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INFORMATION TECHNOLOGY REQUIREMENTS
FOR INDONESIAN NAVY

by

Liasta Ginting Suka

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Thesis Advisor: Myung W. Suh

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ASSESSMENT OF INFORMATION TECHNOLOGY REQUIREMENTS FOR INDONESIAN NAVY

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ABSTRACT

The Indonesian Navy presently relies on a mainframe Univac 90-S to process data and support decision makers. The data are processed by batch processing. Presently, data communications use manual, indirect and direct data entry. Personnel within the organization do not understand and are uncomfortable with the systems.

This thesis suggests an information technology architecture for the Indonesian Navy and addresses the organizational and policy implications, including training issues, information center hardware, software, data communication capability, security, and estimation of cost. The purpose of this examination is to provide the Indonesian Navy with some input to the strategic plan.

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I. INTRODUCTION

A. BACKGROUND

The Indonesian Navy, which is scattered among the islands, needs to improve its data communication systems. The present data communications use manual, semi-automatic, and automatic methods with a mainframe Univac 90-S. The data processing is done by batch-processing. The proposed systems will introduce a new model called on-line transaction processing based on satellite data communications.

B. SCOPE AND PURPOSE OF THE THESIS

The main thrusts of the study will be an examination of the information technology (IT) architecture for the Indonesian Navy and the organizational and policy implications. Factors to be considered include distributed systems, training issues, information center hardware, software, data communication capability, and estimation of cost.

The primary purpose of this thesis will be to provide the Indonesian Navy with an input to the strategic plan for information systems management.

C. METHODOLOGY

This research effort will be conducted mostly through review of current books, periodicals, articles, journals as well as Indonesian Navy Directives, plans, and policy guidance.

D. ORGANIZATION

The organization of this thesis is as follows:

Chapter II is an overview of the Indonesian Navy; the current issues, geography, and telecommunications.

Chapter III discusses IT requirements in general and particularly for the Indonesian Navy.

Chapter IV examines the implication of IT on the Navy organization, such as changes to the working environment, training issues, and reengineering.

Chapter V is the estimated cost assessment of building a new IT system onto the present computer system.

Finally, Chapter VI is the summary and recommendations.

II. OVERVIEW OF THE INDONESIAN NAVY IT

A. GENERAL

The Indonesian Navy is a very large and complex organization. It has many levels in the chain of command including top management, middle management, and lower level management. Though the Navy has a common information system, it is such a big organization that each level of organization could have a different approach to the implementation of the common information system. It should be borne in mind that what has worked well for a major command in the Naval organization may not be an appropriate approach for other levels in the chain of command. The factors that influence these different approaches are:

- Mission Priorities. There are many critical issues to be tackled within an organization before system information development can occur. The structure of the division, role, functions, procedures, and policies are probably different in the various levels of the organization. It is also important to consider "when is the right time" to develop, implement, or re-engineer an information system.

- Management Awareness. In most organizations, top and even middle managers are only vaguely familiar with computer technology. Most managers have been trained in and are familiar with environments where the capabilities of information technology are widely different from what is available today. Many of these

managers feel it would be very difficult to adapt to the new technologies and lack the requisite knowledge to provide the managerial direction to effect the changes. These managers need to decide what type of technologies, roles, procedures, training and education are needed to fulfill the efficient accomplishment of the organization's mission.

- Fragmentation of Responsibility. A few of the major commands within the organization have very different functions and responsibilities. This can create difficulty in developing an integrated information system for the organization. The Financing Directorate needs to be able to use computing for accounting applications. Logistics handles supply, procurement, and maintenance information systems. Operations handles readiness, combat, and operation systems. Personnel Staffing has the responsibility for the human resource management information systems. ASRENA (Assistant for Planning and Budgeting) uses the information related to organizations and methods. As a result of this fragmentation, every component or level of the organization may pursue separate strategies without necessarily interfacing effectively. If that happens, the strategy of an integrated information system will be lost or will not be achieved without drastic changes of culture, norm, and direction.

- User Involvement. The user of the information system should be involved in the development of that system. In some organizations, however, systems may be developed while keeping the users at a defined distance from the project. It is

important in the development of user friendly information systems that the end-user be fully involved from the onset. Presented in this chapter is the current status of the Indonesian Navy's information systems, some problems and issues involved in the Navy data processing and information systems, the geography, and the present communication system of Indonesia. Each of these areas has a significant impact on the future development of an information system.

B. THE CURRENT STATUS OF THE NAVY IT

The foundation for information technology in the Indonesian Navy is data processing using a mainframe computer. The mainframe computer is used to process data at the centralized Data Processing Center with a major emphasis being placed upon batch processing. The types of information systems being used by the Navy could be described as a hierarchy of "free standing", but loosely interfaced subsystems. There are a number of information systems, each oriented toward a specific area of management such as Logistics, Financing and Budgeting, Human Resource, etc. Every subsystem may be put into effect and utilized independently or with another subsystem. To use two or more subsystems involves complex links requiring attention to a great many details such as the inter-relationship in the design process and close coordination with the organizational elements that utilize the information system. The advantages of this implementation strategy are:

- The system is faster and has high reliability, since the subsystems can be designed and prototype subsystems can be tested without awaiting the other subsystems.

- It has a high degree of hardware flexibility. Since the Navy has a hierarchy of independent subsystems, it is not restricted to selecting a specific computer to handle all of the systems. In 1975, the Minister of Defense and Security/ABRI Commander-in-Chief approved a Master Plan for the development of ABRI information systems. The information system architecture was based on the three building blocks of the ABRI information system elements. These elements are system applications, unit command/services, and type of data processing provided. The major applications included:

    1. Manpower subsystem
    2. Major asset management subsystem
    3. Supply management subsystem
    4. Financing and budgeting subsystem
    5. Combat readiness subsystems
    6. Defense industries subsystem
    7. Facilities subsystem
    8. Force planning subsystem
    9. Mobilization subsystem.

Because not all application systems are needed by the Navy, only the following application information subsystems were established:

1. Manpower
2. Supply management
3. Financing and budgeting

4. Combat readiness.

The unit command/services include all levels of the chain of command in the Navy Headquarters and throughout the entire organization of the Navy. Data processing activities can be manual, mechanical and automatic. To support these systems, the Navy uses the Univac-90 series and an estimated 100 Type 286 IBM PC's. There are estimated 300 active duty staff officers and civilians throughout the Data Processing services, including managerial and professional staff. The majority of PC's are not connected to the Navy network. Each department has a LAN (Local Area Network) with Novell software. But for the whole organization the LANs are not integrated.

C. THE EARLIER PLANNED DEVELOPMENT OF IT IN THE NAVY

In general, the success of organizations will depend on the successful fulfillment of two key objectives:

1. How to get the right information systems
2. How to get the information systems right.

The success of the Indonesian Navy partially depends on whether the necessary information systems are properly planned and developed. The planned developments of the Navy IT between 1975-2000 are described by the four phases of organizational learning about information technology [Cash, Mc Farlan, Mc Kenny, 1992]: technology identification and investment, technological learning and adaptation, rationalization/management control, and maturity/widespread technology transfer.

1. 1975 - 1980 Pilot Project Technology Identification and Investment

The first pilot project technology identification and investment in the Navy occurred at the Headquarters, establishing the Data Gathering and Processing Agency Office (DISPULLAHTAL). This office installed a UNIVAC-90S mainframe to develop a program of data conversion from manual to ADP technology, and initiated a major program of education for management and a recruitment program. The design concept for the Navy information systems was to manage defense and security resources. The information system consisted of four subsystems:

a. Personnel Information Systems (SISINFOPERS)

b. Material Information Systems (SISINFOMAT)

c. Finance Information Systems (SISINFOKU)

d. Combat Strategy and Tactics Information Systems (STRATOPUR).

This pilot project technology identification and investment was characterized by impreciseness in the estimation of cost and expected benefits. The evaluation of the resulting system seemed to be quite clumsy. The inefficient evaluation appeared to be due to a lack of management attention or control, lack of user involvement, vendor failure, or incompetent project management.

