copy can be used to back up data if the original database is destroyed. Furthermore, users at any replica can continue to access the database during the entire backup process.

It is important to understand when this type of scenario is not ideal for distributed processing.

- There are large numbers of record updates at multiple replicas: For COMIS, this would not be the case, because COMIS would be pulling all the records out of MIDS so the replicas would not be updating any MIDS data. Therefore, there would not be any record conflicts during the synchronization process. All of these concerns would be addressed at the MIDS level

- Data consistency is critical at all times: If COMIS were an application that relied on up-to-the-second information such as funds transfer, airline reservations, etc. then replication would not be the preferred alternative. This is not the case at the Naval Academy. COMIS would simply pull out the needed records from MIDS and have it accessible by the other replicas.

In order to use database replication, a customized extraction program would have to be created to pull all records from the company officer module of MIDS and import them into COMIS. Once the extraction program exists, then regular updates from MIDS to the Design Master could be accomplished automatically every night at a set time. For security purposes, the Design Master should be located on a file server that only the administrator has access to. Then one replica can be put on a shared file server that all the company officers have access to. When each company officer opens his copy of COMIS, it will then automatically synchronize with the main COMIS replica on the shared file server, and still be able to maintain local confidential information on their individual machines, since those objects are not part of the synchronization process. In the COMIS case, synchronization is misleading because although Access 97 provides the ability to update data on the Design Master, COMIS is coded so that there is only one way synchronization. That way there is less traffic and no chance of trying to update MIDS data. The design layout is illustrated in Figure 15. All areas in the circle represent the existing MIDS structure.

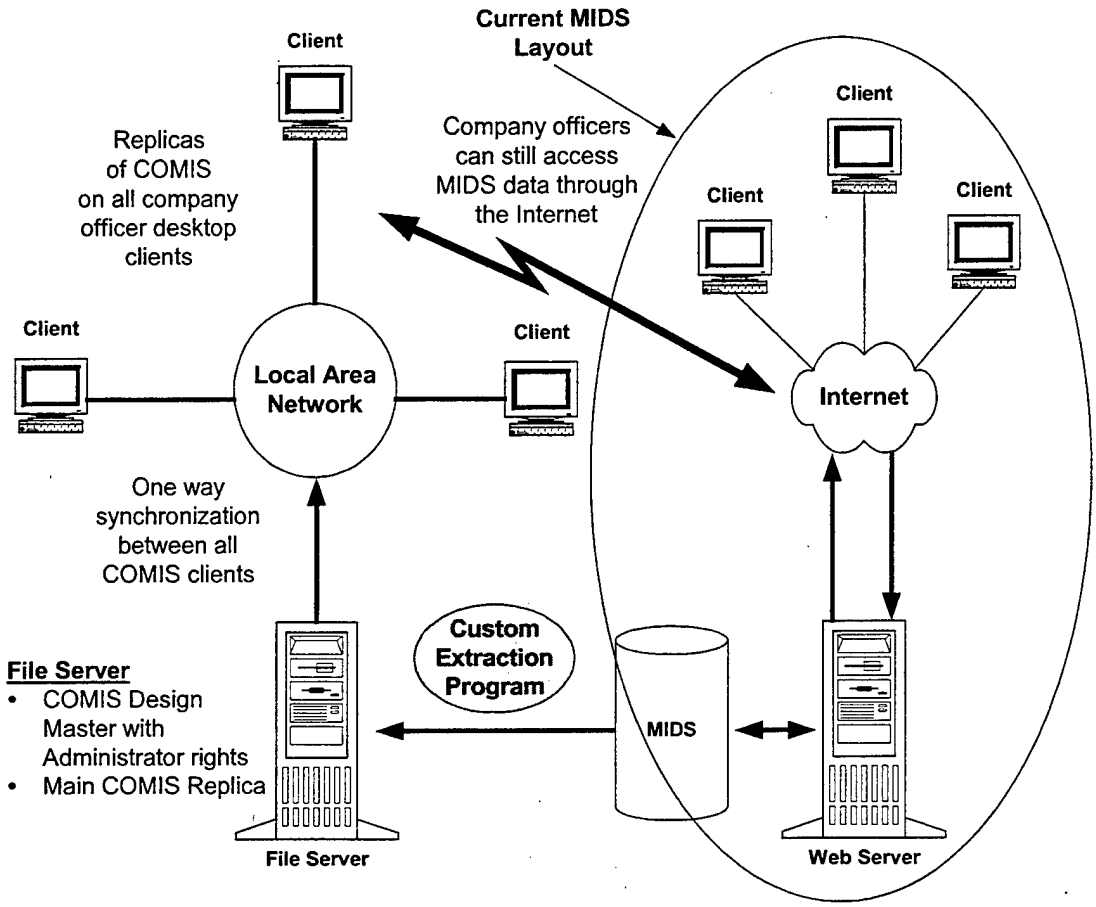

Figure 15: Integration Between MIDS and COMIS

G. CHAPTER SUMMARY

In this chapter the real crux in the development of COMIS is examined. The physical design is based on the already existing MIDS data structure; however, all of the tables, fields, and relationships to input everything into Access 97 were evaluated.

Once the basic database design was determined, COMIS was developed for a multi-user environment keeping security and efficiency on the network as a priority. Database replication offered the best solution between the different architectures. It matches well with keeping the database on the network, but is not as complex a design as

a client server application. It also allows immediate secure, design changes to COMIS so that each company officer can have the latest updates without having to reinstall the original program. Most importantly, none of the records of the MIDS system have any possibility of becoming corrupt and the data stays intact.

VII. IMPLEMENTATION

A. INTRODUCTION

Of the different life cycle phases, implementation is the second most time consuming after maintenance. All the work to build and code the application is done during implementation. Physical design specifications must be turned into a working model and all code must be thoroughly tested. The system also has to be installed, users must be prepared for the new system and trained to make it successful. Documentation and support for the system after it is installed is the final part of implementation.

B. CODING, TESTING, AND IMPLEMENTATION

Coding, testing, and installation are three separate processes in the implementation phase. The purpose of these steps is to convert the final system specifications into working and reliable software and hardware.

1. Coding

The COMIS prototype is not hard coded using C++ or Java programming languages. It is built in Access 97 as a development RDBMS platform. More functionality is added using different software utilities and tools. One of the best features of Access 97 is that it is written in Visual Basic for Applications (VBA). VBA is a powerful event driven language that is the basis for other Microsoft Office applications such as Word, Excel, and Power Point along with non-Microsoft programs such as Visio and Auto Cad. VBA is not a complete programming language per se, like its close cousin

Visual Basic, and must ride on top of another program such as Access 97. Because of this, it is called an "event-driven" language because one can write sophisticated procedures and modules that are called when an event occurs such as a mouse click on a command button, or when certain keys are typed.

Since VBA is a common platform, COMIS will have extended capabilities because it can be easily integrated with these other packages. For example a chart can be created in Excel, VBA code can be written to export a midshipman record to Excel, Excel can analyze the data, create a chart, and then import the chart back into Access 97. Very powerful features can be achieved through VBA code and as the Naval Academy moves to the IT-21 standard of Microsoft Office, COMIS will be able to grow into these other applications and enhance its capabilities.

VBA code is used to run some procedures in COMIS. The VBA code is facilitated through a third party software suite named EZ Developer Suite. The use of this suite helped compress development time. The suite provided ideas and templates to create some of the sophisticated interfaces of COMIS fairly easily, such as the "Outlook" style interface. These software packages are designed for rapid development and they provide many examples to choose from.

2. Testing

The main goal for testing is to confirm that the prototype satisfies requirements and that it is error free. The Mosley (1993) method of software testing is used. This testing method is broken down into seven different types of tests as shown is Table 1.

	Manual	Automated
Static	Inspections	Syntax Checking
Dynamic	Walkthroughs	Unit Test
	Desk Checking	Integration Test
		System Test

Table 1: Software Testing Categories

Static testing means that the code being tested is not executed. The results of running the code are not an issue for that particular test. Dynamic testing, on the other hand, does involve execution of the code. Automated testing means the computer conducts the test while manual means that we do. The following bullets briefly describe each area:

- *Inspections* are formal group activities where we manually examined code for occurrences of well-known errors. We used this method as well as we could to determine what the errors were.
- *Walkthroughs* are a technique to examine the code when it is being executed. This is accomplished before formal testing of the program.
- *Desk checking* is an informal process where we checked each other's work through the code with a paper and pencil. Then we executed each instruction, using test cases.
- *Syntax checking* is accomplished by the compiler. Errors in syntax are uncovered but the code is not executed. The VBA environment offers robust syntax checking capabilities. For the other three automated techniques, the code is executed.
- *Unit testing* is testing each individual module in an attempt to discover any errors that may exist in the module's code.
- *Integration testing* is combining modules while testing. Integration testing is gradual and testing is continued until the entire system is combined as one unit.

- *System testing* is a similar process, but instead of integrating modules into programs for testing, we integrate programs into systems. While doing both integration and system testing, not only do individual modules and programs get tested many times, so do the interfaces between modules and programs.

Third party software is also used to assist in testing COMIS. An analysis program called Analyzer checks module, procedure, table, and examines it for errors. This feature assisted immensely in identifying the different areas that needed to be fixed.

This common template is used for the basis of our test plan. Testing the COMIS prototype provided many challenges, but by following the guidelines, many technical difficulties were solved in timely manner.

3. Implementation

Implementation is an umbrella term for all the phases involved after constructing a working model, and before follow on maintenance. The use of different quality assurance techniques and a sound test plan helps to produce high quality information systems, which can then be turned over to the organization for use. As stated in Chapter III, the COMIS prototype is being developed with the intent that it will work as an enhancement tool for the MIDS Company Officer Module.

a. Software Installation

Four different approaches have emerged for installation techniques, namely Direct, Parallel, Single (Pilot), and Phased. The COMIS prototype will use the parallel method to put the system immediately on line, and still be able to use the existing MIDS. For this system technique, the old system continues to run alongside the new

system so the users can access either method. As MIDS and COMIS continue to improve in development, the company officers will be able to use the best features of each system.

From the perspective of the organizational level of the implementation, we will continue to enhance and nurture the company officer's attitudes toward the new COMIS prototype. We want COMIS to be a successful system in the future, which the company officers want to use, and from which they can benefit. All user feedback is invaluable to make the system function better. More importantly, the goal is to promote and foster a relationship with the MIDS program managers/development team so that future integration of the COMIS prototype is successful and directly benefits the Naval Academy.

b. Documentation

Implementation of a system is not complete upon installation. Documentation about the COMIS prototype is essential for users and follow on developers of COMIS. System documentation records all of the important information of the COMIS prototype such as; requirement specifications, logical design, physical design, testing, and implementation of the prototype. Also included as part of this research is the data dictionary, the relationships, and the entity-relationship diagram.

For COMIS, the documentation will focus on the end users (task-oriented) so that they can use COMIS to its greatest potential. ROBOHELP Office Suite, the industry standard in help authoring is used to provide the user with the necessary help files to use COMIS. ROBOHELP assists in the documentation of basic help files and converts everything from a Word document to the new style of help system, HTML.

Hyperlinks are added for easy access to information. Word processing documents are easily converted to this new format and ROBOHELP integrates the structure for easy navigation and development. This help feature is part of the database itself. Future researchers will continue to build more help features as the COMIS prototype matures into a functional system.

c. Users Training

The company officers must receive training on how to use the COMIS prototype. For initial training, a video teleconference was setup to display the general overview of COMIS to a select number of company officers. An interactive demonstration CD that gives an overview of the COMIS program was developed to further train company officers.

d. Support

A means to get answers for common questions will also be developed that will help identify the needs for future training. Future COMIS developers will provide further support. The authors will also be available for further guidance with COMIS.

C. CHAPTER SUMMARY

The chapter covers the basic implementation and testing procedures of the COMIS prototype. The COMIS prototype is being developed with the intent that it will function on line on one of the Naval Academy's file servers for access by the company officers. It is also being developed to operate in parallel with the existing MIDS program to give the greatest support for the company officers. System and user documentation for

the COMIS prototype is addressed. Documentation of the users/developers manual is provided in Appendix F.

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VIII. CONCLUSION AND RECOMMENDATIONS

A. CONCLUSION

This research led to the design a Company Officer Management Information System (COMIS) prototype. The COMIS prototype is a flexible tool for USNA company officer analysis built on Microsoft Access 97. The main framework for designing COMIS required in depth analysis of performance measurements used at the Naval Academy. The development of the COMIS prototype uses the latest computer IT-21 compliant technology available at the USNA. Research entailed:

1) a thorough company level needs assessment
2) a requirements analysis
3) the design, development, and testing of the COMIS prototype.

The results of this analysis identified the critical result areas and indicators that company officers need to successfully evaluate midshipmen and company performance. These performance measures served as the foundation to design, develop, and test the COMIS prototype that will be utilized by the USNA company officer.

B. LESSONS LEARNED

One of the greatest challenges was identification of the data owners and information stakeholders at the USNA. Early in the research, it became evident that people who develop and manage the MIDS database are not "true" owners and requesting information about the MIDS database became a frustrating task.

Another challenge was the requiring of additional software to complement the prototype. It is imperative to receive any additional software at least six months prior to completion in order to learn and properly integrate it with the main software platform. Delays consume valuable time during the development process.

Lastly, when coordinating with the USNA, always contact the USNA Institutional Research Office. The Institutional Research Office provided excellent support in obtaining critical description of MIDS data. They are a great point of reference for any research and or information needed about the USNA.

C. RECOMMENDATIONS FOR FUTURE RESEARCH

Recently the USNA MIDS system was updated with areas that directly affect the COMIS prototype. The benefit of a prototype is that it is an ever-changing product that is continuously and iteratively refined and updated prior to full production. The following areas should be considered for further research:

- Reevaluate the existing COMIS model and make the necessary updates to conform to the new MIDS Company Officer Module.
- Develop a seamless extraction program that will automate the process of importing midshipmen records and fully integrating MIDS with the COMIS prototype.
- Reevaluate the performance measures outlined in Chapter III and verify their importance and relevance to the company officers.
- Further develop the COMIS user interface and the interaction between user and system.
- Further develop user documentation.
- Continue to improve error checking techniques and procedures.

- Investigate the feasibility of integrating a Decision Support System with COMIS.

Database design and development is an iterative process involving constant communication between the designer, developer and the user. The COMIS prototype is the first step in providing the USNA company officers with a performance-measurement tool capable of enhancing their ability to develop midshipmen into the future officers of the Navy and Marine Corps.

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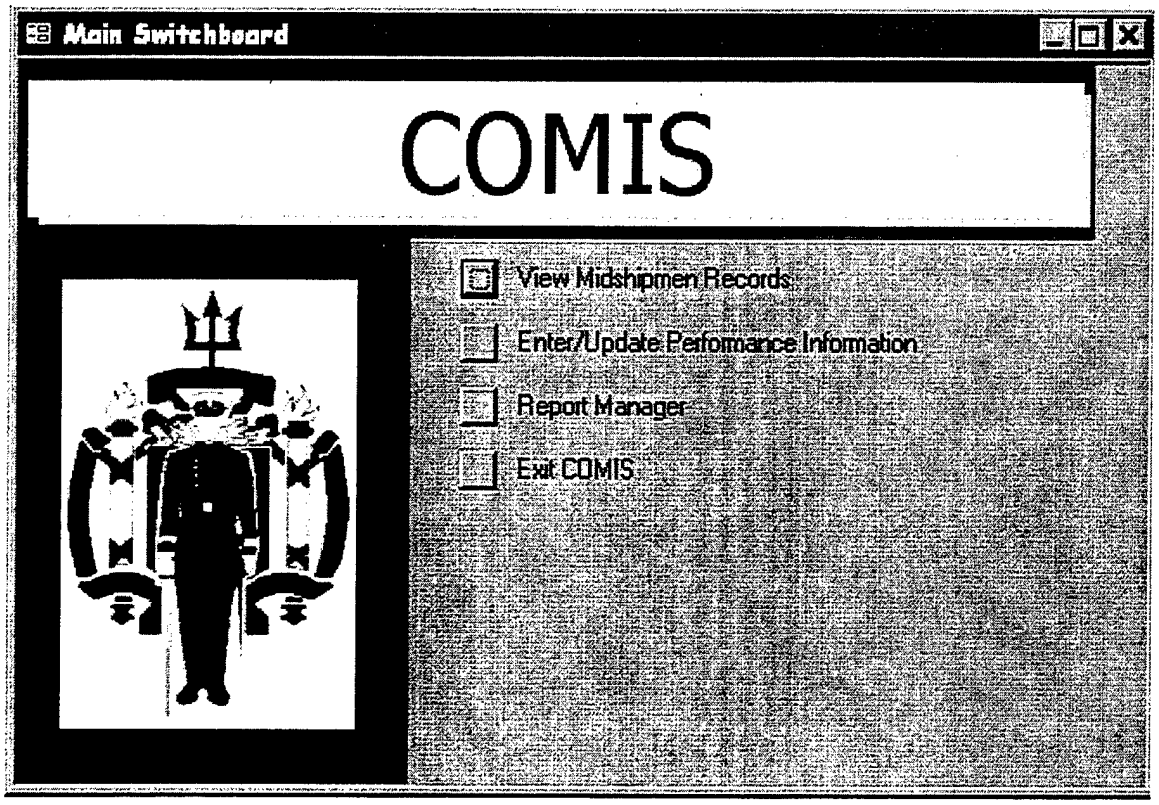
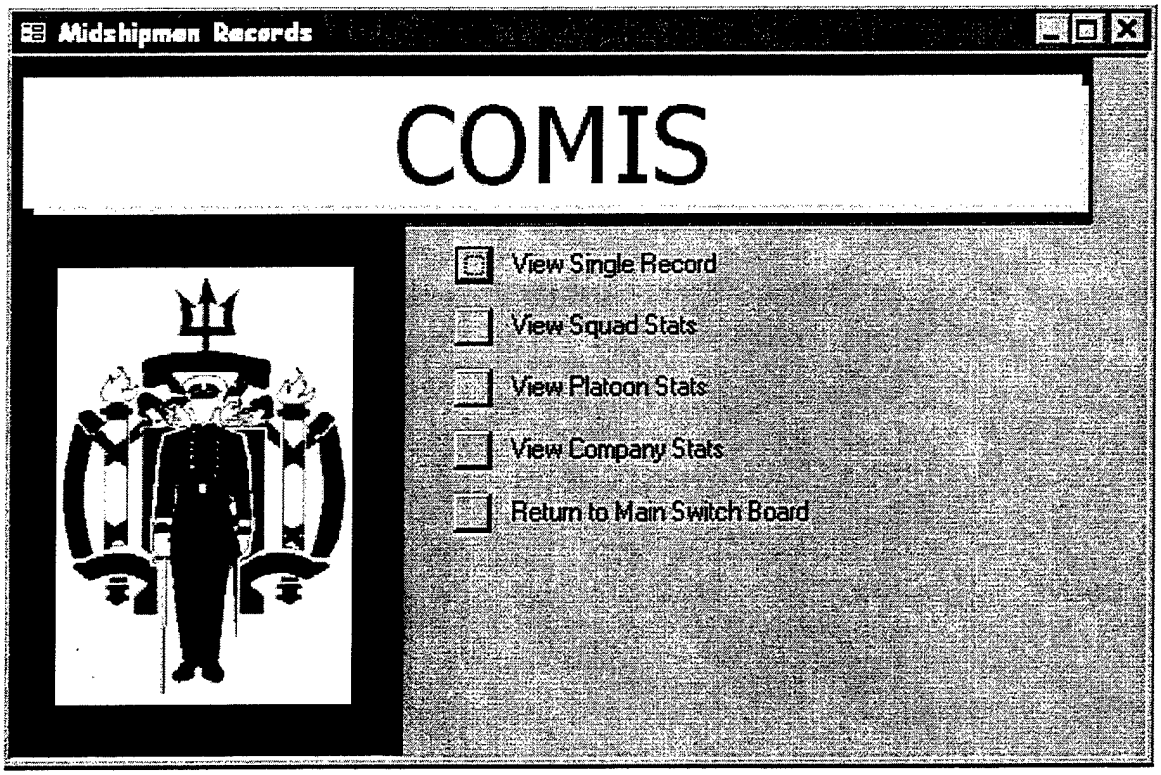
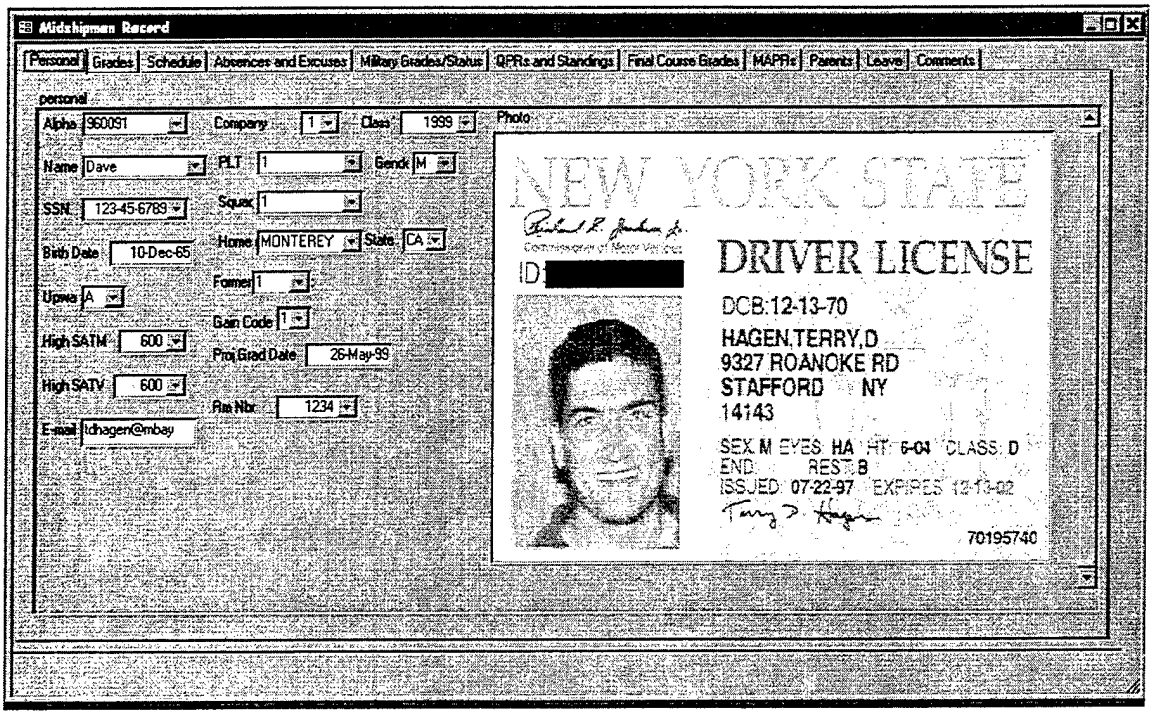
APPENDIX A. MENUS, FORMS, REPORTS, AND VIEWS