2. 1981 - 1985 Technology Learning and Adaptation

The objective during the second phase was to apply newly identified technology to areas of interest. The Navy became involved in an intensive program of new developments in major DP applications to satisfy the initial requirements of the various functions and roles. Concurrently, the Navy began systematic development of a

sequence of interactive models. By the end of 1984, the fundamental building blocks of the Navy information system were in place and were used to carry out a major review for forward strategy on information systems. The Navy information systems had been reviewed to come up with a new conceptual design based on the three building blocks:

a. Administrative Information Systems (SIMIN)

b. Operation Environment Information Systems (SILOP)

c. Office Automation (SIOP)

As technology learning and adaptation took place, the actual benefits realized in this phase were quite often different from what was expected, though not all of the major ADP applications were implemented as originally planned. In this case, a significant amount of learning occurred during implementation.

In 1985, the Navy organization used personal computers (PC's) for word processing as the means of office automation. This system appealed to the Navy because the Navy got some immediate advantage. The cost of the hardware and software was relatively inexpensive as compared to the Univac-90S mainframe which did not support text processing widely. After one year of introducing this equipment some inadequacies were identified. Among these deficiencies were low processing speed and poor print quality of the dot matrix printer. In spite of these weaknesses, PC's have received a good deal of interest from the Navy.

3. 1986 - 1995 Rationalization/Management Control

The challenge in this phase is to develop appropriate systems and controls to ensure that the technologies are utilized efficiently. Early in this phase, the major issues

of the Navy information systems strategies continued to be emphasized in the educational efforts at all levels of management. The logic of data analysis had been set up, a data base team had been established and the project data dictionary was under development. The expectation was that a significant number of new systems might be developed. One of the most important elements in the establishment of the Navy information systems has been the creation of IT Personnel (Dispullahtal), Operational Research, and Naval Education activities. The objectives of the establishment of these departments and the experimental information systems they used was to achieve the goals and needs of the Navy by developing programs in data processing, data communication, telecommunication and office automation.

4. 1996 - 2000 Maturity/Widespread Technology Transfer

Organizations seek to become more advanced in this phase to make effective use of their IT investment. Organizational learning with technological skills, user awareness, and management controls will all be in place. The Navy will have analyzed the various aspects of the product life cycle of innovation and learning; and rationalization and maturity will be clearly understood and in most cases well-managed. In this final phase, the Navy might be expected to be able to judge the feasibility and appropriateness of the new technology to accomplish the tasks or needs of the Navy. Information systems managers will have developed a new style of delegating leadership since the interpersonal involvement will be low. By then operation procedures will be well understood and awareness high and the managers can delegate responsibility to supervisors or subordinates to be completely in charge.

D. PROBLEMS AND ISSUES IN THE NAVY INFORMATION SYSTEMS

The impact of an information system on the organization and management in the Navy can be dramatic, sometimes even leading to resistance to a new application as the conversion date approaches. Information Technology has been set to automate structured commands where the standard operating procedures, decision rules, and information flow have been used with reliability in a predefined manner. These changes indirectly affect management decision making through the aggregation of data in product reports and access to data and product information. The primary problems and issues related to information systems in ABRI (Army, Navy, Air Force, Police State) are described by Paulus (Paulus, 1990) as being managerial frustration with computer technology in general, and IS specialists (system analysts, programmers, etc.) in particular. This is not an uncommon reaction for many decision commanders. Basically the IT has not been matched with what the manager really needs, so the IT fails to support or provide the right information to the managers.

In general, the managers at ABRI have been passive in using IT, since they have had trouble developing computer resources in relation to what they need to make decisions. The lack of professionalism among IS specialists, lack of proper methods and techniques, lack of training staff, limited resource allocation, single minded vendors, and poor planning, have all contributed to this attitude. Some examples of common problems in the past failures of IS development are:

- IS development of application systems took a long time, and the application often ended up out of date. They usually failed to meet the true needs of managers, but generated high costs and cumbersome products.

- Desperate managers might sometimes "strike it lucky" and find that the approach selected may yield dramatic improvements in simple cases. This might lead to false optimism and overly high expectations of the approach. When they use the same approach on larger cases,the results can be very disappointing.

- Buying more new technology does not guarantee success in implementing IS. Many failures have been caused by unprepared personnel attempting inappropriate applications of IS.

- The rapid development of hardware and software by the computer industry is another reason why the development of properly interfaced subsystems had failed. The IT specialists had to invest a significant amount of time in switching from one hardware and software system to another. It also took a long time to upgrade the existing systems to take advantage of the new technology. In addition, the IT specialists could not keep up with the managers' demands for new application systems. Today IT specialists and managers are faced with critical decisions regarding organization, management, and developing or building the information systems.

E. GEOGRAPHY AND TELECOMMUNICATION INFRASTRUCTURE

The Indonesian country covers 1,926 million square kilometers of land area and the territorial waters are almost four times that of the land area. The distance from East to West is around 5,120 kilometers, almost the same as the US continent from East to West coast, and from North to South it is around 1,760 kilometers. The total number of islands is 13,667, with the main islands being Sumatra, Java, Bali, Kalimantan (Borneo), Sulawesi (Celebes), and Irian Jaya (The western part of New Guinea). The Indonesian Navy has its chain of command scattered throughout many of these islands and is responsible for all the islands and waters of Indonesia.

These features have necessitated major investments in advanced telecommunications facilities, as traditional communications such as postal and telephone services have proven inadequate. In order to most effectively link the islands, the government of Indonesia established the first satellite communication system in the developing world, making it the third nation in the world after the United States and the Soviet Union to employ such technology for domestic communications.

1. Postal Service

The Indonesian Postal Service is an essential part of the national communications network used by the entire population for inter-island communication by letter and parcel. The DoD of Indonesia and the Navy still use the Postal Service to mail letters between units and commands on separate islands.

2. Telephone Service

The telephone system has been implemented by the state owned enterprise Perusahaan Umum Telekomunikasi (PERUMTEL), which on September 1991 changed its status to a limited company under the name PT Telekomunikasi Indonesia (TELEKOMINDO). In 1990, they had 1,413,802 phone lines in use, including 1,299,899 automatic, 98,903 manual, and 15,000 mobile.

To establish the telephone system, Indonesia worked together with companies such as AT&T, Phillips, and NEC. The recently deployed telephone communication system uses Integrated Service Digital Network (ISDN) technology and fiber optic systems. The government set a goal of having 5,144,700 telephone lines in 1999.

3. Satellite Technology

To link 27 provincial capitals, the government established the first satellite communications in July 1976 with the assistance of some U.S. companies. The second generation Palapa B2P satellite was launched by the National Aeronautics and Space Administration (NASA) into orbit in March 1987. Palapa B2P contains 24 transponders, each capable of handling one color television channel or 1000 two-way circuits simultaneously. The third satellite (Palapa B2R) was launched in April 1990. It is used for telephone, television, facsimile, and data transmission. And the fourth satellite (Palapa B4) was launched in 1992 to support the current systems. The satellite communications system has revolutionized Indonesia's telex, radio, television, facsimile, and data transmission capabilities. The excess capacity of the Palapa satellite communication

systems are rented by the Philippines, Malaysia, Thailand, and Sri Lanka to improve their own communications capabilities.

The Navy should examine some alternative approaches in the area of satellite communications for its own unique data transmission needs. There is a constant need for the Navy to improve its ability to provide fuller, faster, better information across the island network.