Midshipmen Records
COMIS
View Single Record
View Squad Stats
View Platoon Stats
View Company Stats
Return to Main Switch Board


Midshipmen Record
Personal
Grades
Schedule
Absences and Excuses
Military Grades/Status
QPRs and Standings
Final Course Grades
MAPPs
Parents
Leave
Comments
personal
Alpha 960091
Company 1
Class 1999
Name Dave
PLT 1
Gendr M
SSN 123-45-6789
Squad 1
Birth Date 10-Dec-65
Home MONTEREY
State CA
Upwd A
Former 1
Gain Code 1
High SATM 600
Proj Grad Date 26-May-99
High SATV 600
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E-mail tdhagen@mbay
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14143
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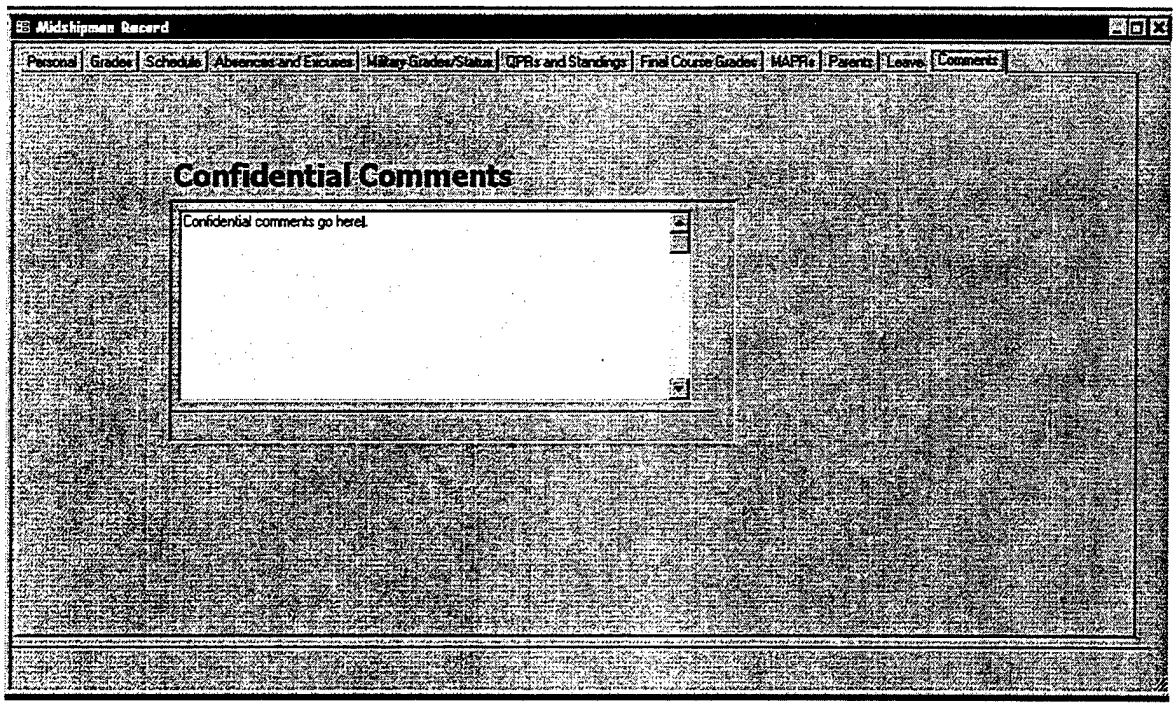
70195740

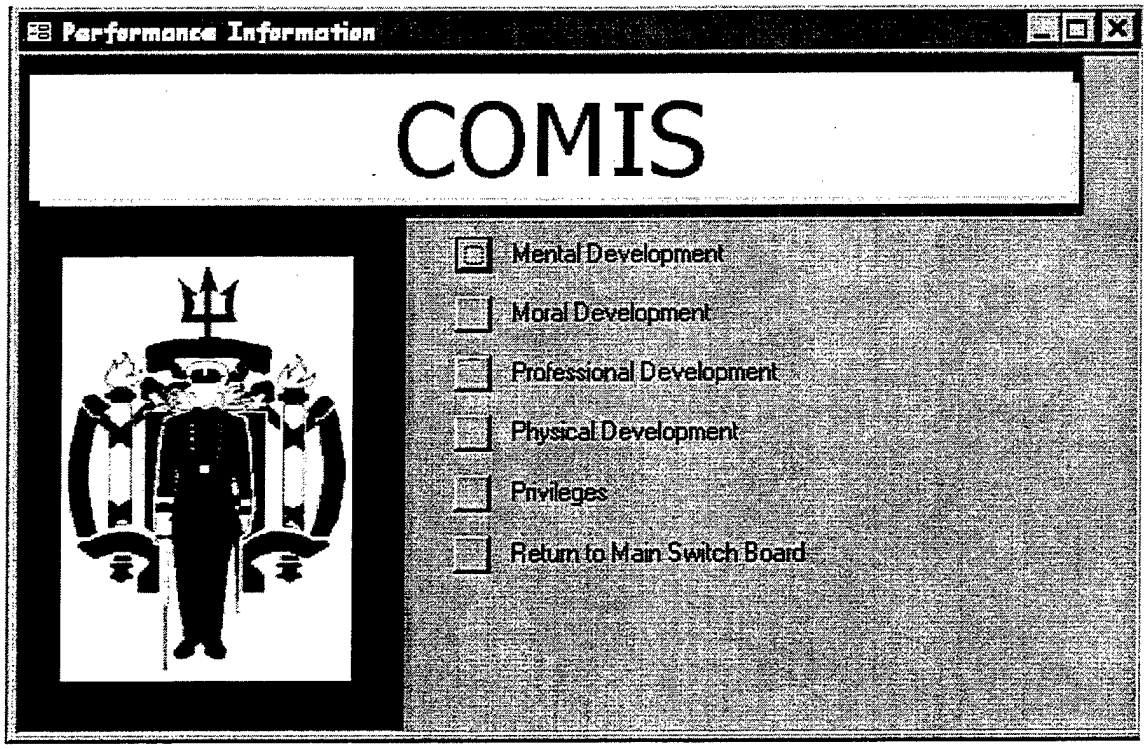


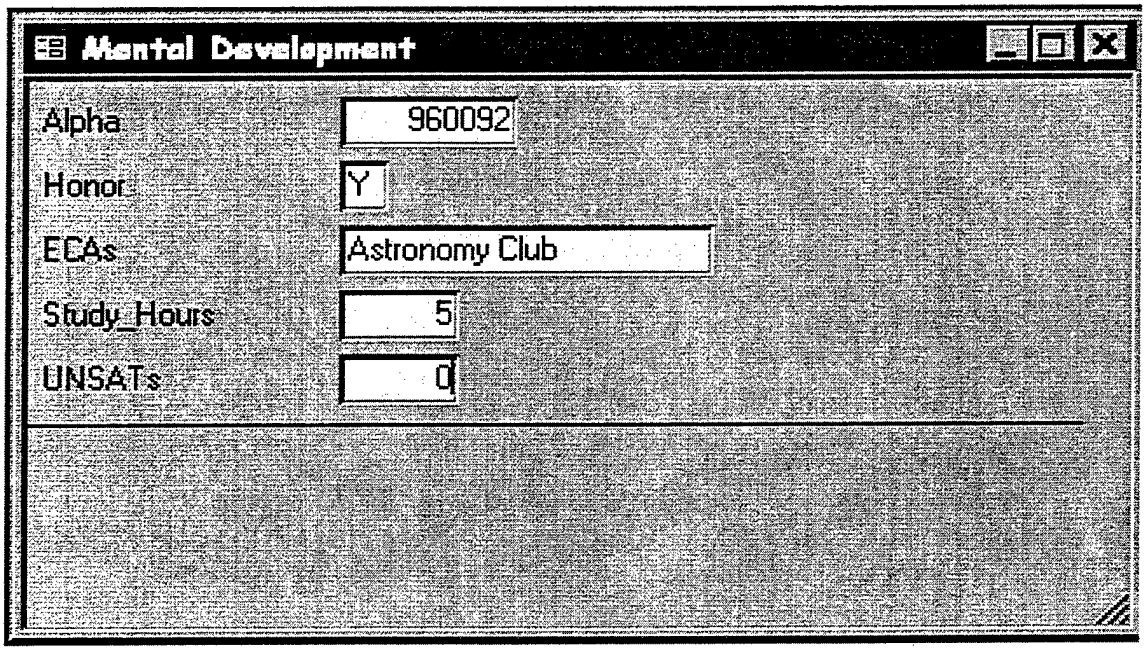
COMIS

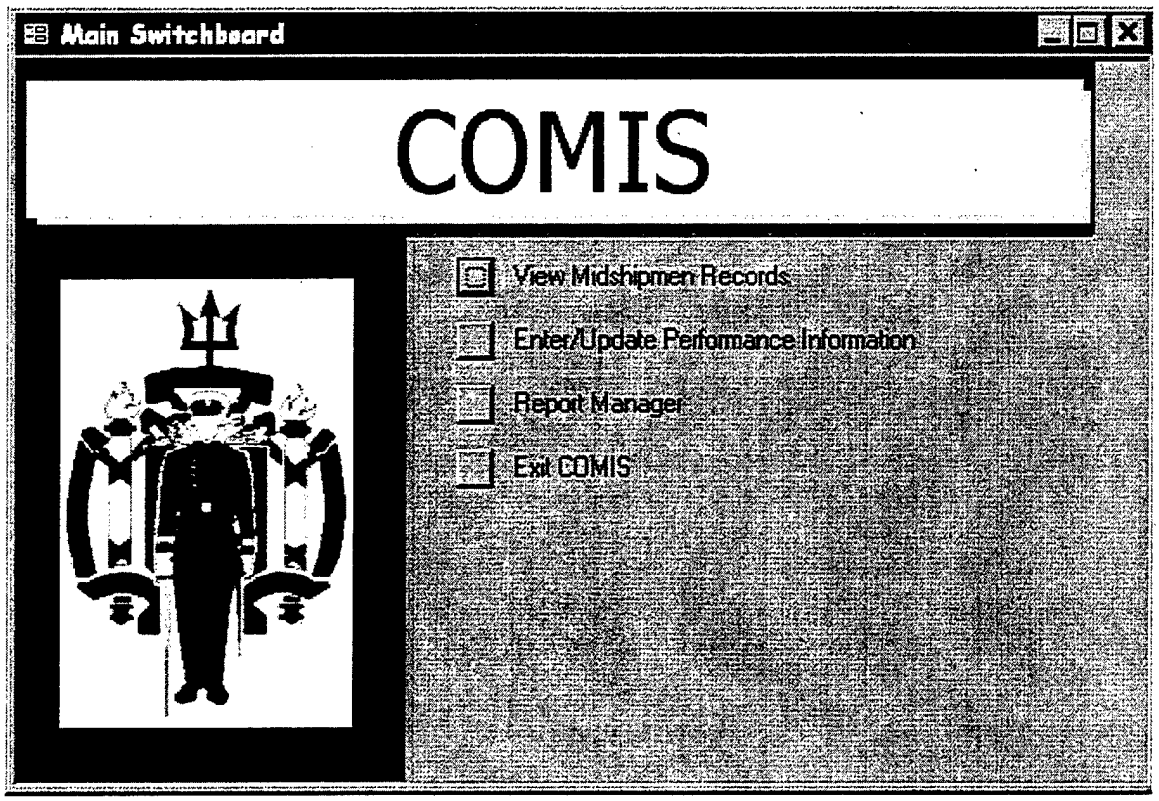
Company Report

Company	Platoon	Squad	LastName	Alpha	QPR	AOM	MOM
11th	1st	1st	Utroska	990001	3.51	50	34
11th	1st	1st	Hagen	990002	4.00	1	1
11th	1st	1st	Boone	990003	3.00	100	100
11th	1st	1st	Franicis	980003	2.00	200	260
11th	1st	1st	Wilson	980003	3.40	66	68
11th	1st	1st	Wetzel	970001	3.78	55	43
11th	1st	1st	Ruiz	970004	2.50	400	450
11th	1st	2nd	Jones	999999	3.00	200	234
11th	1st	2nd	Boger	999998	4.00	2	2
11th	1st	2nd	Basco	999991	3.43	88	96
11th	1st	2nd	Brinkley	999992	3.01	134	149
11th	1st	2nd	Smith	999993	3.57	56	76
11th	1st	2nd	Owen	999994	3.52	57	67
11th	1st	2nd	Owen	999995	3.53	58	56
11th	1st	2nd	Owen	999996	3.55	96	76
11th	1st	3rd	Owen	999997	3.56	64	34
11th	1st	3rd	Owen	999998	3.59	67	78
11th	1st	3rd	Owen	999990	3.51	75	67
11th	1st	3rd	Owen	988888	3.55	72	76
11th	1st	3rd	Owen	988887	3.57	84	65
11th	1st	3rd	Owen	988886	3.52	48	67

Record: 1 of 28


Performance Information
COMIS
Mental Development
Moral Development
Professional Development
Physical Development
Privileges
Return to Main Switch Board


Mental Development
Alpha
960092
Honor
Y
ECAs
Astronomy Club
Study_Hours
5
UNSATs
0


Main Switchboard
COMIS
View Midshipmen Records
Enter/Update Performance Information
Report Manager
Exit COMIS

Company Report

Company 11th

Platoon 1st

Alpha	Last	Middle	First	SSN	Squad	QPR	AOM	MOM
999996	Owen	N	Bob	883-53-75	2nd	3.55	96	76
990002	Hagen	D.	Terry	123-45-09	1st	4.00	1	1
990003	Boone	J.	Michael	999-77-22	1st	3.00	100	100
980003	Franicis	K.	James	656-38-96	1st	2.00	200	260
980003	Wilson	M.	Steven	252-75-67	1st	3.40	66	68
970001	Wetzel	L.	Paul	676-74-74	1st	3.78	55	43
970004	Ruiz	T.	Thomas	777-77-77	1st	2.50	400	450
999999	Jones		Joe	111-11-11	2nd	3.00	200	234
999998	Boger	C	Dan	222-22-22	2nd	4.00	2	2
999991	Basco		Milrose	333-33-33	2nd	3.43	88	96
999992	Brinkley	E.	Doug	555-55-55	2nd	3.01	134	149
999993	Smith	J.	Joe	666-66-66	2nd	3.57	56	76
990001	Utroska	T	William	100-23-00	1st	3.51	50	34
999995	Owen	M	Jim	674-98-36	2nd	3.53	58	56
977776	Brady	K	Susan	003-03-03	4th	3.56	44	76
999997	Owen	B	Art	191-92-83	3rd	3.56	64	34
999998	Owen	V	Dan	565-65-65	3rd	3.59	67	78
999990	Owen	C	Stan	464-73-72	3rd	3.51	75	67
988888	Owen	X	Rick	734-78-95	3rd	3.55	72	76
988887	Owen	Z	Alice	683-98-63	3rd	3.57	84	65
988886	Owen	A	Kay	287-87-92	3rd	3.52	48	67
988885	Brady	S	Terry	103-84-74	4th	3.36	44	76
988884	Brady	D	Allen	101-01-01	4th	2.87	32	67
988883	Brady	F	Conrad	202-02-02	4th	2.00	300	47
988882	Brady	G	Joe	303-03-03	4th	3.54	66	87

Platoon Report

Platoon ***1st***

Squad 1st

Last Name	Alpha	QPR	AOM	MOM
Boone	990003	3.00	100	100
Franicis	980003	2.00	200	260
Hagen	990002	4.00	1	1
Ruiz	970004	2.50	400	450
Utroska	990001	3.51	50	34
Wetzel	970001	3.78	55	43
Wilson	980003	3.40	66	68

Squad 2nd

Last Name	Alpha	QPR	AOM	MOM
Basco	999991	3.43	88	96
Boger	999998	4.00	2	2
Brinkley	999992	3.01	134	149
Jones	999999	3.00	200	234
Owen	999996	3.55	96	76
Owen	999995	3.53	58	56
Owen	999994	3.52	57	67
Smith	999993	3.57	56	76

Squad 3rd

Last Name	Alpha	QPR	AOM	MOM
Owen	999997	3.56	64	34
Owen	999998	3.59	67	78
Owen	999990	3.51	75	67
Owen	988888	3.55	72	76
Owen	988887	3.57	84	65
Owen	988886	3.52	48	67

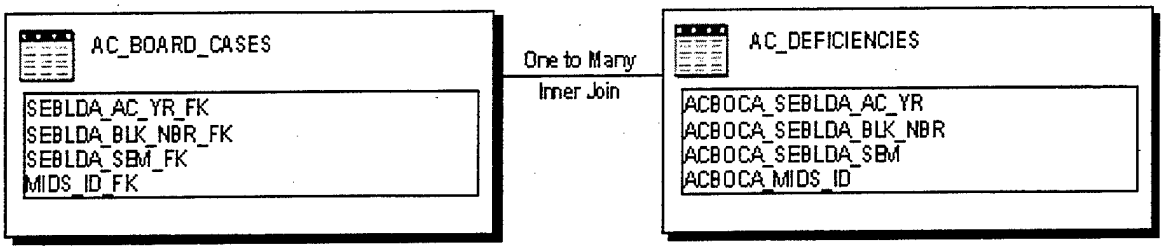
Squad Report

Squad 1st

Last	Middle	First	Alpha	QPR	AOM	MOM
Boone	J.	Michael	990003	3.00	100	100
Franicis	K.	James	980003	2.00	200	260
Hagen	D.	Terry	990002	4.00	1	1
Ruiz	T.	Thomas	970004	2.50	400	450
Utroska	T	William	990001	3.51	50	34
Wetzel	L.	Paul	970001	3.78	55	43
Wilson	M.	Steven	980003	3.40	66	68

APPENDIX B. RELATIONSHIPS

A relationship between tables is an association between the instances of one or more tables that is of interest to the organization. The COMIS prototype uses the relationships provided by the MIDS Company Officer Module and then further develops relationships to properly relate and integrate the five performance-measurement-based tables. The relationships also assist in maintaining referential integrity throughout the model.



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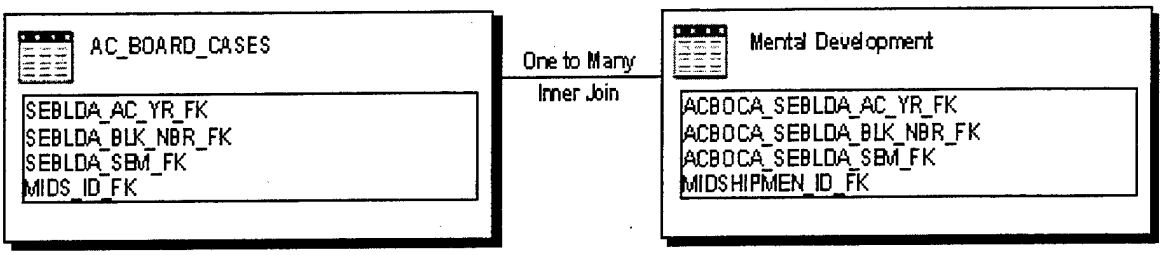

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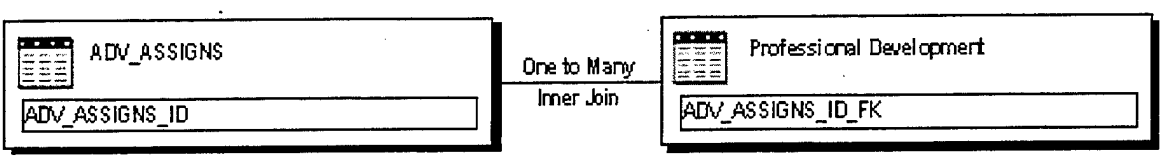

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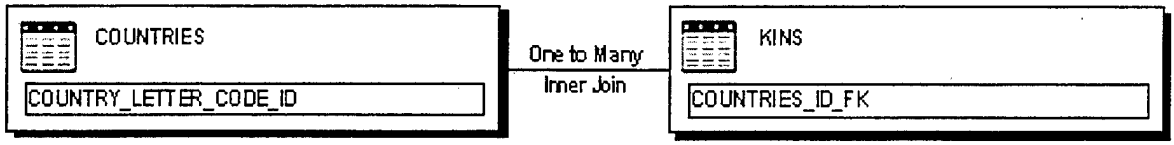

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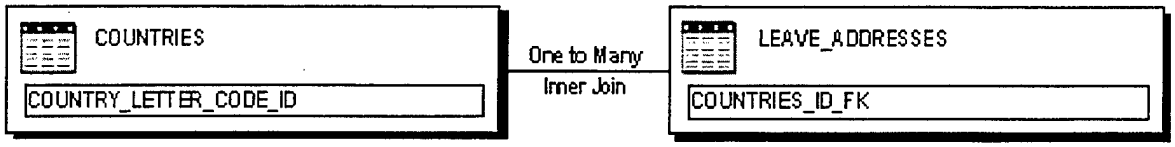

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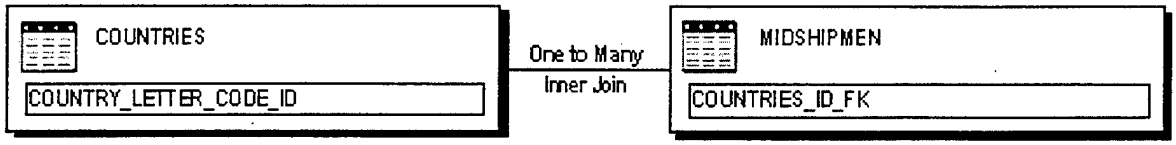

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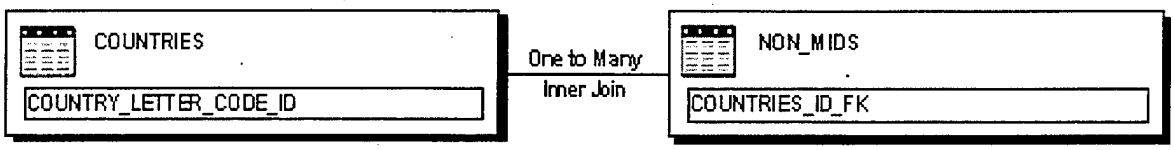

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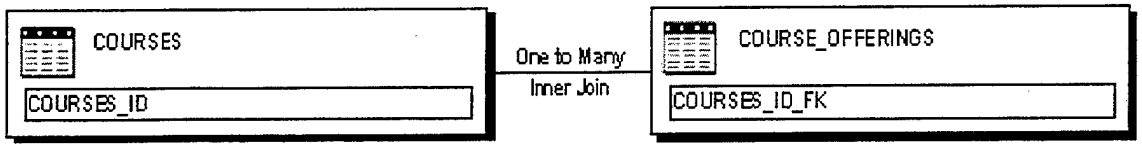

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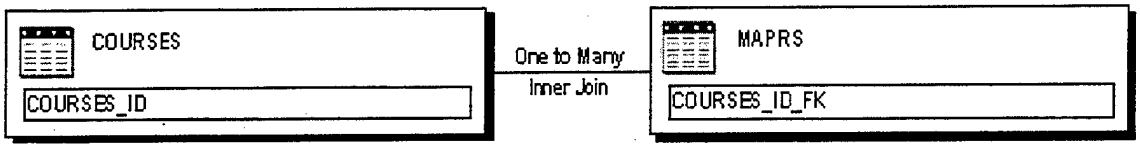

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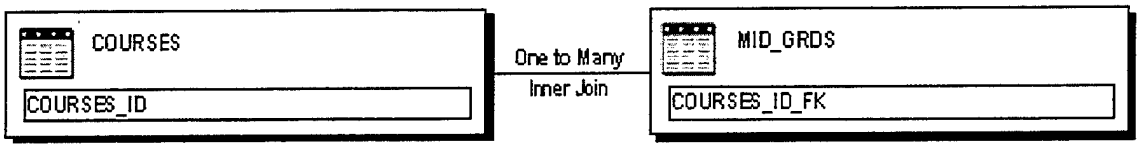

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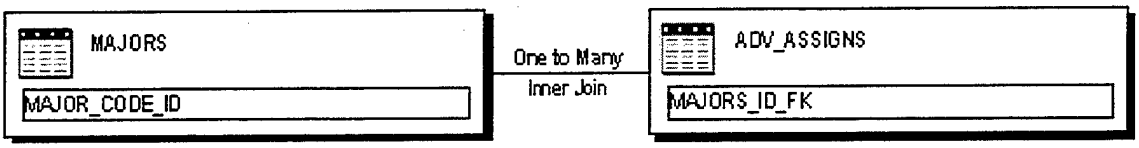

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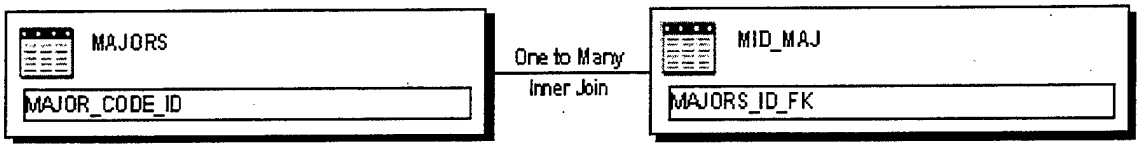

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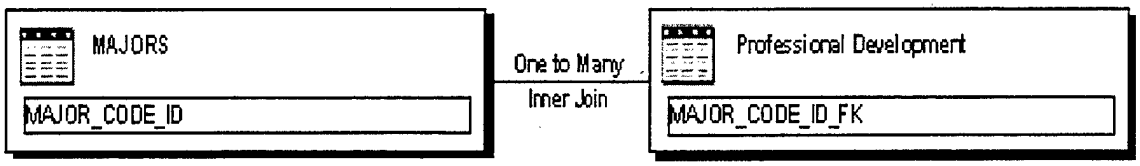

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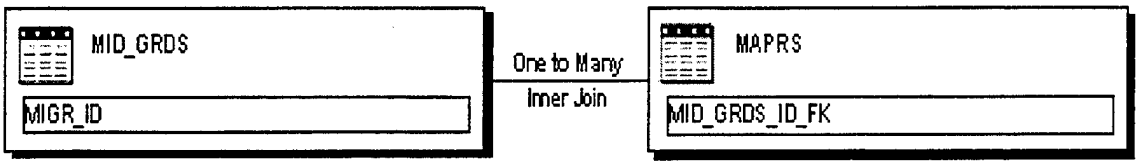

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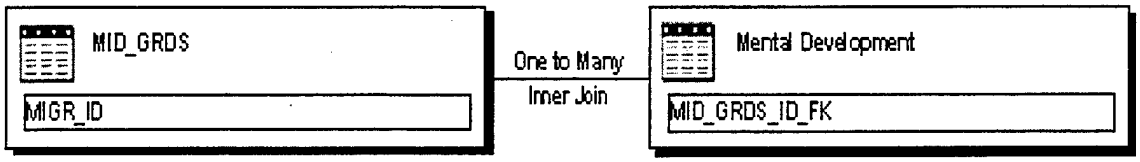

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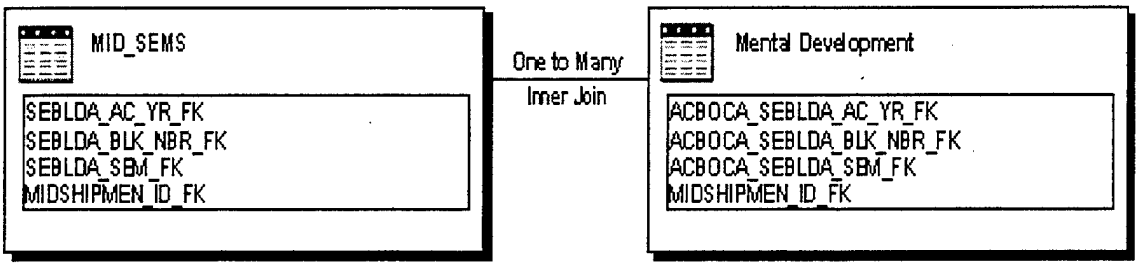

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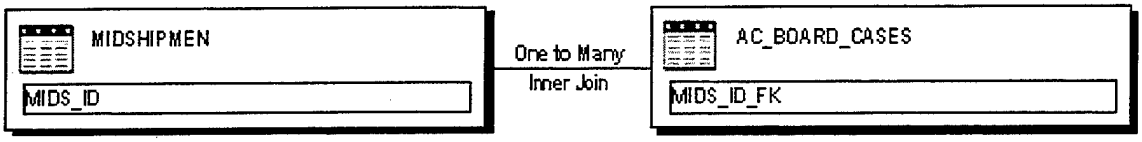

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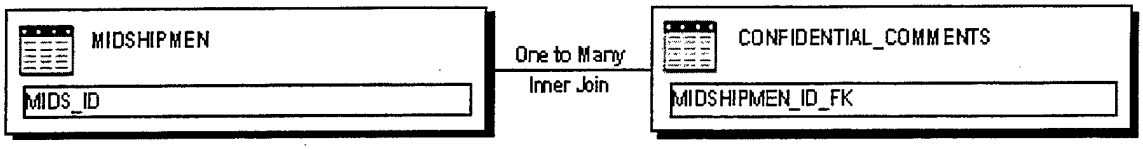

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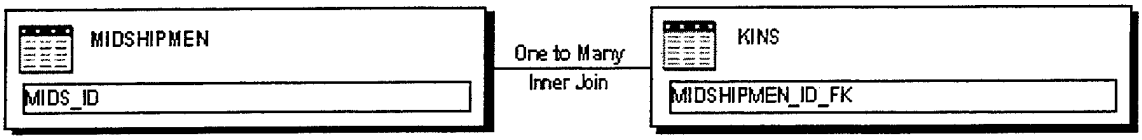

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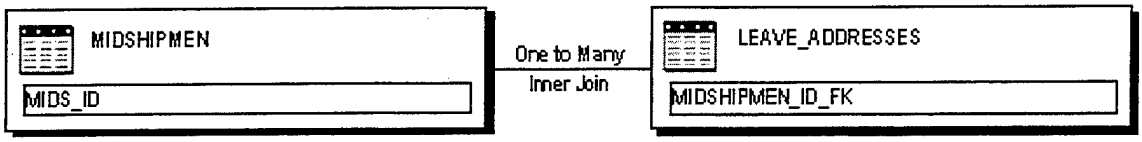

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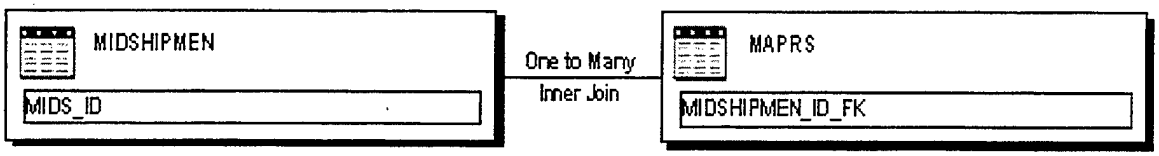

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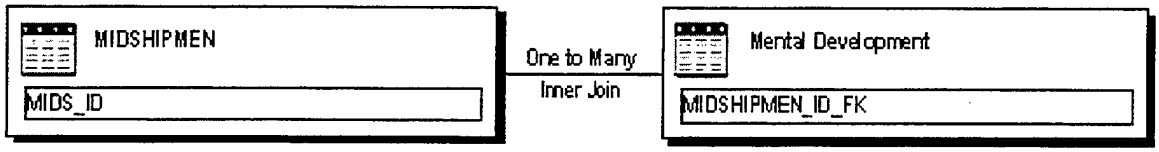

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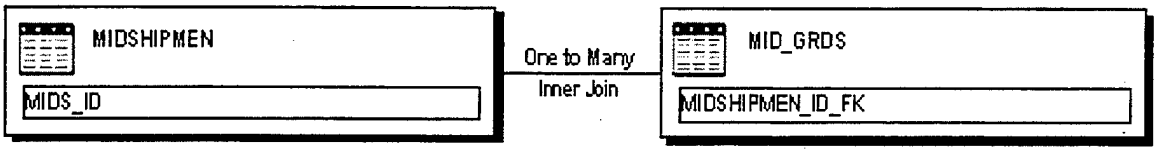

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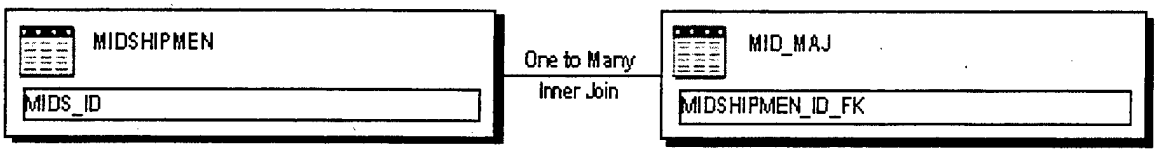

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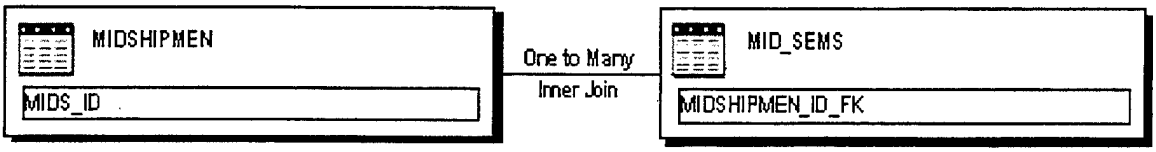

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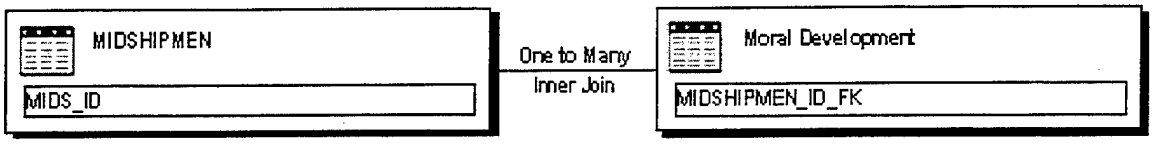