III. INFORMATION TECHNOLOGY REQUIREMENTS

A. ARCHITECTURAL OVERVIEW

1. Application Level Components

a. On-Line Transaction Processing (OLTP)

On-line transaction processing, also called Real-time Processing, is a processing technique in which master file records are updated as soon as individual transactions are entered into the computer system. An individual transaction is processed fast enough for the results to be used almost immediately. These systems are usually used by banking systems and air line reservation systems. Bank clerks and Automatic Teller Machines (ATM) use on-line transaction processing to update their customer's files and give their customers the most accurate information available.

b. Electronic Mail

A lot of universities are using PC's to send E-mail to students, faculty and teachers. E-mail is a fast and inexpensive way of sending, receiving, storing and forwarding messages electronically. E-mail is good not only for inter-office operations but also for inter-island operations. For example, the Indonesian Navy can use E-mail to send messages to those connected to the system and the recipients can read the messages at their convenience. E-mail is a very efficient means of communication; every one connected to the system can check their messages on a daily basis. While they are on the road, they can be

connected to their main office by using a note book computer through telephone lines, giving them access to messages which can then be answered and forwarded as appropriate.

c. Decision Support Systems

Decision Support Systems are a major category of management information systems. DSSs are based on computer information systems that provide interactive information support to managers during the decision-making process. DSS uses analytical models, specialized data bases, a decision maker's own insights and judgments, and an interactive based computer modeling process to support the making of semi-structured and unstructured decisions by individual managers. DSSs are able to directly support the specific types of decisions and the personal decision-making styles and needs of individual managers in organizations. DSS are used for a variety of applications in both business and government. For example, an airline DSS uses the Analytical Information Management System (AAIMS) to support decisions in the airline industry, such as aircraft assignment, route requests, ticket classifications, pricing etc. A Real Estate DSS is used in the Real Estate industry to support complex analysis of investment in commercial real estate. The real estate plan DSS helps decision makers evaluate proposed commercial real estate investments. A geographic DSS uses a Geographic Information System (GIS) that integrates computer graphics and geographic data bases. IBM's Geo-Manager is a GIS which constructs and displays maps and other graphics displays that support decisions affecting the geographic distribution of people and other resources. Geo-Manager can be used for urban growth studies, defining legislative district boundaries, emergency vehicle deployment, electrical power distribution, forest management, and railroad maintenance applications (O'Brien, James A., 1994).

2. Database and Database Management Systems

a. Database

Managing data is part of achieving successful management information support. Without proper management, vital data and essential information will not be available to support the operations of the organization.

The management of databases was largely a technical issue primarily of interest to information systems, but it is becoming increasingly important throughout all types of organizations. A number of recent organizational trends are emerging that emphasize the importance and usefulness of databases. These are:

- Businesses need up-to-date and accurate information. Information is one of an organization's most vital resources and is essential for survival and growth.

- Managers need up-to-date and accurate information in order to make timely and effective decisions.

- Customers need more and more information, insisting on current information about the status of orders, invoices and accounts.

- End-users of databases want to develop their own personal applications in less time than was required using older and more traditional development methods.

In addition to these, according to Senn (Senn, James A., 1990), the seven objectives of managing databases demonstrate the advantages that can be gained: avoiding

unnecessary redundancy, providing access flexibility, providing relatability, maintaining data independence, ensuring evolvability, preserving data integrity and ensuring data security.

b. Database Management Systems (DBMSs)

Databases were developed to overcome the problems of users having to wade through data unrelated to their needs, data redundancy, and program dependency on data. Managing a database is inherently a complicated task. Software packages called database management systems (DBMSs) are used to interact with a database. DBMSs establish a method for storing and manipulating information about a variety of entities, the attributes of the entities and the relationships between the entities.

3. Communications

By telecommunications anyone in the world can communicate with anyone else in the world, almost at the speed of light. End-users need to communicate electronically to succeed in today's global information society. Managers, end-users and organizations need to electronically exchange data and information with other end-users, customers, suppliers and organizations. Only by using telecommunications, can they perform their work activities, manage organizations, and complete successfully in today's fast-changing global economy. Today, many organizations could not survive without an interconnecting network of computers to service the information processing and communications needs of their organizations. Top level management will be expected to make or participate in decisions regarding a great variety of telecommunications options. For these reasons the applications, technology and managerial implications of telecommunications need to be studied.

a. Communication Media

Communication technology is vitally important for distributing information technologies and picking up speed. LANs connected to wide area networks (WANs) are leading to computer connectivity among information workers. Local area networks and wide area networks usually use communications channels or communications media. There are several types of communication media including twisted pair cable, coaxial cable, microwave, satellite and fiber optic cable.

(1) Twisted Pair Cable. Twisted pair cables are often used to connect computers in networks and transmit data over relatively short distances. This technology is inexpensive, but susceptible to noise and every couple of miles needs a repeater to strengthen the signal.

(2) Coaxial Cable. Coaxial cable is a copper wire surrounded by a thick band of insulation, wire mesh and rubber or plastic. It is more expensive than twisted pair cable, but it has a higher capacity, 100 billions bits per second, and can span longer distances than twisted pair cable before it needs to have the signal strengthened. It is also popular for connecting computer systems placed in the same office building.

(3) Microwave systems. A data communication system that transmits data through the atmosphere in the form of high frequency signals similar to radio waves is called a microwave system. These signals do not bend, so relay station towers must be in the line of sight of each other, rarely more than 30 miles apart. Multiple communications over the same frequencies can cause scrambling.

(4) Satellite systems. The satellite communication systems can transmit billions of bits per second, making them appropriate for transmitting large amounts of data. The satellites that are positioned around 22,300 miles above the equator and orbit the earth at the same speed as the earth rotation, are said to be in a geosynchronous orbit. A satellite is a solar-powered electronic device that contains a number of small, specialized radios called transponders that receive signals from transmission stations on the ground, called earth stations, amplify the signals, and transmit them to other earth stations, usually long distances from the originating station. The benefits of satellite systems is the small number of satellites and repeater stations needed to transmit data over long distances. As shown in Figure 3.1, three satellites are positioned to provide access to the entire earth's surface.

Satellites have a long life of more than 10 years in orbit. The cost of establishing a satellite, launching it into orbit, maintaining it, and replacing it can be billions of dollars. Such costs, when shared among many companies, industries, and even nations, make the technology affordable to a greater number of businesses.

Some satellites have been launched into orbit to handle domestic and international data, video and voice communications. For example, the banks in the USA use satellites daily to transmit thousands of customer transactions to other banks. A bank in New York can transfer money from a customer at the bank to the customer's account at another bank in Jakarta, Indonesia within a few seconds by using communications satellites.

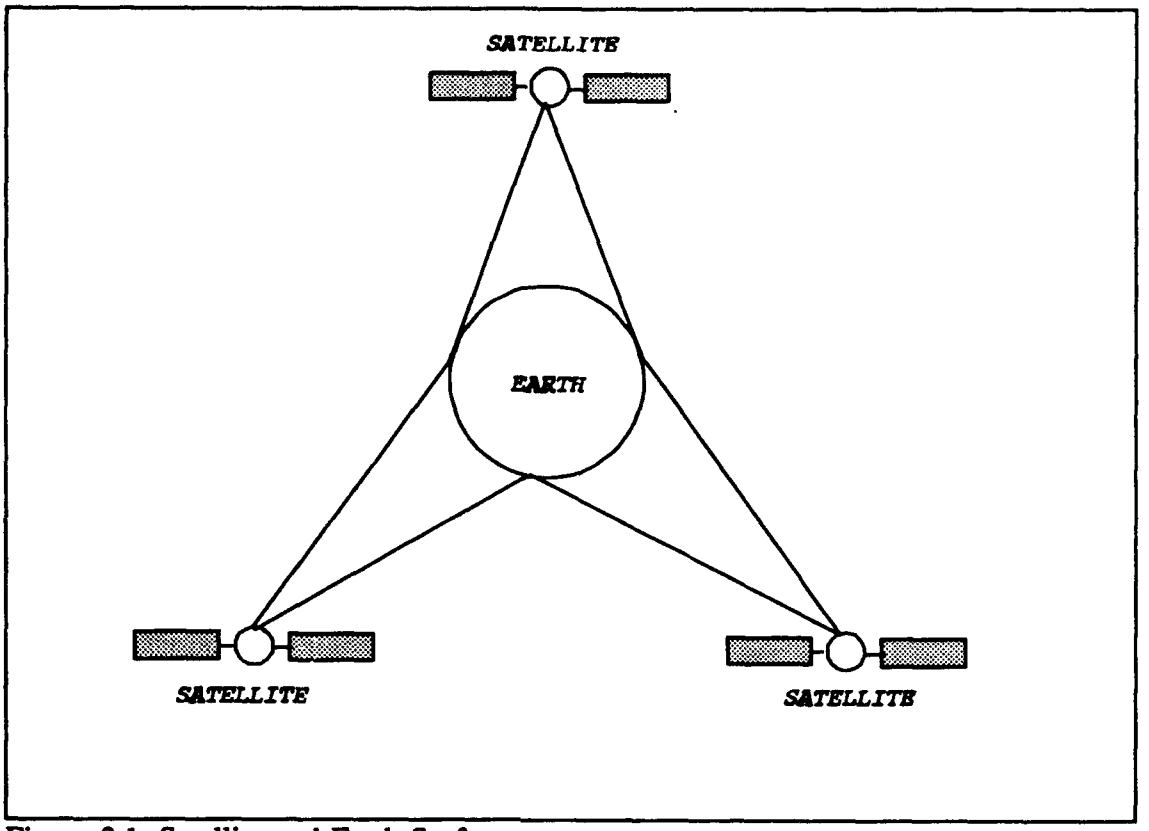

Figure 3.1. Satellite and Earth Surface.