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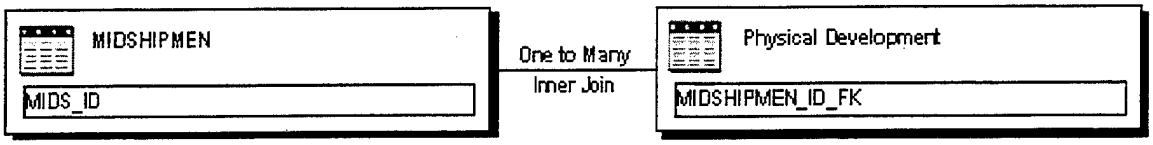

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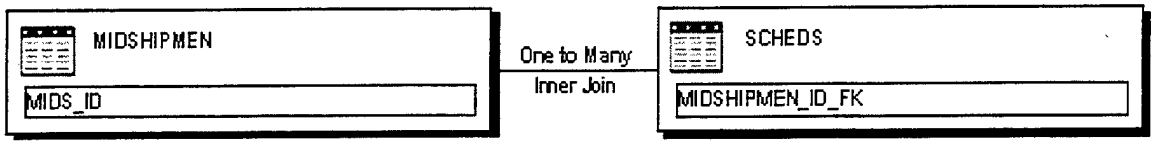

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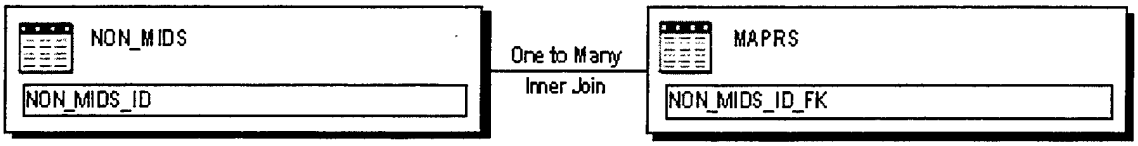

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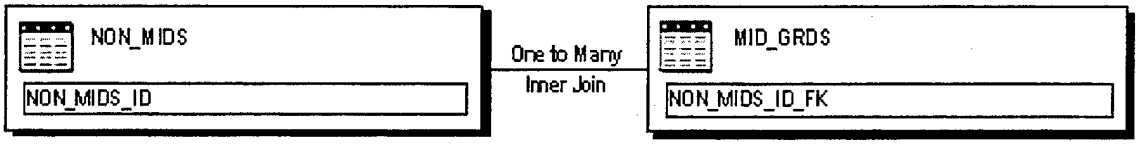

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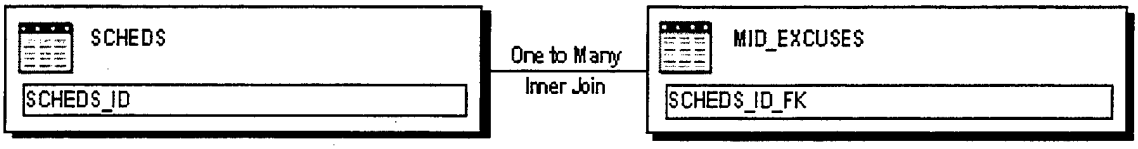

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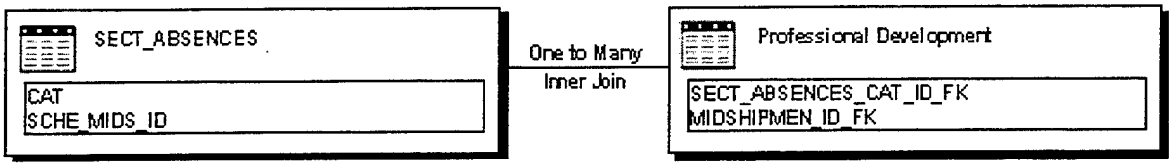

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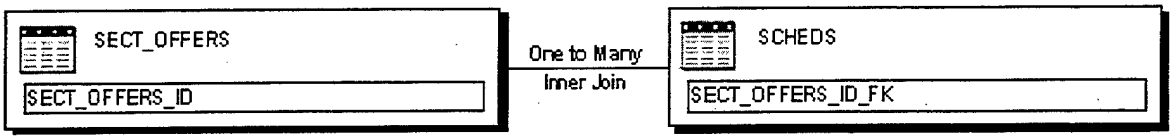

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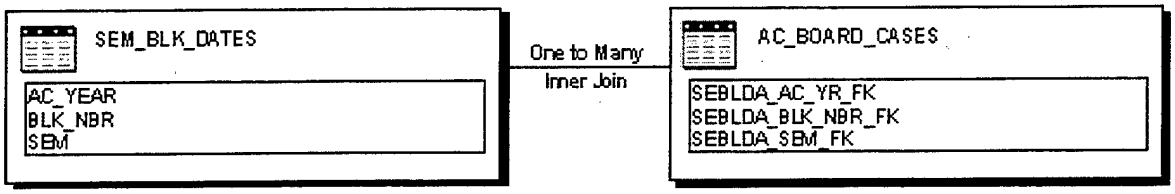

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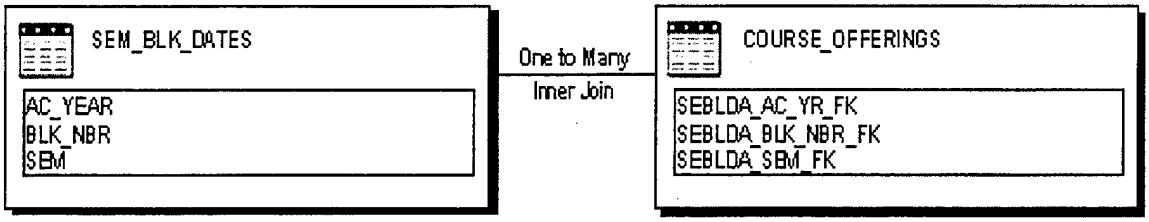

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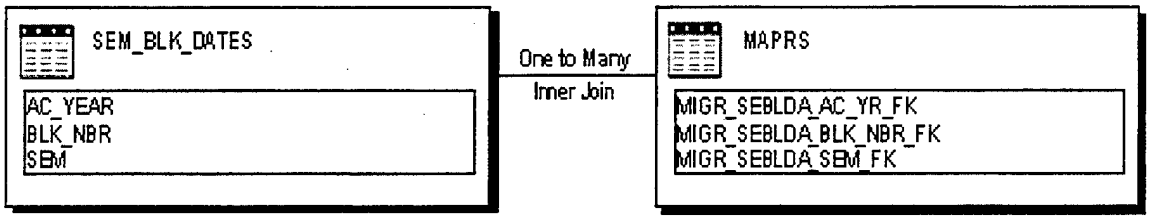

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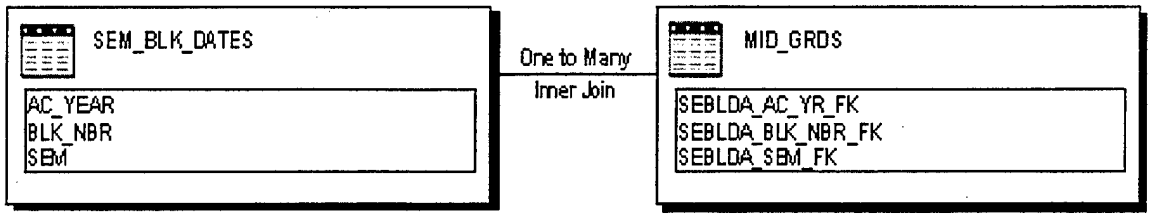

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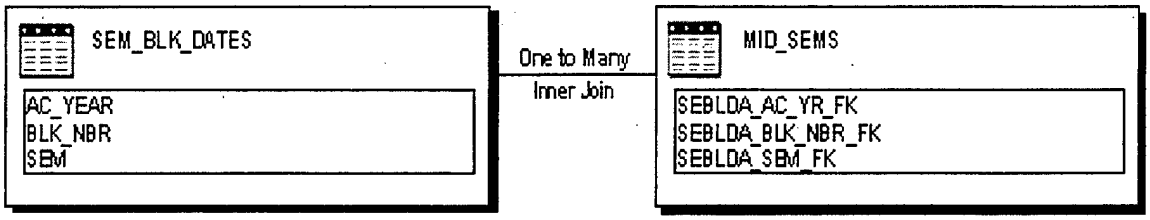

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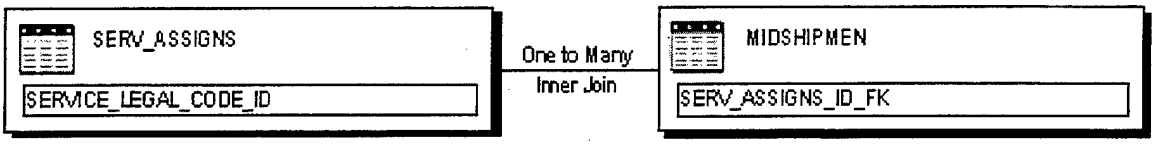

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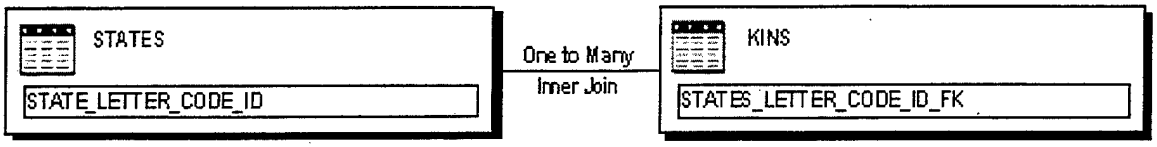

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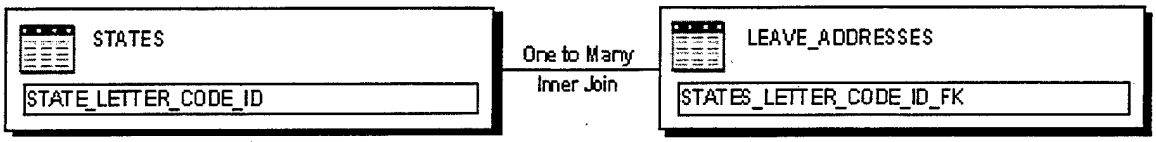

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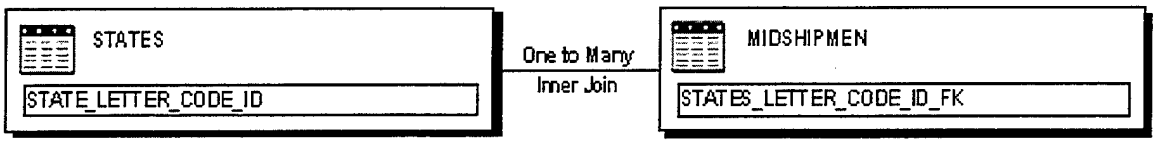
Deletes: Disallow



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Deletes: Disallow

Inherited From Database:
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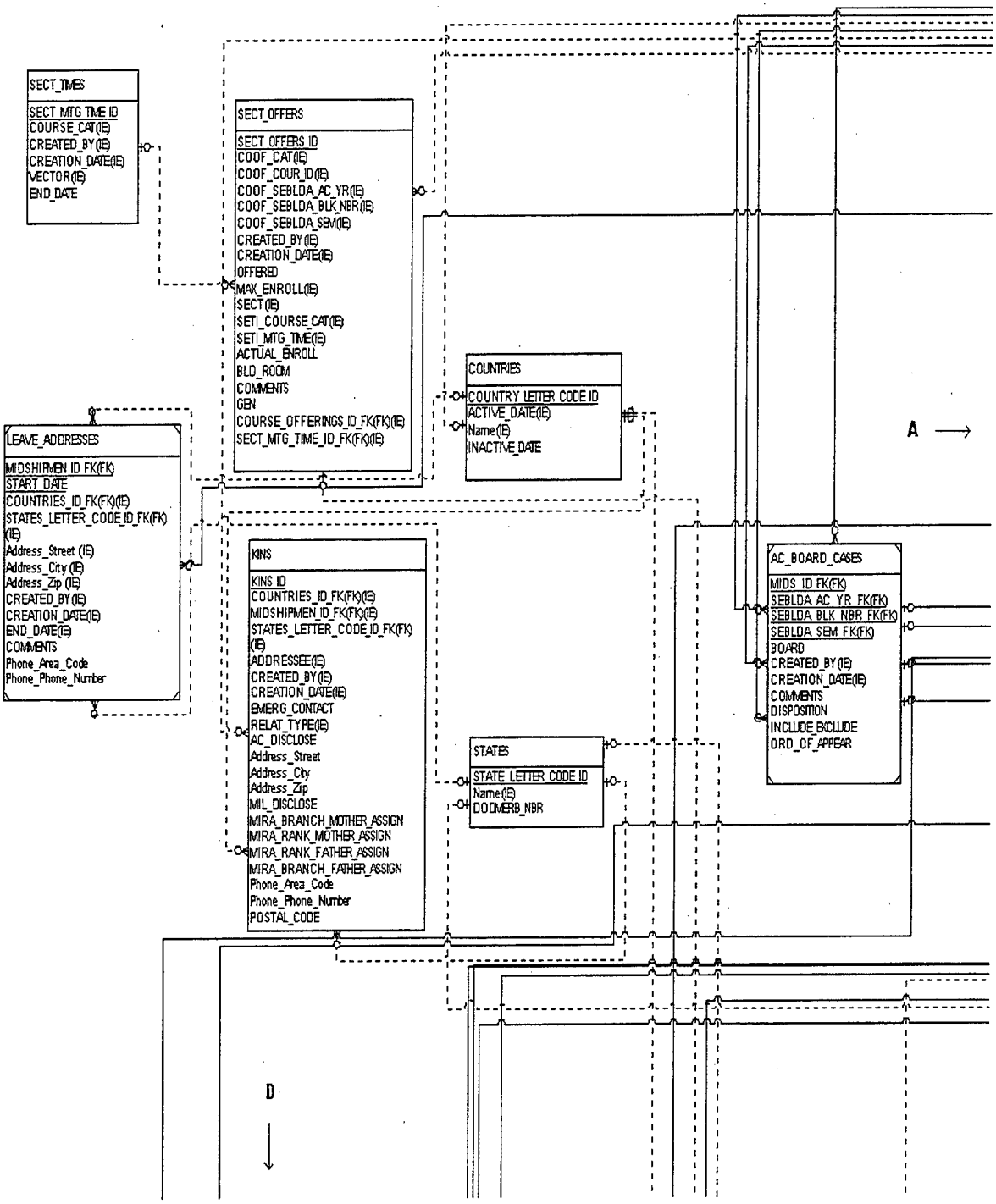
Updates: Cascade
Deletes: Disallow

APPENDIX C. ENTITY-RELATIONSHIP DIAGRAM

An Entity-Relationship diagram is a technique for representing the logical structure of a database in a pictorial manner. The ER diagram facilitates communication to verify data requirements between the database designer and the end-user. Visio Professional 5.0a is the CASE tool used to develop the ER diagram. This case tool conducts an analysis of the COMIS prototype by mapping the database and generating the diagram from Microsoft Access 97.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CREATION_DATE(IE)
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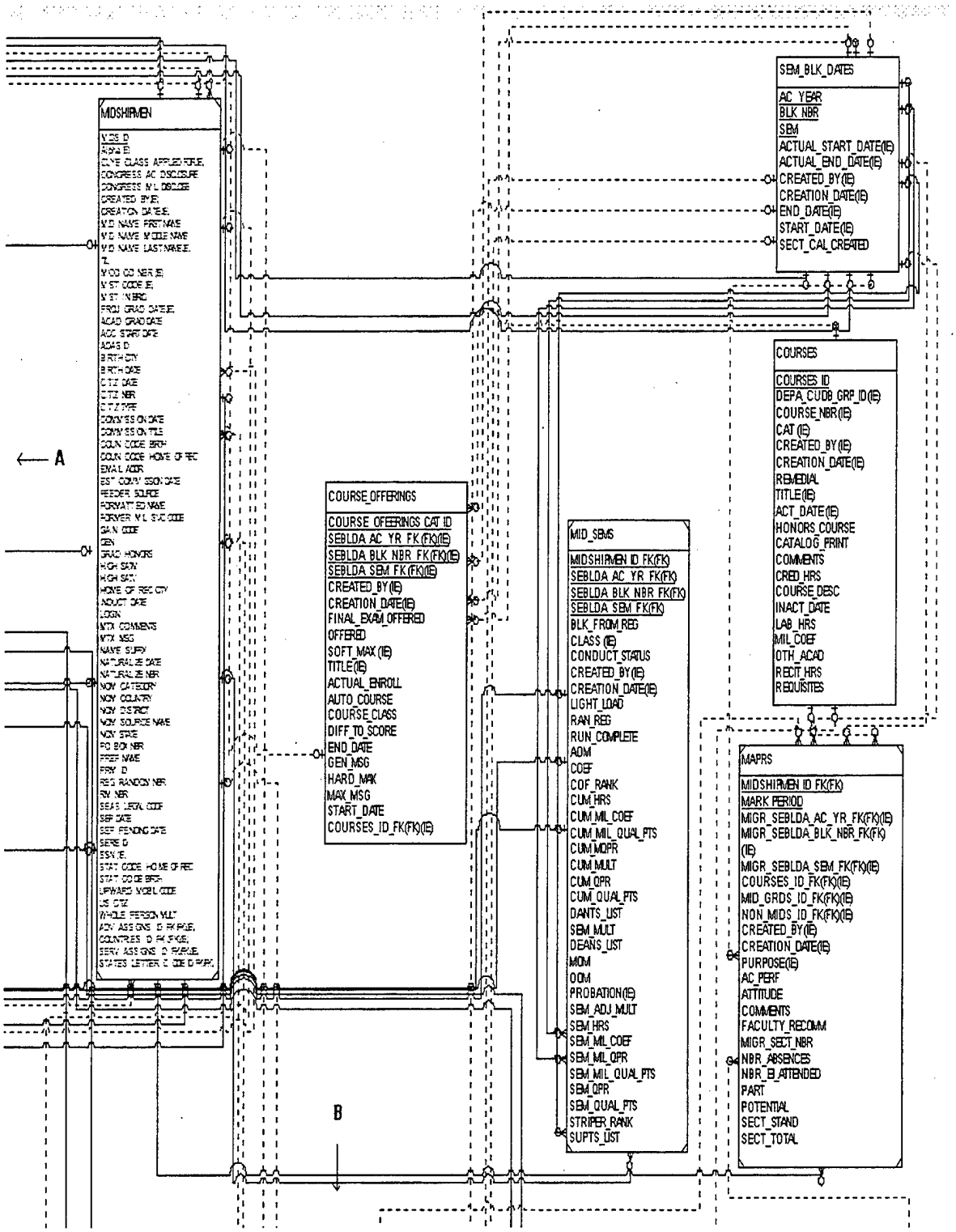
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CUM_MIL_COEF
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PURPOSE(IE)
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NBR_ABSENCES
NBR_B_ATTENDED
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SECT_STAND
SECT_TOTAL
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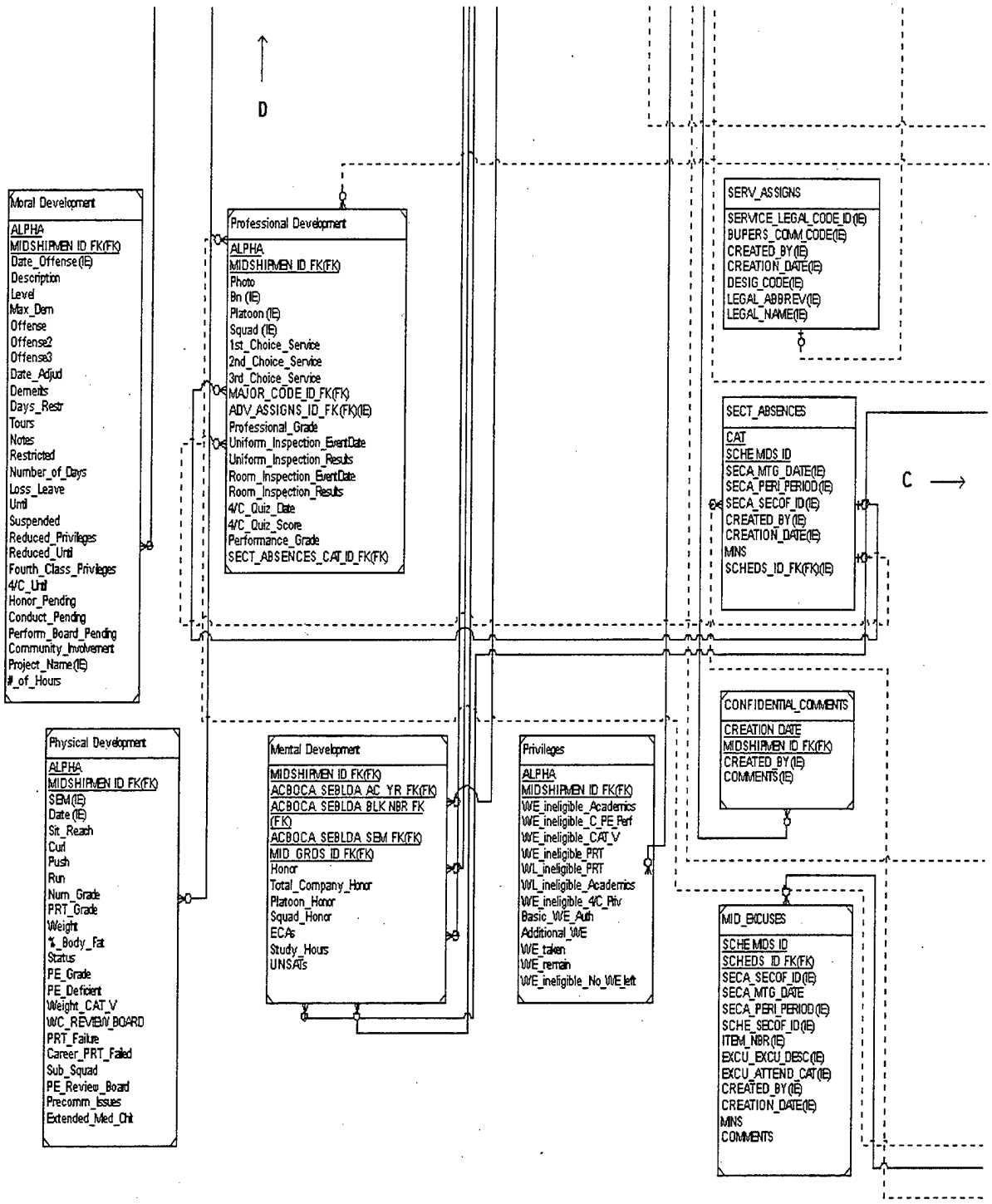
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ALPHA
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Honor_Pending
Conduct_Pending
Perform_Board_Pending
Community_Involvement
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Platoon (IE)
Squad (IE)
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Precomm_Issues
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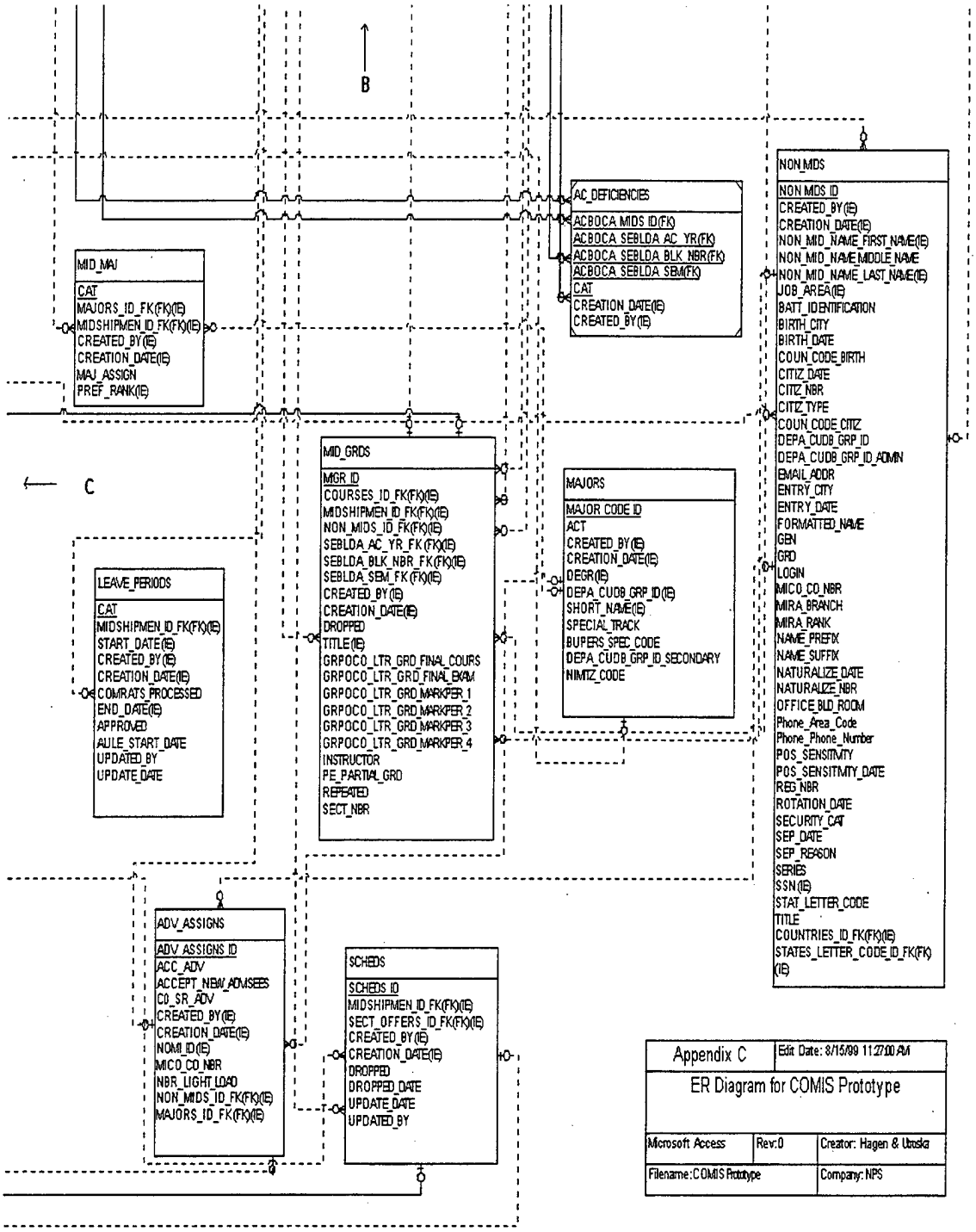
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MIRA_BRANCH
MIRA_RANK
NAME_PREFIX
NAME_SUFFIX
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GRPOCO_LTR_GRD_MARKPER_4
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LEAVE_PERIODS
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UPDATED_BY
Appendix C
Edit Date: 8/15/99 11:27:00 AM
ER Diagram for COMIS Prototype
Microsoft Access
Rev:0
Creator: Hagen & Uroska
Filename: COMIS Prototype
Company: NPS

APPENDIX D. DATA DICTIONARY

A data dictionary is a user-accessible catalog of both database and application metadata. An active data dictionary is a dictionary whose contents are automatically updated by the Relational Database Management System (RDBMS) whenever changes are made in the database or application structure. A passive data dictionary is one whose contents must be updated manually when changes are made. For COMIS we used FMS Total Access Analyzer to generate the data dictionary to a database format and then generated a report from that where we published it Microsoft Word. For conciseness and clarity for our thesis, we included only the table names, primary keys, data types, field sizes, and a short description of each field.

Table Name: tblAC_BOARD_CASES

Primary Key Yes

Field Name	Data Type	Field Size	Description
MIDS_ID_FK	Number, Long	4	System assigned primary key
SEBLDA_AC_YR_FK	Number, Integer	2	Academic Year Block dates apply to
SEBLDA_BLK_NBR_FK	Number, Integer	2	Number identifying semester block or session
SEBLDA_SEM_FK	Text	6	Academic semester block dates apply to

Other Fields

Field Name	Data Type	Field Size	Description
BOARD	Text	1	Will the case be presented before the Board?
COMMENTS	Text	255	A short text field to retain non-standard comments
CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created
DISPOSITION	Text	2	The decision the Academic Board makes concerning
INCLUDE_EXCLUDE	Text	7	Include or exclude from board list
ORD_OF_APPEAR	Number, Integer	2	Order of appearance before the Academic Board.

Table Name: tblAC_DEFICIENCIES

Primary Key Yes

Field Name	Data Type	Field Size	Description
ACBOCA_MIDS_ID	Number, Long	4	System assigned primary key
ACBOCA_SEBLDA_AC_YR	Number, Integer	2	Academic Year Block dates apply to
ACBOCA_SEBLDA_BLK_NBR	Number, Integer	2	Number identifying semester block or session
ACBOCA_SEBLDA_SEM	Text	6	Academic semester block dates apply to
CAT	Text	1	Deficiency ID: Category 1-9: 1) SEM QPR < 1.50,

Other Fields

Field Name	Data Type	Field Size	Description
CREATED_BY	Text	30	ID of person who created the record.
CREATION_DATE	Date/Time	8	Date record was created.

Table Name: tblADV_ASSIGNS

Primary Key Yes

Field Name	Data Type	Field Size	Description
ADV_ASSIGNS_ID	Number, Long	4	System Assigned Primary Key for the Academic

Other Fields

Field Name	Data Type	Field Size	Description
ACC_ADV	Text	1	A YES NO domain without NA
ACCEPT_NEW_ADVISEES	Text	1	A YES NO domain without NA
CO_SR_ADV	Text	1	Is this adviser the senior adviser for the company?

CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created
MAJORS_ID_FK	Text	50	****4 Valid alphabetic code used to represent a
MAX_NBR_NEW_ADVISEES	Number, Long	4	Maximum number of plebes to assign to this adviser
MICO_CO_NBR	Number, Integer	2	Company Number
NBR_LIGHT_LOAD	Number, Integer	2	Number of Mids to light load this adviser
NOMI_ID_FK	Number, Long	4	unique identifier
SR_ADV	Text	1	Is this adviser the senior adviser for the

Table Name: tblCONFIDENTIAL_COMMENTS

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
CREATION_DATE	Date/Time	8	Date record was created
MIDSHIPMEN_ID_FK	Number, Long	4	System assigned primary key

Other Fields

Field Name	Data Type	Field Size	Description
COMMENTS	Memo	0	Comments on midshipman
CREATED_BY	Text	30	ID of person who created the record

Table Name: tblCOUNTRIES

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
COUNTRY_LETTER_CODE_ID	Text	2	Two letter country code

Other Fields

Field Name	Data Type	Field Size	Description
ACTIVE_DATE	Date/Time	8	Date country code became active
INACTIVE_DATE	Date/Time	8	Date country code became inactive
NAME	Text	40	Full name of country

Table Name: tblCOURSE_OFFERINGS

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
COURSE_OFEERINGS_CAT_ID	Text	13	Type of course
COURSES_ID_FK	Number, Long	4	Course system assigned primary key
SEBLDA_AC_YR_FK	Number, Integer	2	Academic Year Block dates apply to
SEBLDA_BLK_NBR_FK	Number, Integer	2	Number identifying semester block or session
SEBLDA_SEM_FK	Text	6	Academic semester block dates apply to

Other Fields

Field Name	Data Type	Field Size	Description
ACTUAL_ENROLL	Number, Integer	2	Number midshipmen enrolled in course
AUTO_COURSE	Text	1	Is this an automatic course?
COURSE_CLASS	Text	3	Course will be assigned to a particular class
CREATED_BY	Text	30	ID of person who created the record

CREATION_DATE	Date/Time	8	Date record was created
DIFF_TO_SCORE	Text	1	Is the exam difficult to score?
END_DATE	Date/Time	8	Date course ends
FINAL_EXAM_OFFERED	Text	1	Is a final exam offered in this course?
GEN_MSG	Memo	0	Message to be printed whenever a midshipman
HARD_MAX	Number, Integer	2	Absolute maximum of the course; upper limit on
MAX_MSG	Memo	0	Message to be printed whenever the course
OFFERED	Text	1	A YES NO domain without NA
SOFT_MAX	Number, Integer	2	Expected number of students; max message will
START_DATE	Date/Time	8	Date course begins (date all classes start for fall and
TITLE	Text	50	Title of Course

Table Name: tblCOURSES

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
COURSES_ID	Number, Long	4	Course system assigned primary key

Other Fields

Field Name	Data Type	Field Size	Description
ACT_DATE	Date/Time	8	Date course becomes an active course
CAT	Text	13	Category of course
CATALOG_PRINT	Text	1	Should this course appear in the course catalog?
COMMENTS	Memo	0	Comments concerning this course
COURSE_DESC	Memo	0	Description of the course
COURSE_NBR	Text	8	Course designator and number given to a specific
CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created
CRED_HRS	Number, Integer	2	Total hours of credits earned towards graduation for
DEPA_CUDB_GRP_ID	Number, Long	4	Department offering the course
HONORS_COURSE	Text	1	Is this an honors course?
INACT_DATE	Date/Time	8	Date course becomes an inactive course
LAB_HRS	Number, Integer	2	Total number of lab hours granted for this course
MIL_COEF	Number, Integer	2	Military Coefficient
OTH_ACAD	Text	5	Indicate course was offered at another academy
RECIT_HRS	Number, Long	4	Total number of recitation hours granted for this
REMEDIAL	Text	1	Is course considered remedial?
REQUISITES	Memo	0	Co-requisites and pre-requisites for the course
TITLE	Text	50	Title of the Course

Table Name: tblKINS

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
KINS_ID	Number, Long	4	System assigned primary key

Other Fields

Field Name	Data Type	Field Size	Description
AC_DISCLOSE	Text	1	May they see academic information
ADDR_LINE_1	Text	50	First line in an address used for number & street,
ADDR_LINE_2	Text	50	Second line in an address used for number & street,
ADDR_LINE_3	Text	50	Third line in an address used for number & street,
ADDRESSEE	Text	100	Person to contact
CITY	Text	40	City
COUNTRIES_ID_FK	Text	2	Two letter country code
CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created
EMERG_CONTACT	Text	1	Indicates whether or not this is the emergency
MIDSHIPMEN_ID_FK	Number, Long	4	System assigned primary key
MIL_DISCLOSE	Text	1	Indicates if kin may see military information
MIRA_BRANCH_FATHER_ASSIG	Text	2	Branch of military service
MIRA_BRANCH_MOTHER_ASSIG	Text	2	Branch of military service
MIRA_RANK_FATHER_ASSIGN	Text	10	Abbreviation of military Rank
MIRA_RANK_MOTHER_ASSIGN	Text	10	Abbreviation of military rank
PHONE_NBR	Text	25	Phone number
POSTAL_CODE	Text	10	Postal code for foreign countries
RELAT_TYPE	Text	11	Indicates the emergency contact's relationship with
STATES_LETTER_CODE_ID_FK	Text	2	Two letter state code
ZIP	Text	5	Standard zip code
ZIP4	Text	4	Extension to the standard zip code

Table Name: tblLEAVE_ADDRESSES

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
MIDSHIPMEN_ID_FK	Number, Long	4	System assigned primary key
START_DATE	Date/Time	8	Date leave started at address

Other Fields

Field Name	Data Type	Field Size	Description
ADDR_LINE_1	Text	50	First line in an address used for number & street,
ADDR_LINE_2	Text	50	Second line in an address used for number & street,
ADDR_LINE_3	Text	50	Third line in an address used for number & street,
CITY	Text	40	City
COMMENTS	Memo	0	Freeform text entry. Comments about where the
COUNTRIES_ID_FK	Text	2	Two letter country code

CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created
END_DATE	Date/Time	8	Date leave ended at address
PHONE	Text	25	Phone number to allow entry of area codes,
STATES_LETTER_CODE_ID_FK	Text	2	Two Letter state code
ZIP	Text	5	Standard zip code
ZIP4	Text	4	Extension to the standard zip code

Table Name: tblLEAVE_PERIODS

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
CAT	Text	9	Type of leave
MIDSHIPMEN_ID_FK	Number, Long	4	System assigned primary key

Other Fields

Field Name	Data Type	Field Size	Description
APPROVED	Text	1	Indicates if this leave request has been approved
COMRATS_PROCESSED	Text	1	Has COMRATS been processed for this leave
CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created
END_DATE	Date/Time	8	Date leave ends
START_DATE	Date/Time	8	Date leave begins
UPDATE_DATE	Date/Time	8	Last date this entry was updated
UPDATED_BY	Text	30	For Created By and Updated By attributes used as

Table Name: tblMAJORS

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
MAJOR_CODE_ID	Text	4	Valid alphabetic code used to represent a major

Other Fields

Field Name	Data Type	Field Size	Description
ACT	Text	1	Indicates if major is active
BUPERS_SPEC_CODE	Text	4	BUPERS major specialization code
CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created
DEGR	Text	25	Degree of major
DEPA_CUDB_GRP_ID	Number, Long	4	For MIDS this will be the Common User Database
DEPA_CUDB_GRP_ID_SECONDA	Number, Long	4	Department ID
NIMITZ_CODE	Text	3	Major code used by Nimitz INNOPAC system
SHORT_NAME	Text	25	Major short name
SPECIAL_TRACK	Text	1	A YES NO domain without N/A

Table Name: tblMAPRS

Primary Key Yes

Field Name	Data Type	Field Size	Description
MARK_PERIOD	Text	11	Periods by which a MAPR can be entered for a
MIDSHIPMEN_ID_FK	Number, Long	4	System assigned primary key