(5) Fiber Optic Cable. With fiber optic cable, data is converted into light pulses and transmitted by laser through tiny threads of insulated glass or plastic. The benefits of using fiber optic cables are:

- High volume
- High speed (light speed)
- Low error rate
- High security
- Long life.

The diameter of a fiber optic cable is about 1/2000 inch. It has the capability of carrying thousands of telephone conversations, transferring billions of bits of data per second, as with satellites, but without a time delay. The speed of transmittal is about 10,000 times faster than copper wire. The cost of installing fiber optic cable is cheaper than other types of transmission media due to its very long life. Large and complex organizations with branch offices throughout the United States often use combinations of channels to send and receive data between locations.

b. Local Area Network (LAN)

A local area network is a communications network that provides for the interconnection of a variety of data communicating devices within a small area (e.g. the same building or large in-building network with two or more computers). LAN's make it convenient to share hardware, software and databases. LAN's usually use a dedicated microcomputer (PC), called a "file server", that allows other PCs to remotely access its resources. With a file server and a high-capacity hard disk, called a disk server, users can access programs and data just as easily as if they were on their individual hard drives. Having these items on the disk server frees up space on the hard disks in their individual computer systems for their specific files. Similarly, a "print server" manages the flow of traffic on expensive printer devices. By sharing resources such as applications programs, expensive hard disk capacity and high-quality printers over networks saves companies enormous amounts of money in software and equipment costs.

c. *Wide Area Network (WAN)*

As referred to in Chapter II, the Indonesian Navy is scattered among many islands. Large geographic areas can be spanned by wide area networks. The long distance telephone network is the oldest form of WAN. Though the long distance monopoly was broken up years ago, many telephone companies in the United States are linked together electronically. Communication media devices continue to improve speed, capacity, and benefits in sending and receiving data long distances through communications channels. Now, the most prevalent WANs are public access networks and value added networks.

(1) Public Access Networks. Telephone companies such as the Bell network, MCI, US Sprint and AT&T are known as common carriers. Communications networks maintained by such common carriers are called public access networks (PANs) because the companies provide voice and data communications channels to other organizations across long distances. Today, companies which own satellite transmission facilities have established PANs also. In Indonesia, the Indonesian Navy can use satellite transmissions by paying a fee to the telephone company.

(2) Value Added Networks. Value added networks are companies that use the facilities of common carriers to offer the public additional communications service at a subscription fee. VANs reduced the price to users by sharing communication lines among many users making the cost of the service economical. Services include access to electronic mail, information processing and network database. VANs provide networks, conversions

between differing systems and ensures that subscribers receive data they need and at lower cost than if they pursued the same service through PANs.

Subscribers need only install a modem and make a local call to access a VAN. Data is then routed between the subscriber's computer, the VAN's local terminal, and a long distance host computer. The most popular service offered by VANs is information retrieval, such as American On-line, GENIE, MCI Mail, Prodigy etc.

To improve the data communications around Headquarters and among the islands, the Navy should prepare two separate network systems. The system that should be established around Headquarters is a LAN (Local Area Networks) while the network system for among the islands should be a WAN (Wide Area Network).

4. Hardware

Hardware consists of input devices, output devices and storage devices. All of these are electronic components of an information processing system than can be physically seen and touched, and are included in telecommunications systems.

The Indonesian Navy has computer hardware such as main frames, work stations and PC's. The transaction processing has been done by batch processing and stand-alone processing.

5. Security

Controls are needed for on-line transaction processing, DSS, Database and communications systems. These are vital business assets. Such resources of information systems need to be protected by built-in controls to ensure their quality and security.

In general, the organization needs to control three major categories:

- Information system controls (input, processing, output and storage controls)
- Procedural controls (separation of duties, standard procedures documentation, authorization requirements and auditing)
- Physical facility control (physical protection, computer failure controls, telecommunications controls and insurance).

The target of a crime involving computers might be any piece of the computer system. Any computer system, mainframe or PC, is an expensive investment that requires protection. Computer resources including hardware, software, storage media, and data, should be protected from unauthorized access by persons or groups that might cause interruption, fabrication, modification, or destruction of resources. For example, on August 10, 1984, the Sperry Computer Corporation defense plant in Egan, Minnesota was entered by two people. Using hammers, the pair maliciously smashed military prototype computers and other equipment. The damage to the equipment was estimated to cost $65,000 and showed the vulnerability of "secure computer installations". (Fuller, Floyd 1994)

The term "computer security" means the physical protection of hardware, software, tape reels, disk packs, source documents, documentation manuals, computer files and computer programs. These computer facilities usually represent millions of investment dollars. Perhaps even more important is the value of the programs, data and information about

customers, employees, competitors and other organizations. All organizations should have a carefully planned security program, implemented and enforced to protect the computer facility.

B. INFORMATION TECHNOLOGY REQUIREMENTS FOR THE INDONESIAN NAVY

Section A discussed IT requirements in general including hardware, software, communications, database, and security. It is only after the Indonesian Navy improves data communications among its islands that such requirements can effectively be fulfilled. There are three alternatives to make the network systems operate properly.

1. Alternative 1

Currently, the Indonesian Navy has a mainframe (UNIVAC 90-S) and each command has several PCs. Alternative 1 is to install LANs to interconnect PCs at the Headquarters and use satellite communications to connect remote PCs to the mainframe. The satellite service is offered by a joint venture between the government and a commercial company. The implementation cost is not high, and only some devices and software need to be added. Figure 3.2 shows a model of this alternative for data communications between Navy Headquarters and major commands.

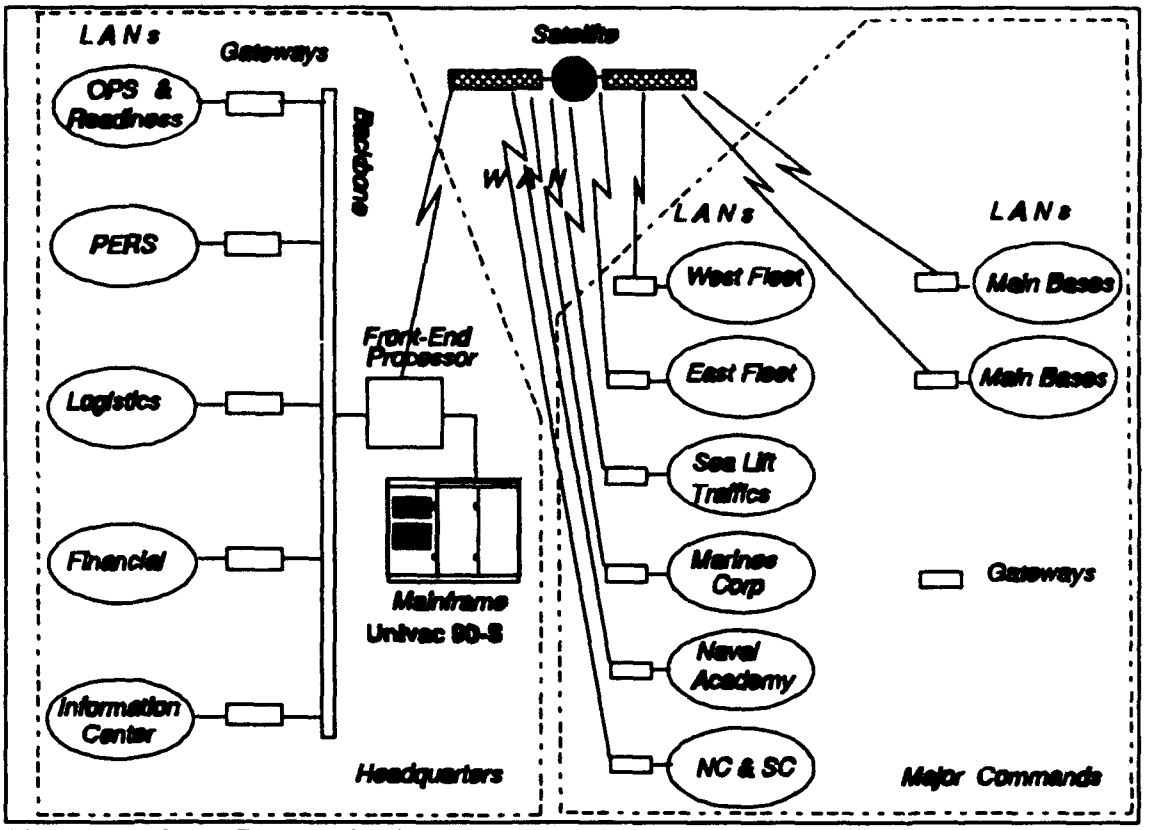

Figure 3.2. Data Communication Systems Alternative 1.