Other Fields

Field Name	Data Type	Field Size	Description
AC_PERF	Text	10	Academic performance rating, The instructor
ATTITUDE	Text	12	Attitude rating, Estimate of the attitude of this
COMMENTS	Memo	0	Comments on midshipman
CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created
FACULTY_RECOMM	Text	8	Faculty recommendation
MIGR_COUR_ID_FK	Number, Long	4	**No Display, Course system assigned primary key
MIGR_ID_FK	Number, Long	4	System assigned primary key
MIGR_SEBLDA_AC_YR_FK	Number, Integer	2	Academic Year Block dates apply to
MIGR_SEBLDA_BLK_NBR_FK	Number, Integer	2	Academic Year Block dates apply to
MIGR_SEBLDA_SEM_FK	Text	6	Academic semester block dates apply to
MIGR_SECT_NBR	Text	7	Section of course
NBR_ABSENCES	Number, Integer	2	Number of absences from class
NBR_EI_ATTENDED	Number, Integer	2	Number of Extra Instruction sessions attended
NOMI_ID_FK	Number, Long	4	Unique identifier
PART	Text	10	Class participation rating
POTENTIAL	Text	14	Officer potential rating
PURPOSE	Text	20	Purpose of MAPR
SECT_STAND	Number, Integer	2	Where mid stands in section
SECT_TOTAL	Number, Integer	2	Number of Mids in section

Table Name: tblMental Development

Primary Key Yes

Field Name	Data Type	Field Size	Description
ACBOCA_SEBLDA_AC_YR_FK	Number, Integer	2	Academic Year Block dates apply to
ACBOCA_SEBLDA_BLK_NBR_FK	Number, Integer	2	Number identifying semester block or session
ACBOCA_SEBLDA_SEM_FK	Text	6	Academic semester block dates apply to
MID_GRDS_ID_FK	Number, Long	4	System assigned primary key
MIDSHIPMEN_ID_FK	Number, Long	4	System assigned primary key

Other Fields

Field Name	Data Type	Field Size	Description
ECAs	Text	25	Extra Curricular Activities
Honor	Text	1	Is the midshipman an honor student (Yes/No)

Platoon_Honor	Number, Integer	2	Total number of honor students in the platoon
Squad_Honor	Number, Long	4	Total number of honor students in the squad
Study_Hours	Number, Integer	2	Number of Study hours
Total_Company_Honor	Number, Integer	2	Total number of honor students in the company
UNSATs	Number, Integer	2	Number of UNSATs

Table Name: tblMID_EXCUSES

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
SCHE_MIDS_ID	Number, Long	4	System assigned primary key
SECA_MTG_DATE	Date/Time	8	Date of section meeting
SECA_PERI_PERIOD	Text	2	Period designator
SECA_SECOF_ID	Number, Long	4	System assigned primary key

Other Fields

Field Name	Data Type	Field Size	Description
COMMENTS	Memo	0	Additional comments on reason for missing class
CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created
EXCU_ATTEND_CAT	Text	10	Designation used for part or all of a section meeting
EXCU_EXCU_DESC	Text	30	Description to be displayed
ITEM_NBR	Number, Long	4	Item number for each excuse within section
MINS	Number, Integer	2	Number of minutes tardy or left early

Table Name: tblMID_GRDS

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
MIGR_ID	Number, Long	4	System assigned primary key

Other Fields

Field Name	Data Type	Field Size	Description
COURSES_ID_FK	Number, Long	4	Course system assigned primary key
CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created
DROPPED	Text	1	Indicates if course has been dropped
GRPOCO_LTR_GRD_FINAL_COU	Text	4	Letter Grade-Course
GRPOCO_LTR_GRD_FINAL_EXA	Text	4	Letter Grade-Final Exam
GRPOCO_LTR_GRD_MARKPER_	Text	4	Letter Grade-6 week
GRPOCO_LTR_GRD_MARKPER_	Text	4	Letter Grade-12 week
GRPOCO_LTR_GRD_MARKPER_	Text	4	Letter Grade-3rd period
GRPOCO_LTR_GRD_MARKPER_	Text	4	Letter Grade-End of term
INSTRUCTOR	Text	40	Section Instructor
MIDSHIPMEN_ID_FK	Number, Long	4	System assigned primary key

NON_MIDS_ID_FK	Number, Long	4	System assigned primary key
PE_PARTIAL_GRD	Number, Long	4	Instructor given PE grade equaling 2/3 of final PE
REPEATED	Text	1	Indicates if the course is being repeated
SEBLDA_AC_YR_FK	Number, Integer	2	Academic Year Block dates apply to
SEBLDA_BLK_NBR_FK	Number, Integer	2	Number identifying semester block or session
SEBLDA_SEM_FK	Text	6	Academic semester block dates apply to
SECT_NBR	Text	7	Section number
TITLE	Text	50	Title of course for this semester

Table Name: tblMID_MAJ

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
CAT	Text	11	Tentative, preliminary or declared

Other Fields

Field Name	Data Type	Field Size	Description
CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created
MAJ_ASSIGN	Text	1	Indicates if this is the assigned major
MAJORS_ID_FK	Text	4	Valid alphabetic code used to represent a major
MIDSHIPMEN_ID_FK	Number, Long	4	System assigned primary key
PREF_RANK	Number, Byte	1	Preference rank given to major

Table Name: tblMID_SEMS

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
MIDSHIPMEN_ID_FK	Number, Long	4	System assigned primary key
SEBLDA_AC_YR_FK	Number, Integer	2	Academic Year Block dates apply to
SEBLDA_BLK_NBR_FK	Number, Integer	2	Number identifying semester block or session
SEBLDA_SEM_FK	Text	6	Academic semester block dates apply to

Other Fields

Field Name	Data Type	Field Size	Description
AOM	Number, Long	4	Academic order of merit
BLK_FROM_REG	Text	1	Indicates if one is blocked from selecting
CLASS	Text	3	Indicates which class
COEF	Number, Integer	2	Coefficient used in calculations
COF_RANK	Text	15	Military Performance Company Officer Ranking
CONDUCT_STATUS	Text	3	Proficient, Deficient or Unsatisfactory in Conduct
CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created
CUM_HRS	Number, Integer	2	Cumulative hours (used for graduation check)
CUM_MIL_COEF	Number, Long	4	Cumulative military coefficient

CUM_MIL_QUAL_PTS	Number, Long	4	Cumulative military quality points
CUM_MQPR	Number, Long	4	Cumulative Military QPR
CUM_MULT	Number, Long	4	Cumulative multiple
CUM_QPR	Number, Long	4	Cumulative QPR
CUM_QUAL_PTS	Number, Long	4	Cumulative quality points
DANTS_LIST	Text	1	Indicates if midshipman is on the Commandant's List
DEANS_LIST	Text	1	Indicates if midshipman is on the Dean's List
LIGHT_LOAD	Text	1	ADAA allows a mid to take < 15 credit hrs this
MOM	Number, Long	4	Military Order of Merit
OOM	Number, Long	4	Overall Order of Merit
PROBATION	Text	1	Indicates if the Midshipman is currently on
RAN_REG	Text	1	Indicates if the midshipman has run the registration
RUN_COMPLETE	Text	1	Indicates if the registration has been processed
SEM_ADJ_MULT	Number, Long	4	Adjusted multiple(not used)
SEM_HRS	Number, Long	4	Semester hours
SEM_MIL_COEF	Number, Long	4	Semester Military Coefficient
SEM_MIL_QPR	Number, Long	4	Semester Military QPR
SEM_MIL_QUAL_PTS	Number, Long	4	Semester military quality points
SEM_MULT	Number, Long	4	Semester multiple
SEM_QPR	Number, Long	4	Semester QPR
SEM_QUAL_PTS	Number, Long	4	Semester Quality Points
STRIPER_RANK	Text	15	Military Performance Striper Ranking
SUPTS_LIST	Text	1	Indicates if the midshipman is on the

Table Name: tblMIDSHIPMEN

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
MIDS_ID	Number, Long	4	System assigned primary key

Other Fields

Field Name	Data Type	Field Size	Description
ACAD_GRAD_DATE	Date/Time	8	Date Midshipman graduated from USNA
ACC_START_DATE	Date/Time	8	Date this midshipman became an Academic Center
ADAS_ADV_ASSIGNS_ID_FK	Number, Long	4	Academic adviser code assigned to the faculty
Alpha	Text	6	Midshipman identifier
BIRTH_CITY	Text	40	The city where the midshipman was born
BIRTH_DATE	Date/Time	8	Date of Birth
CITIZ_DATE	Date/Time	8	Date of Citizenship
CITIZ_NBR	Text	10	Citizenship Number
CITIZ_TYPE	Text	4	(NATI)ve, (NATU)ralized,(IMMI)grant alien,
CLYE_CLASS_APPLIED_FOR	Number, Integer	2	Class Year
COMMISSION_DATE	Date/Time	8	Date the midshipman is commissioned
COMMISSION_TITLE	Text	30	Commissioning title used for transcript

CONGRESS_AC_DISCLOSURE	Text	1	Indicates whether the congressman may receive the
CONGRESS_MIL_DISCLOSE	Text	1	Indicates whether the congressman may receive the
COUN_CODE_HOME_OF_REC	Text	2	Two letter country code
COUNTRIES_ID_FK	Text	2	Two letter country code
CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created
EMAIL_ADDR	Text	70	E-mail address
EST_COMMISSION_DATE	Date/Time	8	Estimated date midshipman will be commissioned
FEEDER_SOURCE	Text	1	Preparatory program supplying midshipmen
FORMATTED_NAME	Text	100	Complete proper name
FORMER_MIL_SVC_CODE	Text	1	Former military service
GAIN_CODE	Text	1	Gain code 1-Civil Life, no prior service;2-Civil life,
GEN	Text	1	(M)ale or (F)emale
GRAD_HONORS	Text	16	Graduation honors
HIGH_SATM	Number, Integer	2	Maximum SAT/converted ACT Math score for this
HIGH_SATV	Number, Integer	2	Maximum SAT/converted ACT Verbal score for this
HOME_OF_REC_CITY	Text	40	Home city of midshipman
INDUCT_DATE	Date/Time	8	Date on which oath of office is taken
ITL	Text	1	Indicates if the midshipman is a foreign national
LOGIN	Text	8	Oracle Login ID
MICO_CO_NBR	Number, Integer	2	Company number
MID_NAME_FIRST_NAME	Text	40	First name
MID_NAME_LAST_NAME	Text	40	Midshipman's last name
MID_NAME_MIDDLE_NAME	Text	40	Middle name or middle initial
MIST_CODE	Text	2	The code used for this status
MIST_IN_BRIG	Text	1	Indicates if a midshipman in this status is considered
MTX_COMMENTS	Memo	0	Comments concerning mid to be used on the major
MTX_MSG	Memo	0	Message concerning mid to be used on the major
NAME_SUFFIX	Text	3	The person's name suffix
NATURALIZE_DATE	Date/Time	8	Date of Naturalization
NATURALIZE_NBR	Text	10	Naturalization Number
NOM_CATEGORY	Text	2	Nominator Category
NOM_COUNTRY	Text	40	Nominating Country name
NOM_DISTRICT	Number, Integer	2	Congressional district nominator source is located in
NOM_SOURCE_NAME	Text	70	Name of nominator source
NOM_STATE	Text	40	Nominating state name
PO_BOX_NBR	Number, Integer	2	P.O. box number in Bancroft hall
PREF_NAME	Text	40	The name the person prefers to be called
PRMI_ID	Number, Long	4	Unique identifier
PROJ_GRAD_DATE	Date/Time	8	USNA projected graduation date
REG_RANDOM_NBR	Number, Integer	2	Random number used in Registration
RM_NBR	Number, Integer	2	Wing, deck, and room number in Bancroft Hall
SEAS_SERV_ASSIGNS_ID_FK	Number, Long	4	Identifies specific service assignments

SEP_DATE	Date/Time	8	Date midshipman was separated from USNA
SEP_PENDING_DATE	Date/Time	8	Date midshipman left the academy due to a pending
SERE_ID	Number, Long	4	Standardized length of system assigned primary keys
SSN	Number, Long	4	Social security number
STAT_CODE_HOME_OF_REC	Text	2	Two Letter State code
STATES_LETTER_CODE_ID_FK	Text	2	Two Letter State code
UPWARD_MOBIL_CODE	Text	1	Upward mobility code
US_CITIZ	Text	1	Is the midshipman a U.S. citizen?
WHOLE_PERSON_MULT	Number, Long	4	Whole person multiple

Table Name: tblMoral Development

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
ALPHA	Number, Long	4	Midshipman Alpha Code
MIDSHIPMEN_ID_FK	Number, Long	4	Mids System assigned primary key

Other Fields

Field Name	Data Type	Field Size	Description
#_of_Hours	Number, Long	4	Number of hours in community involvement
4/C_Until	Date/Time	8	4/C Privileges reduced until
Community_Involvement	Text	1	Is the midshipman involved in the community
Conduct_Pending	Text	1	Pending conduct board(Yes/No)
Date_Adjud	Date/Time	8	Date offense adjudicated
Date_Offense	Date/Time	8	Date of Offense
Days_Restr	Number, Integer	2	Number of days restricted
Demerits	Number, Integer	2	Number of demerits
Description	Memo	0	Description of Offense
Fourth_Class_Privileges	Text	1	4/C Privileges reduced
Honor_Pending	Text	1	Pending honor board(Yes/No)
Level	Text	30	Level of Offense
Loss Leave Until	Date/Time	8	Date loss leave ends
Loss_Leave	Text	2	Has the midshipman loss leave
Max_Dem	Text	30	********
Notes	Memo	0	Notes
Number_of_Days	Number, Long	4	Number of days restricted
Offense	Text	10	1st Offense
Offense2	Text	10	2nd Offense
Offense3	Text	10	3rd Offense
Perform_Board_Pending	Text	1	Pending performance board(Yes/No)
Project_Name	Text	25	Name of Project
Reduced_Privileges	Text	1	Has the midshipman privileges been reduced?
Reduced_Until	Date/Time	8	Date reduction of privileges ends
Restricted	Text	1	Restricted(Yes/No)

Suspended	Text	1	Is the midshipman suspended?
Tours	Number, Long	4	Numbers of tours

Table Name: tblNON_MIDS

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
NON_MIDS_ID	Number, Long	4	Unique Identifier

Other Fields

Field Name	Data Type	Field Size	Description
BATT_IDENTIFICATION	Number, Integer	2	Battalion number
BIRTH_CITY	Text	40	Employee's city of birth
BIRTH_DATE	Date/Time	8	Date of Birth
CITIZ_DATE	Date/Time	8	Date of Citizenship
CITIZ_NBR	Text	10	Citizenship Number
CITIZ_TYPE	Text	4	(NATI)ve, (NATU)ralized,(IMMI)grant alien,
COUN_CODE_CITI	Text	2	Two letter country code
COUNTRIES_ID_FK	Text	2	Two letter country code
CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created
DEPA_CUDB_GRP_ID	Number, Long	4	Common User Database Group ID Academic
DEPA_CUDB_GRP_ID_ADMIN	Number, Long	4	Common User Database Group ID Academic Admin
EMAIL_ADDR	Text	70	E-mail address
ENTRY_CITY	Text	40	City Of Entry in the U.S.
ENTRY_DATE	Date/Time	8	Date of Entry into the U.S.
FORMATTED_NAME	Text	100	Complete proper name
GEN	Text	1	(M)ale or (F)emale
GRD	Text	5	Civilian Employee grade
JOB_AREA	Text	10	General job classification as specified in the Current
LOGIN	Text	8	Oracle Login ID
MICO_CO_NBR	Number, Integer	2	Company number
MIRA_BRANCH	Text	2	Branch of military service
MIRA_RANK	Text	10	Abbreviation of military Rank
NAME_PREFIX	Text	5	Name Prefix
NAME_SUFFIX	Text	3	The person's name suffix
NATURALIZE_DATE	Date/Time	8	Date of Naturalization
NATURALIZE_NBR	Text	10	Naturalization Number
NON_MID_NAME_FIRST_NAME	Text	40	First name as specified in the Current Common User
NON_MID_NAME_LAST_NAME	Text	40	Last name as specified in the Current Common User
NON_MID_NAME_MIDDLE_NA	Text	40	Middle name or initial as specified in the Current
OFFICE_BLD_ROOM	Text	254	Building and room location(s) of office
OFFICE_PHONE	Text	25	Phone number as specified in the Current Common
POS_SENSITIVITY	Text	2	Critical Sensitive, Noncritical

POS_SENSITIVITY_DATE	Date/Time	8	Date of person sensitivity
REG_NBR	Text	10	Alien registration number
ROTATION_DATE	Date/Time	8	Date employee is due to rotate
SECURITY_CAT	Text	13	Type of person as designated by the Security office
SEP_DATE	Date/Time	8	Date employee was separated from USNA
SEP_REASON	Text	3	Reason employee separated from USNA
SERIES	Text	7	Job series number
SSN	Number, Long	4	Social security number
STAT_LETTER_CODE_ID_FK	Text	2	Two Letter State code
TITLE	Text	40	Person's title

Table Name: tblPhysical Development

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
ALPHA	Number, Long	4	Midshipman Alpha Code
MIDSHIPMEN_ID_FK	Number, Long	4	Mids System assigned primary key

Other Fields

Field Name	Data Type	Field Size	Description
%_Body_Fat	Text	30	Percent of Body Fat
Career_PRT_Failed	Number, Long	4	Number of PRT failures while at USNA
Curl	Number, Long	4	Raw number of curls
Date	Date/Time	8	Date of PRT
Extended_Med_Chit	Text	30	Extended Medical Chit
Num_Grade	Text	30	Number grade
PE_Deficient	Text	10	PE Deficient
PE_Grade	Text	10	PE Grade
PE_Review_Board	Text	1	Midshipman before a PE review board
Precomm_Issues	Text	30	Pre Commissioning issues reference PRT
PRT_Failure	Text	1	PRT Failure
PRT_Grade	Text	30	PRT Grade
Push_up	Number, Long	4	Raw numbers of push up's
Run	Number, Long	4	Official time for the 1 1/2 mile run
SEM	Text	6	Academic semester block dates apply to
Sit_Reach	Number, Long	4	Raw number of sit and reach
Status	Text	30	Weight Status
Sub_Squad	Text	1	Remedial Physical Training
WC_REVIEW_BOARD	Text	1	Weight control review board
Weight	Text	30	Official weight of midshipman
Weight_CAT_V	Text	1	Overweight Category V

Table Name: tblPrivileges

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
ALPHA	Number, Long	4	Midshipman Alpha Code
MIDSHIPMEN_ID_FK	Number, Long	4	Mids System assigned primary key

Other Fields

Field Name	Data Type	Field Size	Description
Additional_WE	Number, Long	4	Additional weekends authorized
Basic_WE_Auth	Number, Long	4	Weekend authorization
WE_ineligible_4/C_Priv	Text	1	Weekend ineligible due to 4/C Privileges
WE_ineligible_Academics	Text	1	Weekend ineligible due to academics
WE_ineligible_C_PE_Perf	Text	1	Weekend ineligible due to PE Performance
WE_ineligible_CAT_V	Text	1	Weekend ineligible due to CAT V Weight Control
WE_ineligible_PRT	Text	1	Weekend ineligible due to PRT
WE_taken	Number, Long	4	Weekends taken
WL_ineligible_Academics	Text	1	Weekday Liberty ineligible due to academics
WL_ineligible_PRT	Text	1	Weekday Liberty ineligible due to PRT