2. Alternative 2

Alternative 2 is similar to alternative 1 except that it replaces the Univac 90-S mainframe with a Unix-Host. This not only promises greater flexibility, but will also provide excellent graphics capability. Such a system is shown in Figure 3.3.

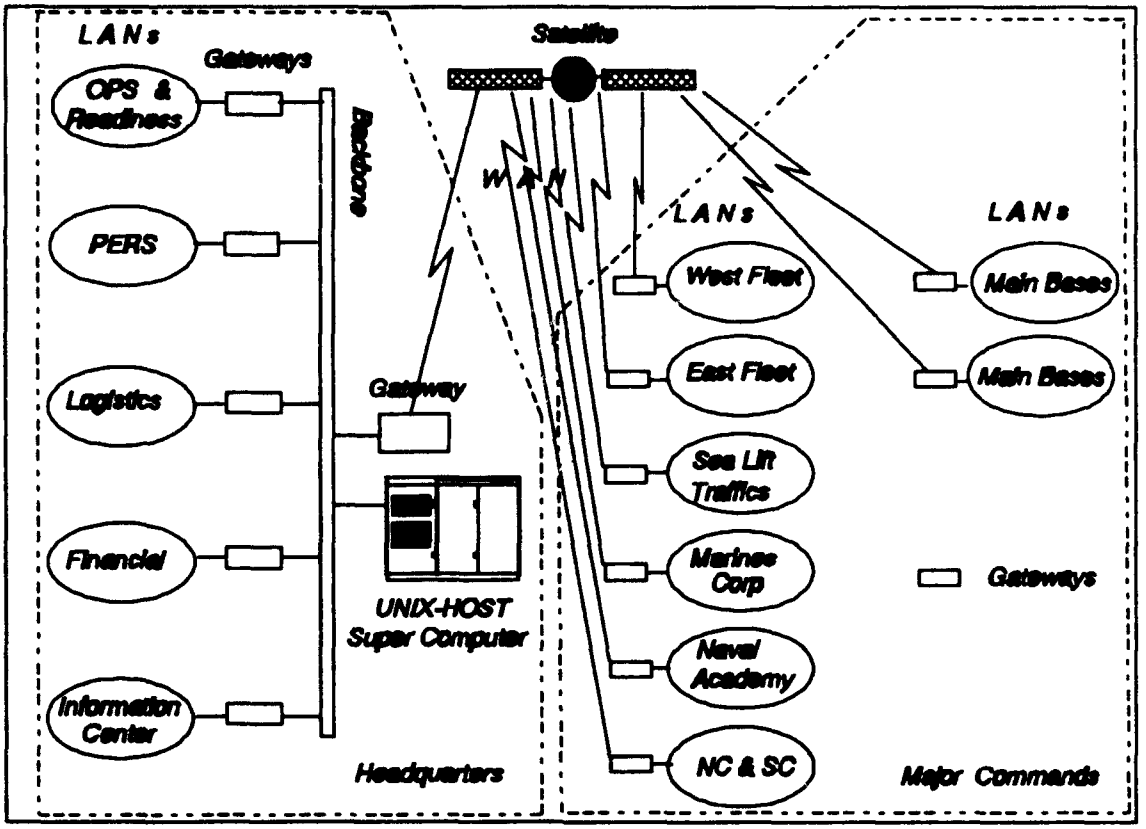

Figure 3.3. Data Communication Systems Alternative 2.

3. Alternative 3

Rather than using satellites, the Indonesian Navy could install Fiber Optics among the islands to communicate with each other. Because of the long distances involved, repeaters would have to be installed to amplify the signals. Installing the repeaters and fiber optics would initially be extremely expensive, but due to the longevity of the components, over time it would not be quite so expensive. In addition to the speed, this system also provides greater security and reliability as satellite signals could be jammed or intercepted. This system is shown in Figure 3.4.

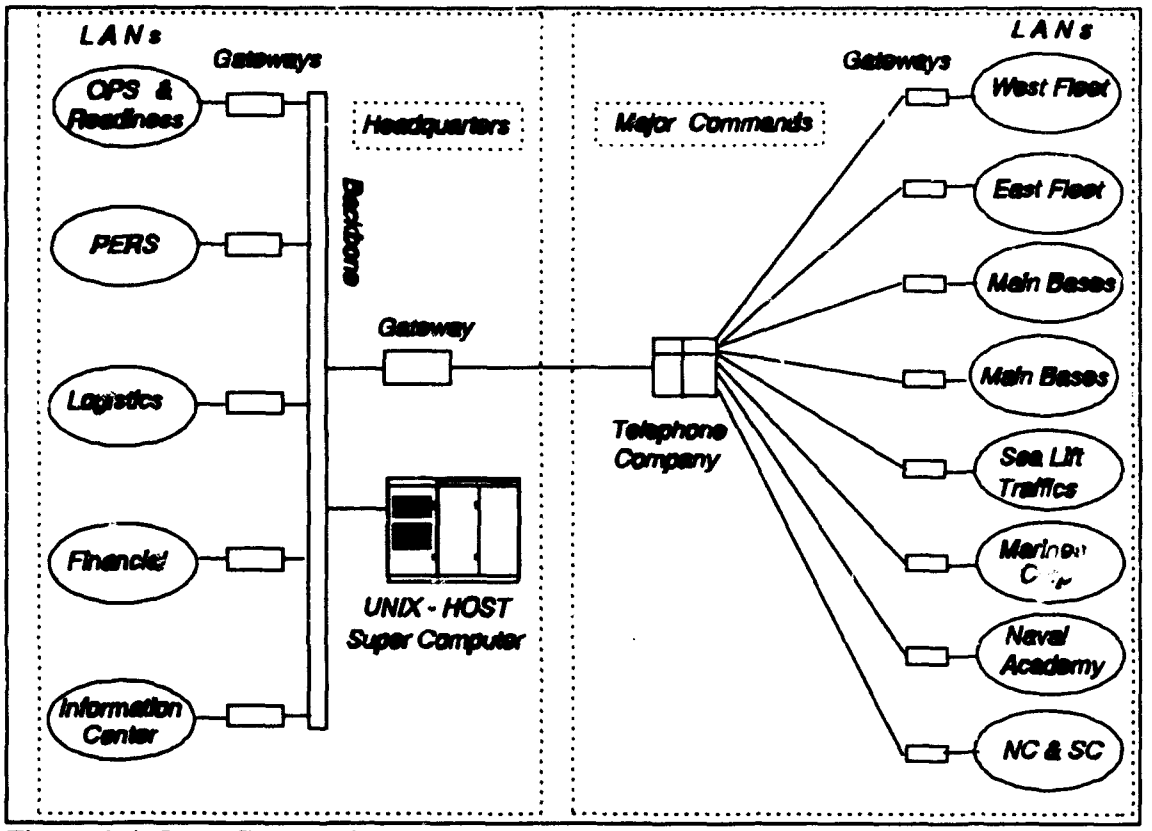

Figure 3.4. Data Communication Systems Alternative 3.

Table 1. summarizes the various methods of improving data communication systems throughout the Indonesian Navy. Upgrading the information technology will have implications on the structure and organization of the entire Navy.

TABLE 1. ALTERNATIVES FOR INSTALLING ON-LINE DATA COMMUNICATIONS.

Alternative 1.

1. ***Mainframe Univac 90-S and PCs (Old versions)***
2. ***Backbone***
3. ***Gateways***
4. ***Front-end Processor***
5. ***Satellite Communication***
6. ***Communication Networking Software***

Alternative 2.

1. ***Unix - Host Super Computer and PCs (New Version)***
2. ***Backbone***
3. ***Gateways***
4. ***Satellite Communication***
5. ***Communication Networking Software***

Alternative 3.

1. ***Mainframe Univac 90-S or Unix-Host Super Computer and PCs***
2. ***Backbone - Fiber Optics***
3. ***Gateways***
4. ***Fiber Optics - Wire***
5. ***Communication Networking Software***

IV. ORGANIZATIONAL IMPLICATIONS

Before introducing a new IT system, the full implications on the organization should be foreseen in advance. The new IT system can change the method of doing business in the Navy. The Navy needs to train and educate executives, line-executives (middle management), end users and staff members. Also included in the changes will be re-engineering the structure of the organization and the job descriptions.

A. CHANGING WORK ENVIRONMENT

The installation of a new IT system in the Naval organization will result in a changing work environment. This will result in a transition from an old style of doing business to a new style of working.

1. Present Method

Presently each unit usually uses paper and pencil, has the document verified by the line-manager (officers and command), and mails it through the postal system to Headquarters, c/o staff of Deputies. From the Deputies it is sent to Dispullahtal (Gathering Data and Processing Services), and then Dispullahtal enters the data by batch-processing with the Univac 90-S mainframe. After finishing the processes in Dispullahtal, executives use this information to make decisions, as shown in Figure 4.1.

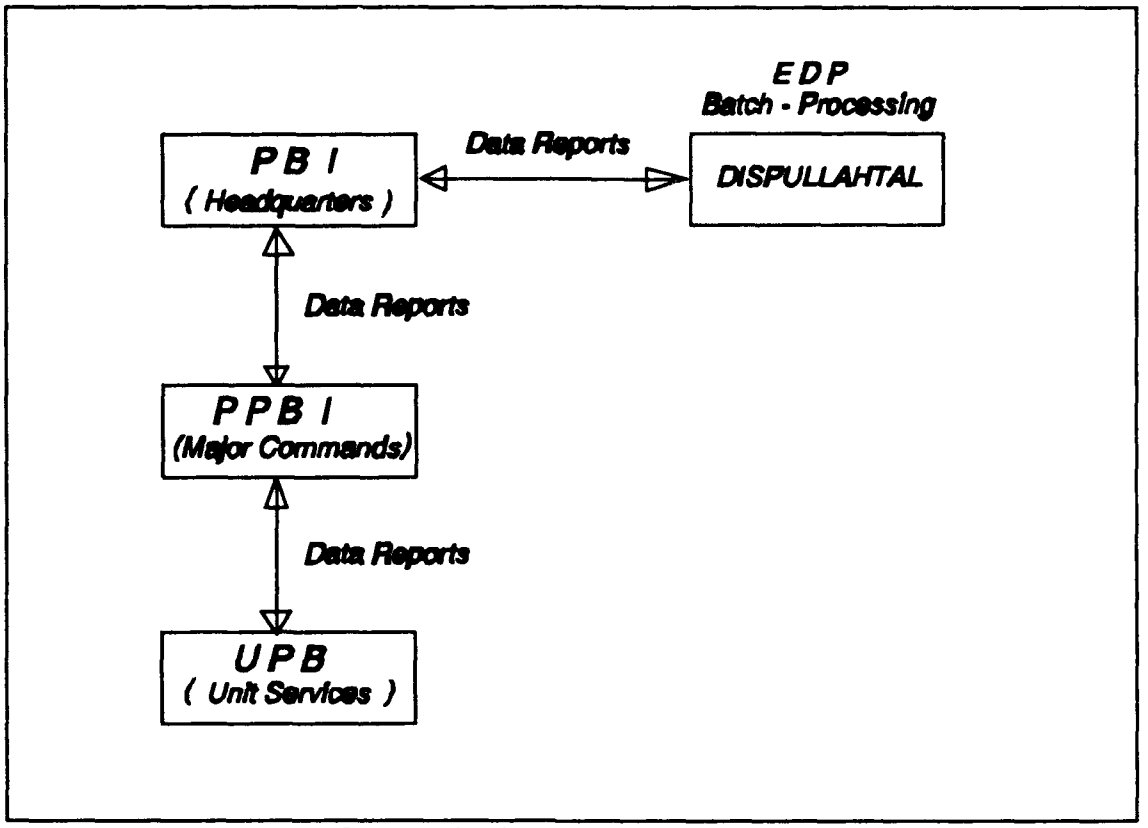

Figure 4.1. Present Data Communications.

2. Proposed Method

Under the proposed method the individual units would use their own computers to enter the data. The data then would be sent by satellite communication and be immediately accessible by staff and Deputies from their PCs. Dispullahtal, as a data bank, can access and process the data making it available to all executives at Headquarters almost immediately. As shown in Figure 4.2.

With the introduction of IT systems and the ability to communicate immediately and directly among the islands will come a change in the culture of the entire Navy. The

Navy would have new skill and staff requirements. Dispullahtal and the Deputy staff would develop new roles and manning levels.

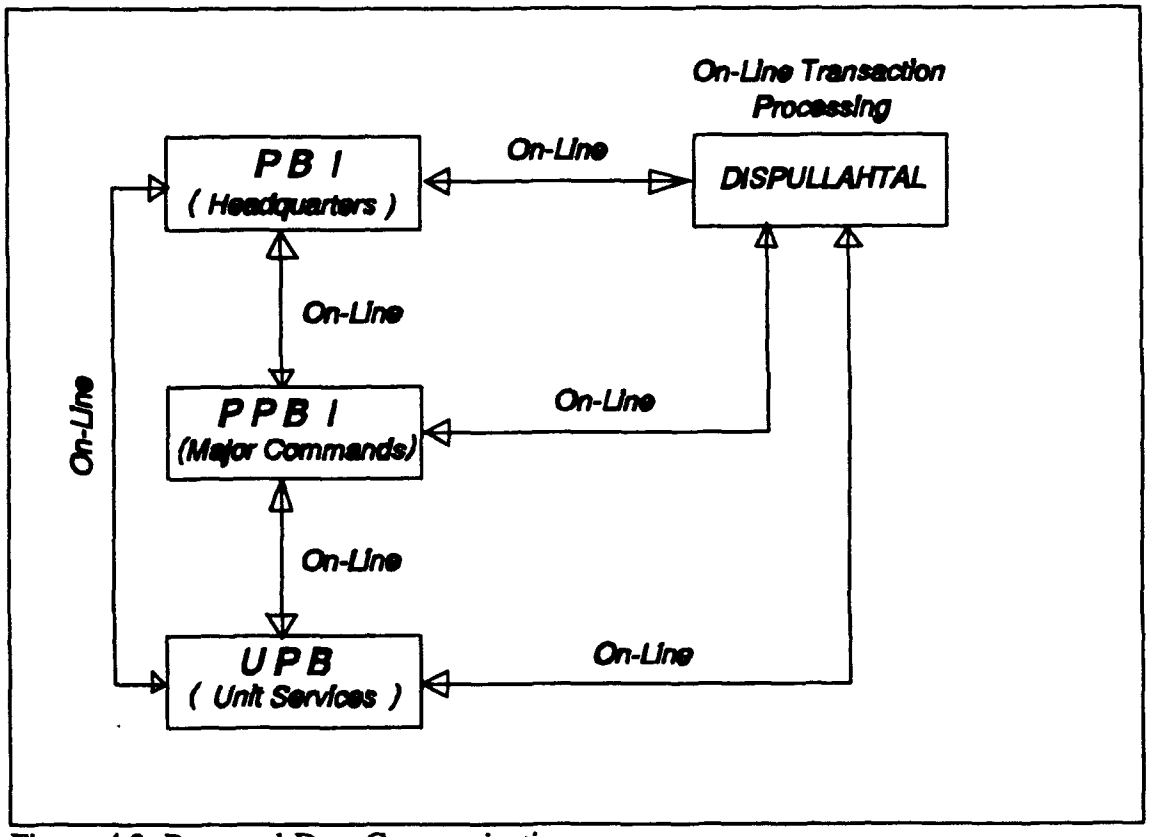

Figure 4.2. Proposed Data Communications.

3. Office

The offices throughout the Naval organization should be rearranged to support the new IT system. Computer rooms and accessories need special environments with special temperature requirements.