Table Name: tblProfessional Development

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
ALPHA	Number, Long	4	Midshipman Alpha Code
MIDSHIPMEN_ID_FK	Number, Long	4	Mids System assigned primary key

Other Fields

Field Name	Data Type	Field Size	Description
1st_Choice_Service	Text	30	1st Service choice
2nd_Choice_Service	Text	30	2nd Service choice
3rd_Choice_Service	Text	30	3rd Service choice
4/C_Quiz_Date	Date/Time	8	4/C Quiz date
4/C_Quiz_Score	Number, Long	4	4/C Quiz Score
ADV_ASSIGNS_ID_FK	Number, Long	4	Midshipman's Adviser
Bn	Text	6	Battalion Midshipman is in
MAJOR_CODE_ID_FK	Text	30	Midshipman's major
MAPRS_ID_FK	Text	11	MAPR
Performance_Grade	Text	10	Performance Grade
Photo	OLE Object	0	Midshipman Photo
Platoon	Text	6	Platoon Midshipman is in
Professional_Grade	Text	2	Professional Letter Grade
Room notes	Memo	0	Room Notes
Room_Inspection_EventDate	Date/Time	8	Date of Room Inspection
Room_Inspection_Results	Text	4	Results of inspection (Pass/Fail)
SECT_ABSENCES_CAT_ID_FK	Text	50	Absences

Squad	Text	30	Squad midshipman is in
Uniform_Inspection_EventDate	Date/Time	8	Date of last inspection
Uniform_Inspection_Results	Text	50	Results of inspection
Unifrom Notes	Memo	0	Uniform Notes

Table Name: tblSCHEDS

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
MIDSHIPMEN_ID_FK	Number, Long	4	System assigned primary key
SECT_OFFERS_ID_FK	Number, Long	4	System assigned primary key

Other Fields

Field Name	Data Type	Field Size	Description
CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created
DROPPED	Text	1	Drop this course from this midshipman's selected
DROPPED_DATE	Date/Time	8	Date Course/Section was dropped
UPDATE_DATE	Date/Time	8	Date this record was last updated
UPDATED_BY	Text	30	User who last updated this record

Table Name: tblSECT_ABSENCES

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
CAT	Text	10	Indicates the category of part or all of a missed
SCHE_MIDS_ID	Number, Long	4	System assigned primary key

Other Fields **Field**

Field Name	Data Type	Size	Description
CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created
MINS	Number, Integer	2	Number of minutes tardy or left early
SCHE_SECOF_ID	Number, Long	4	System assigned primary key
SECA_MTG_DATE	Date/Time	8	Date of section meeting
SECA_PERI_PERIOD	Text	2	Period designator
SECA_SECOF_ID	Number, Long	4	System assigned primary key

Table Name: tblSECT_OFFERS

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
SECT_OFFERS_ID	Number, Long	4	System assigned primary key

Other Fields

Field Name	Data Type	Field Size	Description

ACTUAL_ENROLL	Number, Integer	2	Number of midshipman registered for this section
BLD_ROOM	Text	255	Building and room location
COMMENTS	Memo	0	Additional information about section
COOF_COUR_ID	Number, Long	4	Course system assigned primary key
COOF_SEBLDA_AC_YR	Number, Integer	2	Academic Year Block dates apply to
COOF_SEBLDA_BLK_NBR	Number, Integer	2	Number identifying semester block or session
COOF_SEBLDA_SEM	Text	6	Academic semester block dates apply to
COURSE_OFFERINGS_ID_FK	Text	13	Type of Course
CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created
GEN	Text	1	(M)ale or (F)emale
MAX_ENROLL	Number, Integer	2	Maximum number of midshipman allowed in the
OFFERED	Text	1	A YES NO domain without NA
SECT	Text	7	Section number
SECT_MTG_TIME_ID_FK	Text	18	Represents date and period that a section is offered
SETI_COURSE_CAT	Text	13	Type of offered course

Table Name: tblSECT_TIMES

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
SECT_MTG_TIME_ID	Text	18	Represents date and period that a section is offered

Other Fields

Field Name	Data Type	Field Size	Description
COURSE_CAT	Text	13	Type of offered course
CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created
END_DATE	Date/Time	8	Date this meeting time becomes invalid
VECTOR	Text	42	Vector of time slots

Table Name: tblSEM_BLK_DATES

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
AC_YEAR	Number, Integer	2	Academic Year Block dates apply to
BLK_NBR	Number, Integer	2	Number identifiying semester block or session
SEM	Text	6	Academic semester block dates apply to

Other Fields

Field Name	Data Type	Field Size	Description
ACTUAL_END_DATE	Date/Time	8	Actual end date of semester
ACTUAL_START_DATE	Date/Time	8	Actual start date of semester
CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created

END_DATE	Date/Time	8	Date semester block ends
SECT_CAL_CREATED	Text	1	Flag indicating the section calendar has been created
START_DATE	Date/Time	8	Date semester block starts

Table Name: tblSERV_ASSIGNS

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
SERVICE_LEGAL_CODE_ID	Number, Long	4	Identifies specific Service Assignments

Other Fields

Field Name	Data Type	Field Size	Description
BUPERS_COMM_CODE	Number, Integer	2	Commission code used for Bupers
CREATED_BY	Text	30	ID of person who created the record
CREATION_DATE	Date/Time	8	Date record was created
DESIG_CODE	Number, Integer	2	Identifies the officer's field of service
LEGAL_ABBREV	Text	15	Short name for the legal name
LEGAL_NAME	Text	50	Community description used for Service Assignment

Table Name: tblSTATES

Primary Key **Yes**

Field Name	Data Type	Field Size	Description
STATE_LETTER_CODE_ID	Text	2	Two Letter state code

Other Fields

Field Name	Data Type	Field Size	Description
DODMERB_NBR	Number, Integer	2	Numeric reference needed for DODMERB interface
Name	Text	40	Full state name

APPENDIX E. USERS/DEVELOPERS MANUAL

This User's Manual is intended for both the end user and the developer. COMIS was developed to provide company officers of the United States Naval Academy an easy way to track midshipmen performance and compare their midshipmen with others across the Brigade, other Battalions, and other Companies.

This COMIS prototype was developed using Microsoft Access 97, a Navy IT-21 standard. COMIS also uses additional add on software called the EZ Access Developer Suite 97 from Database Creations, Inc. that helped create the user interface.

Company Officer Management Information System User's and Developer's Manual

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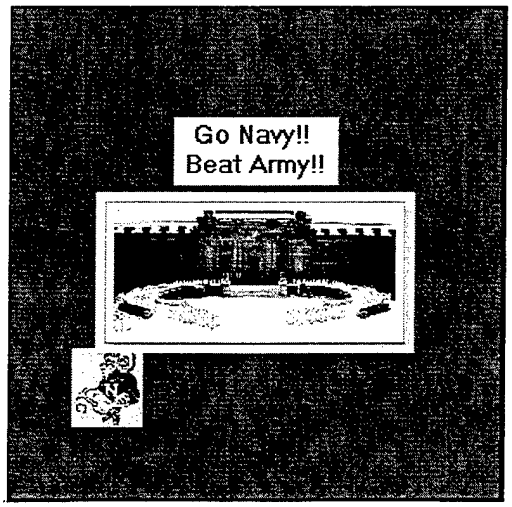
Installation:

COMIS was developed as a stand alone application with the intention of being replicated throughout the Brigade with a master database file. As such, each installation of COMIS will have to be at each desktop computer where it will be used by the company officer. Once the replicated database is created, then this will be the file installed on the desktop using a run-time version of Access. Installing the application is easy. Each company officer will be given a CD-ROM that contains the installation files or the setup file will be made available in a shared directory on a file server with permissions granted for the company officers. The user can execute the setup.exe file by double clicking the file in explorer or choosing Start, Run, and then the file name. The setup wizard will guide the user through the rest of the installation.

Once COMIS is installed, the user can go to Start, Program Files, COMIS, and then select the application name to execute it.

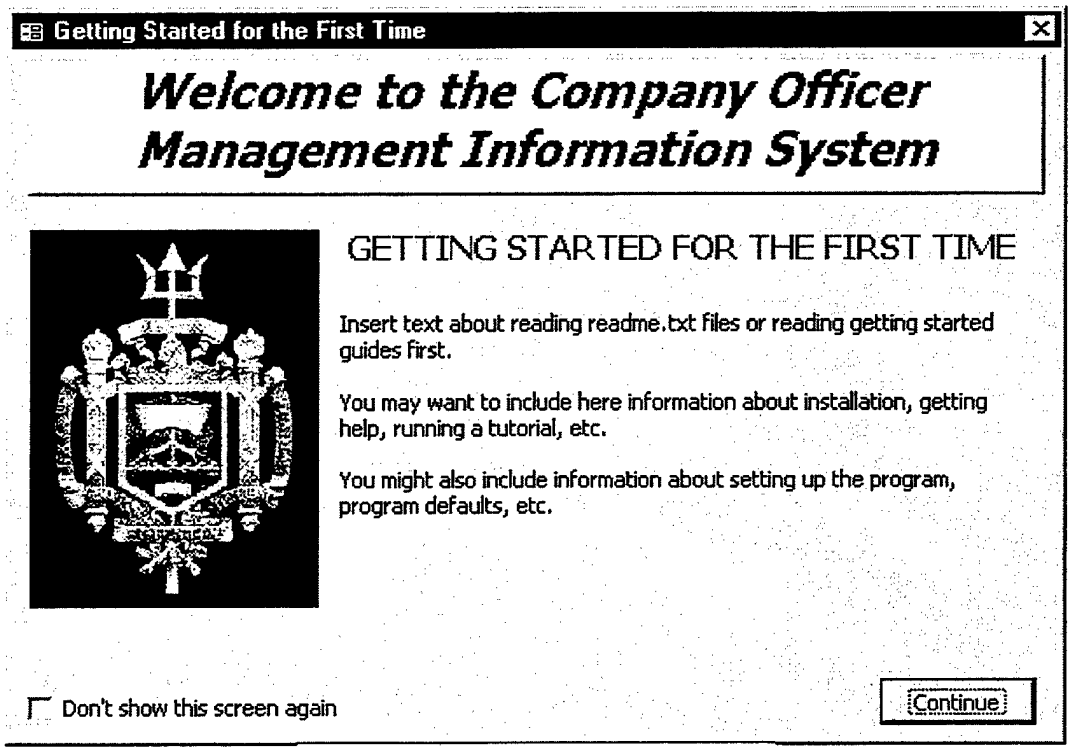
User Interface:

The Splash Screen appears when the program first loads up:



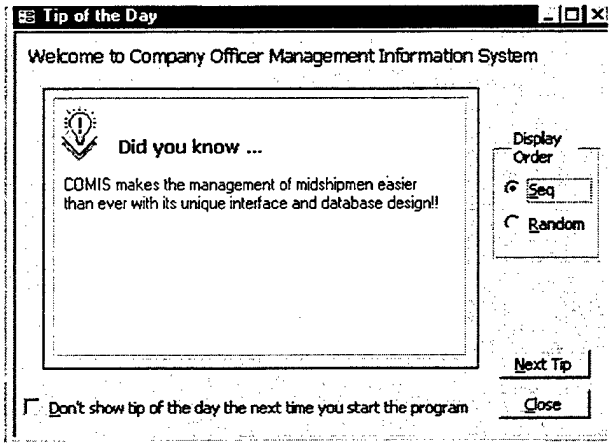
Splash Screen

If this is the first time the user is using COMIS, then the next screen will be a "First Screen" that welcomes the user to COMIS. There is an option on this screen to check if the user does not want to see this screen again. This screen is helpful for the first time user to select a tutorial, installation guide, details about defaults, and readme.txt type information.



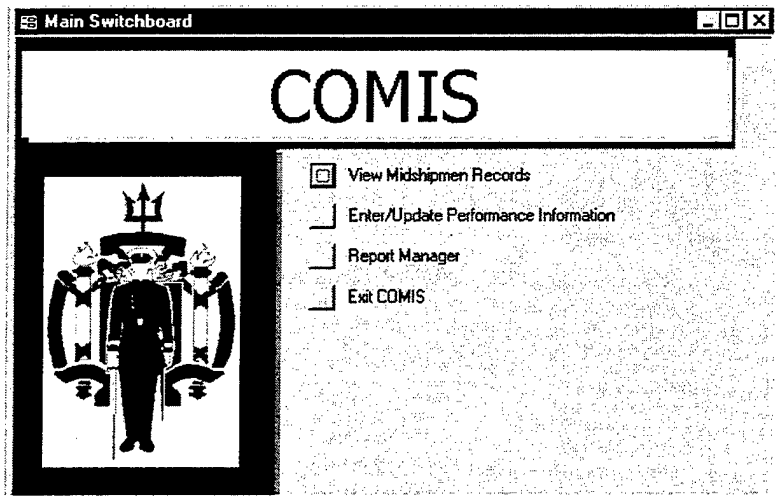
First Screen

After this screen comes the "Tip of the Day" form that displays a tip for using the COMIS database. The user will have the option of clicking this selection off so that it does not appear again.



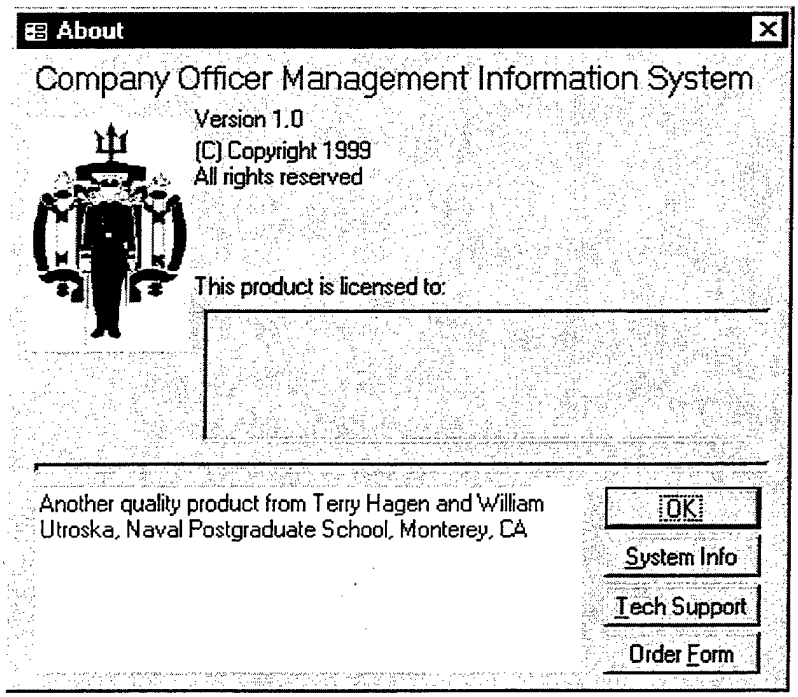
Tip of the Day

After the "Tip of the Day", the next screen is the COMIS Main Switchboard. From the main switchboard, the user will be able easily access all of the forms and reports of COMIS.

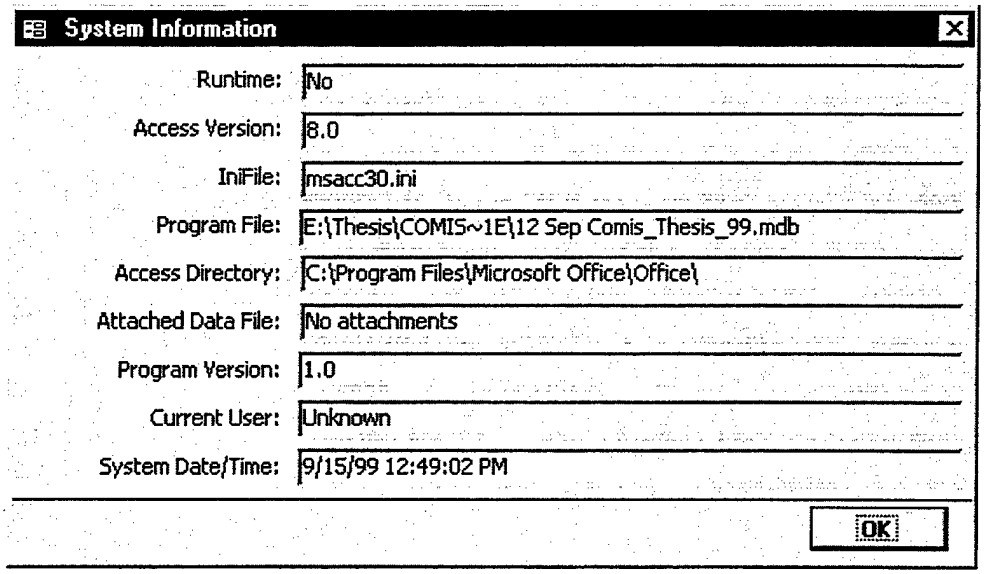


Main Switch Board

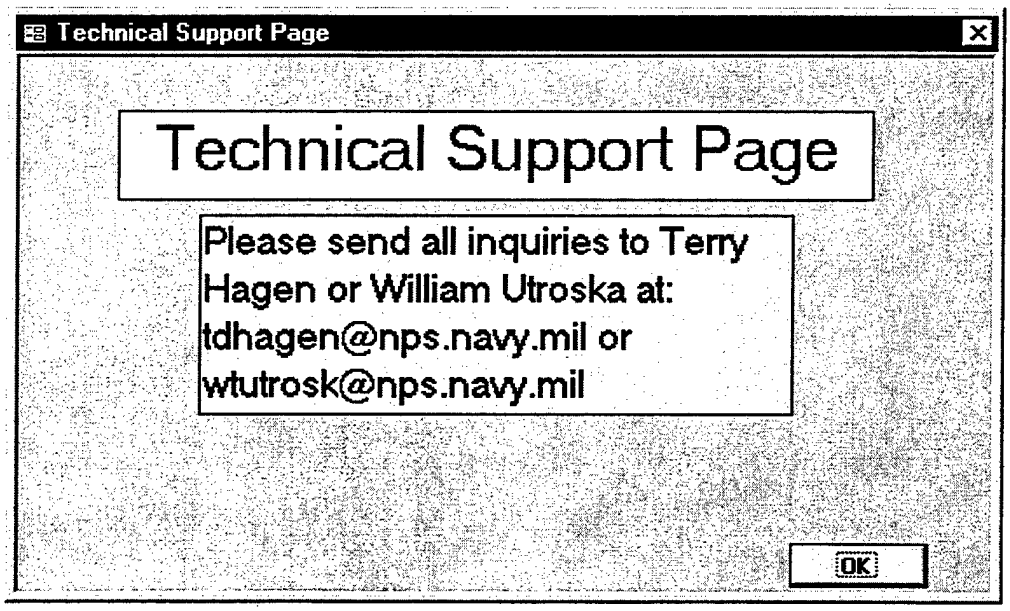
From the main switchboard, the user can access the About box by going to Help, About. From this screen the user can get system information, technical support, or an order form for the software.



COMIS About Box



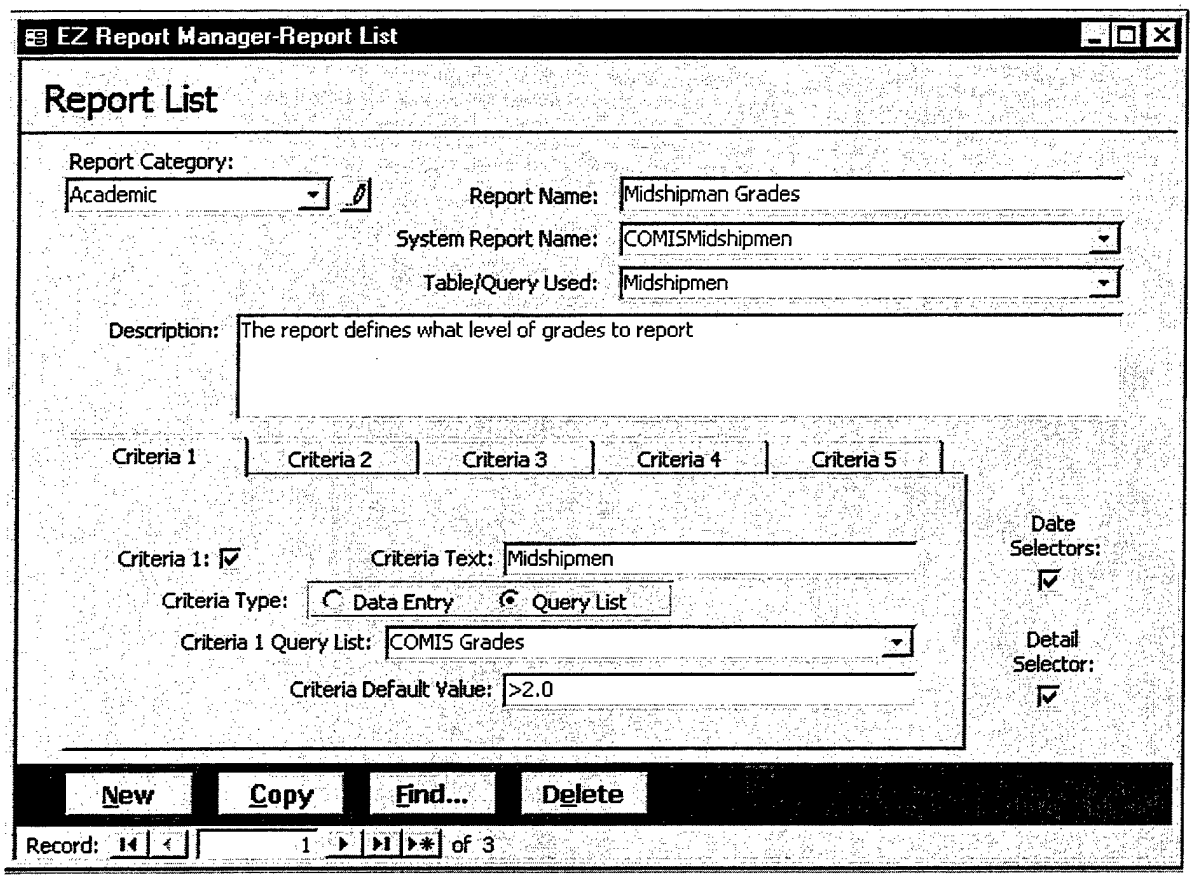
COMIS System Information



COMIS Technical Support Page

Report Manager:

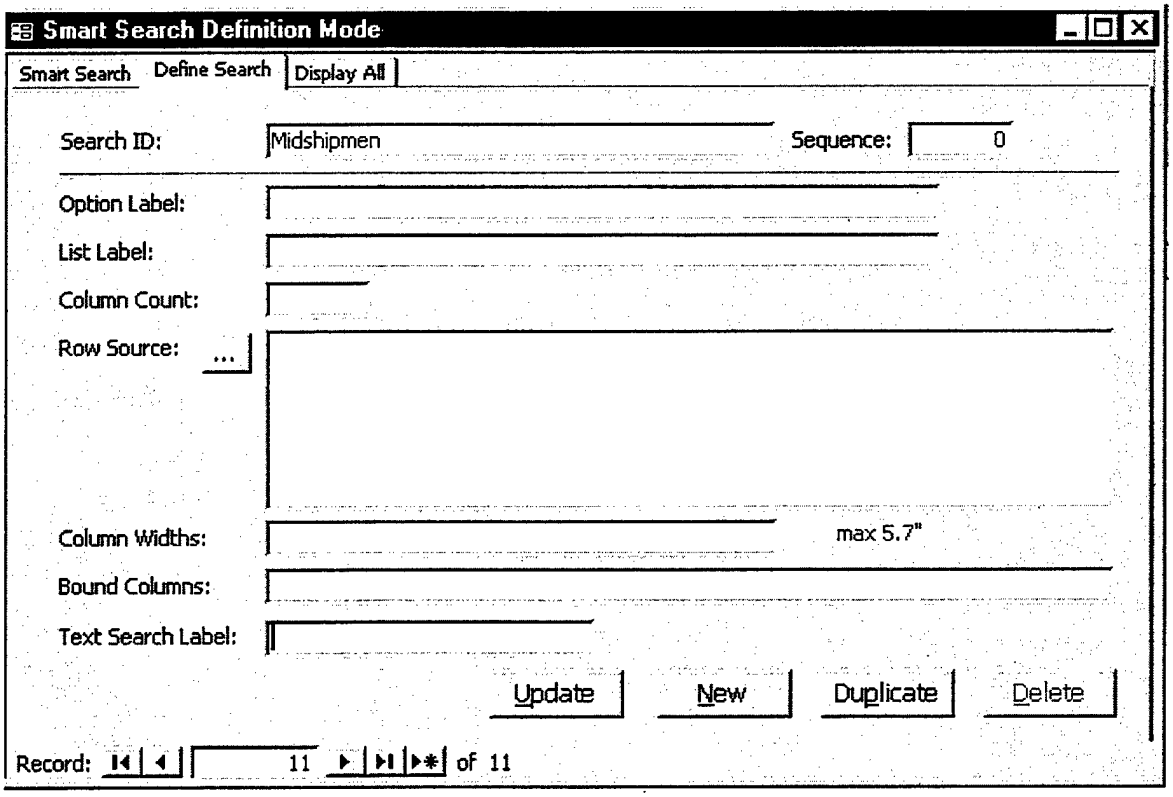
The Report Manager, as the name implies, manages the reports. There are many reports that COMIS can generate. With the Report Manager, the user does not have to create individual reports for everything they generate. In many cases, the only difference in a basic report are different dates, different squads, platoons, etc. So instead of making each individual report, the Report Manager maintains one report and the user can change the criteria for what they want to see. This significantly reduces down the number of reports the user needs to keep track of. The Report Manager also makes it easy to print multiple reports from one single queue. Normally Access only allows one report to be printed at a time.



COMIS Report Manager

Search Manager:

Every application must make it easy for the user to search for the records that they are interested in. With the Search Manager, this is easily accomplished by establishing up to eight basic criterias that the user selects and then the Search Manager finds those records. The Search Manager is called from any of the forms in COMIS, or it can be called directly from the Main Switchboard. This leaves many options for the users. If the Search Manager is called from a particular form, then when the Search Manager has found the associated records, the user has the option of returning to the form that the Search Manager was called from with the associated record set just found.

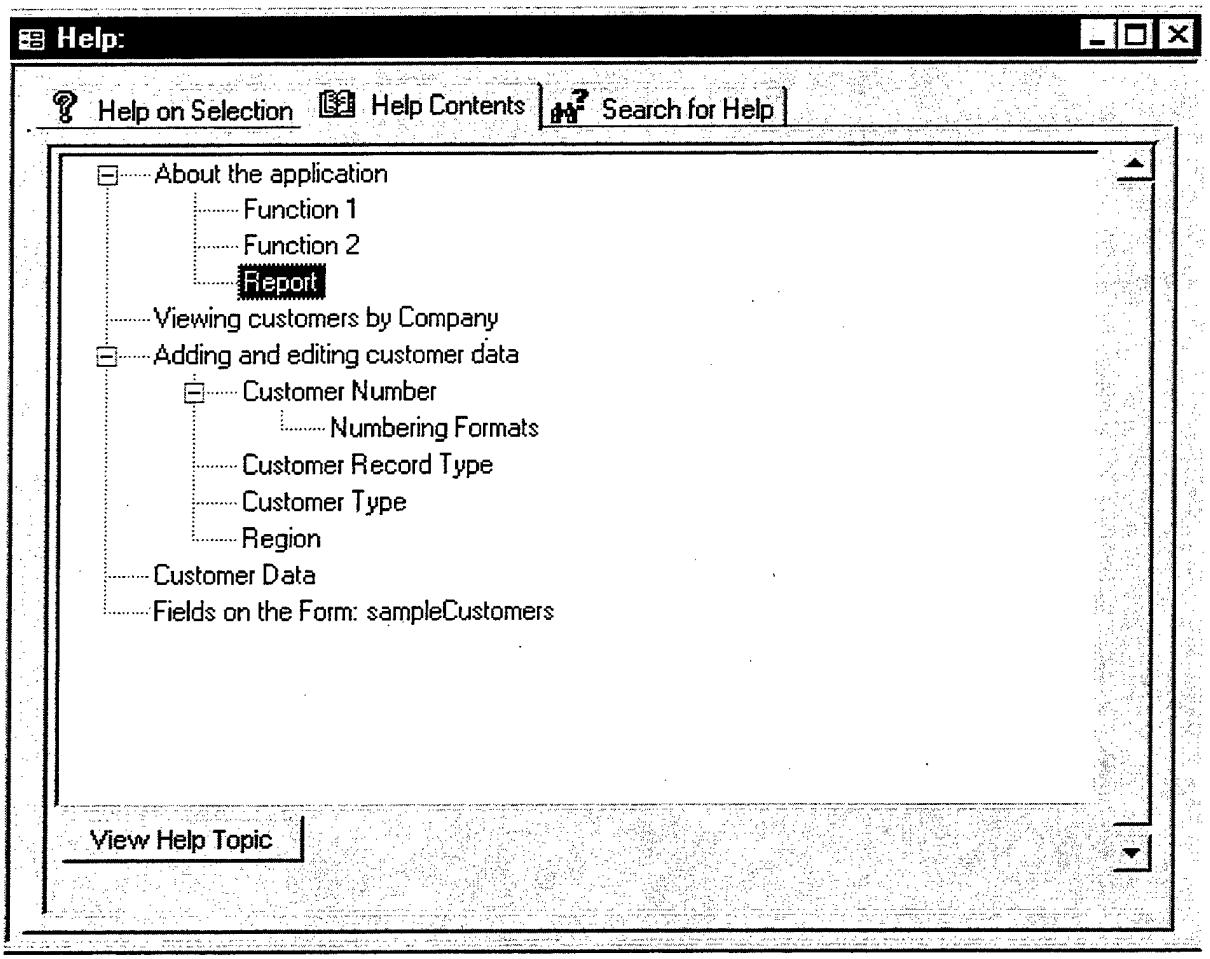


COMIS Search Manager

Help System:

The help system for COMIS uses only tables and forms to create a user help system with the following features:

- Only requires the developer to be familiar with Access
- Help text can be changed by editing a memo field in a table
- Help can be provided for any control, Access object, menu item, or application function
- Help text can be utilized to print a user manual
- Help text can be displayed in a contents window
- Help text can be searched
- Illustrations can be included
- The help system can be further customized by the developer
- Help contents are viewed as a hierarchical tree
- The Help Interface provides a pop-up help system, which is normally called by the F1 keystroke but could be called by a button on a form.

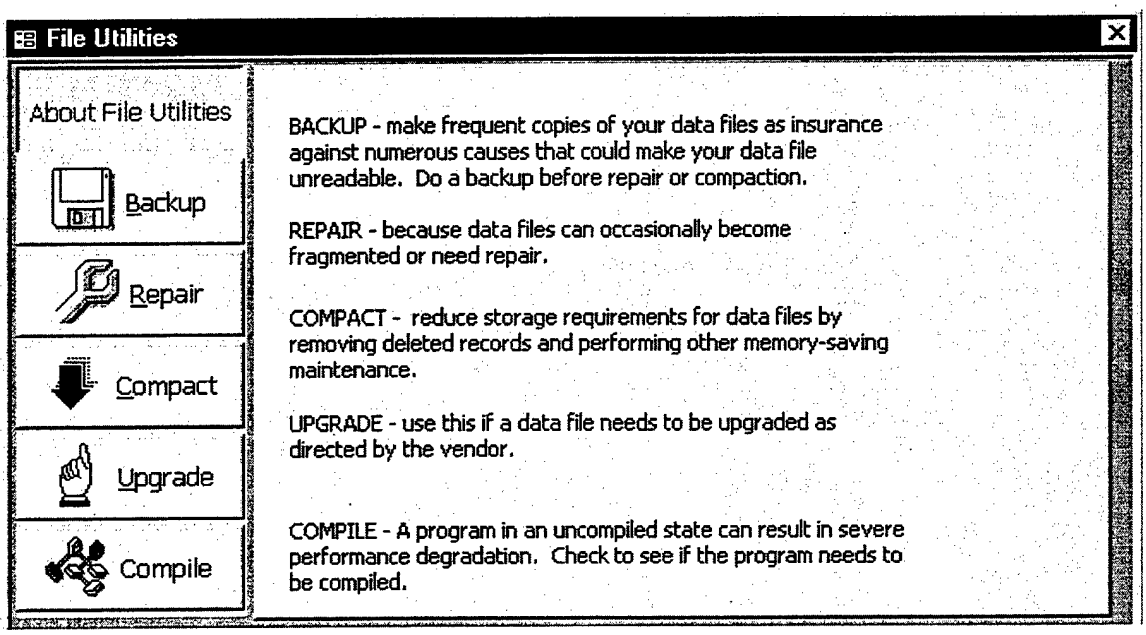


COMIS Help Manager

File Utilities Manager:

The File Utilities form is a self-contained, functional interface that handles the unique file maintenance requirements on COMIS, and with it, a user can perform the following functions:

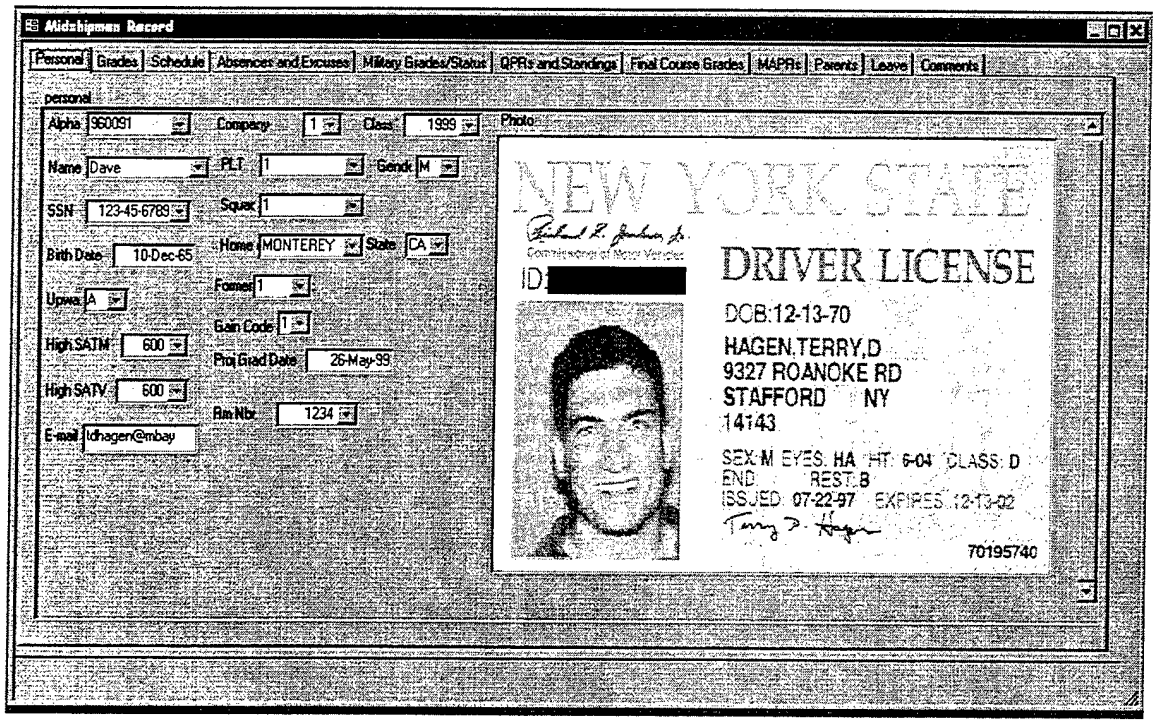
- Backup COMIS
- Repair COMIS
- Compact COMIS
- Upgrade COMIS
- Compile the current COMIS file



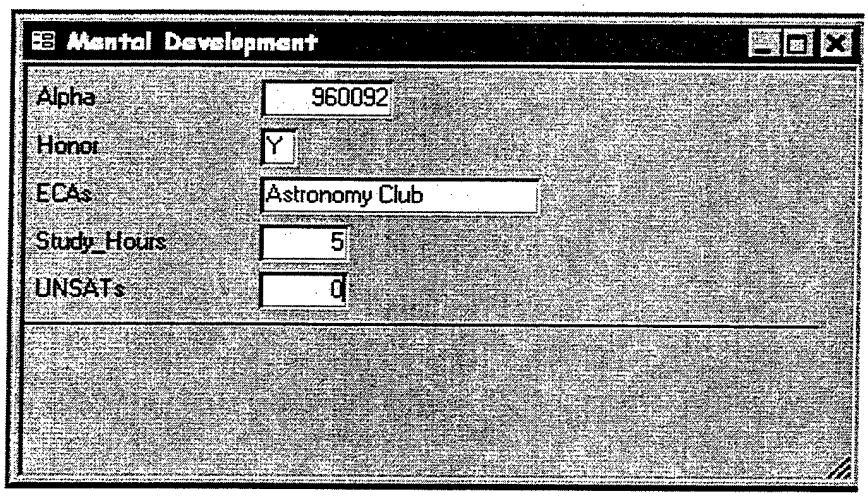
COMIS File Utilities

Forms:

The following screen shots represent a sample of the forms in COMIS. A detailed explanation of each one can be viewed from each form's Help menu.



Personal Information Tabbed Form



Mental Development Input Form

This completes the overview of COMIS. For further help and questions, please contact technical support.

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Systems Management Department
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11. Walter E. Owen (SM/WO) 2
Naval Postgraduate School
Systems Management Department
Monterey, CA 93943-5000

12. Daniel R. Dolk (SM/DK) 1
Naval Postgraduate School
Systems Management Department
Monterey, CA 93943-5000

13. Daniel C. Boger, Code IS. 1
Naval Postgraduate School
Monterey, CA 93943-5000

14. LT Michael J. Boone 1
1205 Farley Court
Arnold, MD 21012

15. Capt Terry D. Hagen 1
9327 Roanoke Rd.
Stafford, NY 14143

16. Major William T. Utroska 1
260-46 Langston Ave
Glen Oaks, NY 11004