4. Group Working

After users become comfortable using computers, they will work together as a gr to improve what they need at the unit, major command and Headquarters level.

The next section will discuss improving the skill and knowledge of executives, line executives, and end users.

B. TRAINING ISSUES

The second issue necessary to support the successful implementation of a new IT system through the Information Systems Management department of the Indonesian Navy is to have a training and education program for executives, line executives (middle managers), end users and staff members. That is the subject of this section.

1. Corporate Executives Education Program

Executives of the Navy should understand computer and communication technologies, including the nature and ramifications of information technology, to make the proper decisions for the Navy organization. This understanding is very important because information systems are having a significant impact on the way organizations are structured and the way people work. One way to better understand computer based technology would be for executives to have an education program. This education program is very important. With it, executives of the Navy can make wiser decisions about:

- Aligning IT with Navy objectives
- Assessing cost and benefits
- Envisioning IT as an input to Navy strategy

- Using information systems with comfort
- Setting the tone of the Navy organization toward technology
- Enhancing their role in Naval re-engineering
- Being supportive during the introduction of IT
- Being concerned with the environment.

These are some reasons why information systems executives need an education program which will benefit the organization and make the job of information systems executives easier. Types of executive education programs that have proven successful are informal programs, semiformal programs and formal programs.

a. Informal Education Programs

The three methods of informal education executives most often use to keep themselves up to date are: reading technological publications, being in contact with IT specialist staff, and consultant demonstrations.

- Technical Publications. By providing publications such as newspapers and magazines on computers, communications, LAN, PC etc. to executives, they will gain more and more understanding of information technology.

- IT Specialists. The Information Technology specialist staff organization can educate executives in an informal way. IT specialists regularly introduce secretaries to new equipment and products, knowing that secretaries will spread the word to their bosses.

- Consultant Demonstrations. In this informal approach, the Chief of Information Systems of the Navy would indoctrinate Naval executives by inviting them to see consultants demonstrate new computers and communications equipment and discuss possible uses in the Naval organization and implications to the organization.

These are some informal approaches to educate executives of the Navy and keep them abreast of new developments. An improved method of educating executives would be to use semiformal programs.

b. Semiformal Education Programs

Semiformal education for executives often consists of organized courses usually requested by users where attendance is generally voluntary. These courses can be used for introducing new ideas or for increasing knowledge. In practice, companies usually use three informal methods to educate executives:

- Executive Briefings. Executive briefings are usually short presentations during management meetings, and are a widely used executive education technique. For example, information systems specialists might brief a top level committee on a technology before requesting project funding.

- Brown Bag Theaters. A brown bag theater is where the training department presents a series of video tapes at lunch time. The tapes generally have a wide audience appeal; not too technical, people-oriented and entertaining. After the video tape showing, a team of experts may answer questions.

- Short Seminars. A short seminar is more formal than a brown bag theater, and the topic of the seminar is chosen for a narrower audience. Short seminars usually last approximately one to three hours and attendance is also voluntary. A seminar opens with a formal presentation by outside experts and explains how the technology affects the Navy, and concludes with a question-and-answer period.

c. Formal Education Programs

Formal programs are designed to introduce Navy executives to information technology with more intensive programs, probably one to three days long depending on the subject. Attendance may be mandatory for certain levels of Navy executives. In practice, most companies usually use two variations of formal education programs. These are single one-to three-day sessions, and a series of short sessions.

- Single Session. A single session for the Navy executives education would be the most effective at getting top management's attention. The best approach is to hold the seminar offsite. This approach can work well if top management strongly believes that the subject is important and deserves their time.

- A Series of Shorter Sessions. This approach is to spread the presentation over several short sessions. It creates a two part education program. The first session is a one-day seminar to expose the top executives to future computer systems. The following day the consultant would give a similar seminar to the information systems executives of the Navy. The second part of the education program consists of video tapes that present

an executive overview and discuss the future system. Video tapes are more convenient for the executives.

To achieve a successful executive education program there must be three ingredients (Spragne, Ralph H Jr, 1993)

- It must educate a critical mass of executives
- It must be accepted psychologically by the executives
- It must be relevant to their jobs and to current events.

Though having top management support the development of new technology is essential, line managers must also be brought onboard, as discussed in the next section.

2. Line Executives

Line executives play a pivotal role in the successful implementation of IT, because, whether they are aware of it or not, they can nurture or kill a new system by their support or resistance. Since the use of distributed systems is throughout the entire Naval organization from West Coast to East Coast, the crux of responsibility for the correct use of IT will shift from top-level executives to middle management. Line executives, therefore, should be trained to become familiar with the risk and problems of new systems in the Naval organization. Line executives should understand the differences between how they are working now and when computers will play an integral part, and be trained to manage the transition from old to new.

Two areas where line managers should be trained are the ability to manage technological change and how to win IT projects.

a. Manage Technological Change

Change management is the process of guiding people in making major changes in the working environment. The change caused by the introduction of a new computer system to the Navy would need to be managed, and the middle managers have the responsibility to manage this change.

Sprague (Sprague Ralph H. Jr, 1993) describes the methodology to help companies manage technological change. He uses three terms from the field of organizational development to describe the types of people involved in the change project.

- Sponsor. The sponsor is the person or group of Navy executives that legitimizes the change.

- Change Agent. The change agent is the person or group in the Navy (such ASRENA and DISPULLAHTAL) that causes the change to happen.

- Target. The target is the person or group in the Navy that is being expected to change and at whom the change is aimed.

The change must be made successfully with the sponsor, change agent and targets. By evaluating each area, the change agent can see where more education or a new approach is needed to make the project more likely to succeed.

b. Winning Information Technology Projects

To win information technology projects, line managers need to have strong ties to others in the Naval organization. They should have the organizational power to get strategic innovations implemented. Line managers also need three things from information systems management: information, resources, and support.

- Line managers need information. Line managers can gather and assess information about a technology's capabilities, its costs, and risks of operation, from information systems executives. Information system's staff can assist line managers in understanding current applications and data relevant to their project.

- Line managers need resources. Information systems executives should provide line managers with needed material resources such as hardware and software as well as technical training.

- Line managers need support. Finally, line managers need their superiors and information systems department to approve of what they are doing and give legitimacy to their projects. The information systems department should promote the technology to build enthusiasm for it and to win support from others.

Information systems management can help line managers win the endorsement of upper management by helping to create the plans for introducing the new information technology.

Another group that has a very important role in organizational change is the end users of the technology. The next section will discuss this group.

3. End Users

Training end users on the technology focuses on skills required for non-technical users to interact with a computer directly. The training could either be done in a classroom or on the user's own computer using an interactive program controlled by the user. With an interactive program the training could be specific to the interests of the user and performed at his convenience without requiring a human instructor to be involved in the process.

C. THE ORGANIZATIONAL IMPACT OF A NEW IT SYSTEM

The implementation of a new system and training for its use will have an impact on each level: executive, major command, and unit.

1. Executive Level

With the introduction of an IT system the Dispullahtal (Data collecting and processing service) and executives will see some modifications in a few job descriptions. Because data will be entered by the users, the data entry function will then disappear, making the data entry personnel available for other positions or retraining. Executives will support major commands with materials they need and provide training to help the units develop their own systems such as word processing, spreadsheet, desktop-publishing and E-mail. Another function would be to provide a group support system to offer consulting help, such as establishing and manning a help desk.

2. Major Command Level

The major commands have to become more knowledgeable about computerized data processing, processing controls and physical controls including security. Through direct on-line data entry and information accessibility, major commands should eliminate redundant paper handling and manual procedures. These procedures and capabilities will greatly enhance their productivity. Major commands will more easily and quickly be able to meet current and future needs at both the local and executive levels.

3. Unit Level

The units will have responsibility for the daily operation of the system, including data entry, input/output control and scheduling of the equipment. With a new IT system some procedures and functions will have to change. It is most likely that the Navy will emphasize redesigning jobs to more fully take advantage of the power of information technology and to give people a more humane work environment. Since the Navy partially changed with the new processing system that replaced paper with electronic images, the Navy would only have to partially re-engineer their work processes to take advantage of new technology.

A new IT system will more easily fit in the Naval organization by management being aware concerning the changing work environment, education and training, and partial re-engineering of the structure and job process.

The effects on the culture, work force, and structure is only one of the aspects of IT that will influence which system is adopted by the Navy. The other major consideration is the costs of the various options. These will be discussed in the next chapter.

V. COST ASSESSMENT

Cost assessments for a new IT system for the Indonesian Navy consist of a number of different elements. As discussed in Section B of Chapter III, there are three alternative methods of implementing a data communications system. This chapter provides estimates of the cost of each of those alternative methods.

The prices of these devices and software (sources of prices from articles in CD-ROM Knox Library, May-July 1994):

Gateway	**$ 10,000.- to $ 100,000.-**
Front-end processor	**$ 10,000.- to $ 80,000.-**
Install Backbone	**$ 5,000.- to $ 10.000.-**
Communication Networking-Software.	**$ 25,000.- to $ 250,000.-**
Unix-Host Super Computer	**$ 175,000.- to $ 750,000.-**

A. COST ASSESSMENT FOR ALTERNATIVE 1

As shown in Figure 3.2, Alternative 1 utilizes data communications based on satellites and computers presently in use. What the Indonesian Navy needs to do is to install some new equipment such as gateways, a backbone, a front end processor, and software. Because the

traffic through these systems is expected to be low to medium, low-end products with the low price range will be sufficient. The estimated cost for alternative 1 is as follows:

Gateway	**@ $ 20,000.- x 20 =**	**$ 400,000.-**
Front-end processor		**$ 20,000.-**
Install Backbone		**$ 7,500.-**
Communication Networking Software		**$ 50,000.-**

Total estimated cost :		**$ 477,500.-**

This estimated cost assessment for alternative 1 assumes that satellite-communication channels will be leased from commercial companies (such as Telephone Companies). Its costs are not included here.

B. COST ASSESSMENT FOR ALTERNATIVE 2

As shown in Figure 3.3, alternative 2 involves data communications based on satellites, using the Unix-Host super computer rather than the present mainframe Univac 90-S, and with the newer version PC's to increase capacity and capability. The price of PC's range between $ 2,000.- to $ 5,000.-.

Unix-Host Computer			$ 400,000.-
A new version PCs	@ $ 2,000.- x 500	=	$ 1,000,000.-
Gateway	@ $ 20,000.- x 20	=	$ 400,000.-
Install Backbone		=	$ 10,000.-
Communication Networking Software		=	$ 25,000.-

Total estimate cost :			$ 1,835,000.-

This estimated cost assessment for alternative 2 assumes that satellite-communication channels will be leased from commercial telephone companies. These costs are not included here.

C. COST ASSESSMENT FOR ALTERNATIVE 3

Figure 3.4 shows the third alternative of using fiber optics for the data communications. This option costs a huge amount of money. In the June 1, 1994 edition of The New York Times was the following article:

> "The Nippon Telegraph and Telephone Corp. has begun installation of a $ 400 billion optical network throughout Japan ..."

If the Indonesian Navy were to install a fiber optic network throughout the Navy, it would cost a lot of money. The cost would probably be in the range of a few to ten's of millions of dollars. Fiber optics networks can be used not only for data communication, but also for TV channels, fax, voice mail, and video. The government and commercial companies could join together to build the fiber optic network and then the government, commercial companies, and the military could all use it.

An estimated cost for fiber optic networks for all LANs is between $ 1 million to $ 10 million. The Navy could pay a fee for the wide area networks to use the fiber optics networks of the telephone companies.

Of these three alternatives, alternative 1 is the cheapest, but the Navy should anticipate the life-time of computer devices. The maintenance cost for the old computer devices will continue growing higher and higher. The second alternative is more reasonable, even though the Navy will spend a million dollars. Alternative 3 would be for future communications because right now the cost is very expensive, at the level of at least a few million dollars.

Finally, the next chapter will provide a summary of data communications for The Indonesian Navy.

VI. SUMMARY AND RECOMMENDATIONS

A. SUMMARY

The Indonesian Navy is a very large and complex organization. To help achieve its goal/task the Navy uses common information systems. However, these systems do not successfully achieve their goal because of a lack of management awareness and user involvement.

The foundation for information technology in the Indonesian Navy was data processing using a mainframe computer (Univac 90-S). The mainframe was used to process data by a centralized Data Processing Center with major emphasis being placed upon batch processing and could be described as a hierarchy of "free standing", but closely interfaced subsystems.

The earlier planned development of IT in the Navy between 1975-2000 is described by the four phases of organizational learning about information technology: technology identification and investment, technological learning and adaptation, rationalization/management control, and maturity/widespread technology transfer.

The problems and issues in the Navy information systems are described by Paulus (Paulus, 1990) as being managerial frustration with computer technology in general, and with IS specialists (system analysts, programmers, etc.) in particular.

The geography of Indonesia is composed of 13,667 islands, with the main islands being Sumatra, Java, Kalimantan, Sulawesi, and Irian Jaya. The government of Indonesia and commercial companies have necessitated major investments in advanced telecommunications

facilities. In order to most effectively link the islands, the government of Indonesia established the satellite communication systems to link 27 provincial capitals. With this satellite communications, we provide/examine possible data communications among the islands. To make it work in the Navy, we need to understand the information technology issues.

In general, IT issues are hardware, software, communications, personnel, data and security. Information technology requirements for the Indonesian Navy include the need to install new hardware, software and communication systems, in addition to training and educating personnel.

To implement a new IT system, the Indonesian Navy should prepare in advance for the impact of IT on an organization, such as the changing work environment, training and education issues at all levels, and partial re-engineering of the structure and job processes.

The effects on the culture, workforce and structure is only one of the aspec' of IT. The other major consideration is the cost of the various options.

We proposed three alternatives to improve data communications among the islands :

Alternative 1. Data communication based on satellite. The Indonesian Navy should install hardware and software, such as gateways, front end processors, and a backbone.

Alternative 2. Data communications based on satellite. The Indonesian Navy should install hardware and software, such as gateways, backbone, Unix-Host super computer, and new PCs.

Alternative 3. Data communications using fiber optic to link entire Indonesia islands. The Indonesian Navy needs to install backbone, gateways, Unix-Host super computer, and new PCs.

The estimated cost for alternative 1 is cheaper than alternative 2, but right now alternative 2 is more feasible and it is easy to get new hardware and software at commercial companies. Alternative 3 is very expensive, however this system could work if government and commercial companies start a joint venture to build wire (fiber optics) between all the islands.

B. RECOMMENDATION

To improve data communications among the islands, the Indonesian Navy needs to install a new IT system. We have three alternatives to build a new IT system with various alternative costs. Alternative 1, as shown in Figure 3.2. Alternative 2, as shown in Figure 3.3, and alternative 3, as shown in Figure 3.4.

My recommendation is that the Indonesian Navy should select alternative 2 as the new IT system, because all the devices are available on the market, it is more reliable, it has more capacity and it is more capable. The cost of maintenance is also cheaper than maintaining the old computers present in alternative 1. But no matter what alternative the Navy selects, the important issues to consider to support a successful new IT system (data communication among islands) are the need to train and educate people, and to re-engineer the organization structure, job description, roles, functions and procedures.

There is a variety of remaining areas which should be considered for future research such as:

- Examination of a model database for the Indonesian Navy.
- Feasibility study of a Decision Support System for data communication among islands.
- Feasibility study of the existing on-line processing data communication among islands.

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APPENDIX

Acronyms and Abbreviations

AAIMS = Analytical Information Management System.
ABRI(Angkatan Bersenjata Republik Indonesia) = Armed Forces of the Republic of Indonesia.
ADP = Automatic Data Processing.
ASRENA(Asisten Perencanaan dan Anggaran) = Assistant for Planning and Budgeting.
ATM = Asynchronous Transfer Mode.
AT&T = American Telephone & Telegraph.
B2P = The second generation Palapa Satellite.
CAI = Computer Assisted Instruction.
CBT = Computer Base Training.
CMI = Computer Managed Instruction.
DBMS = Database Management System.
DBMSs = Database Management Systems.
DISPULLAHTAL(Dinas Pengumpulan dan Pengolahan Data TNI Angkatan Laut) = Naval Data Gathering and Processing Agency.
DoD = Department of Defense.
DP = Data Processing.
DSS = Decision Support Systems.
E-Mail= Electronic Mail.
EDP = Electronic Data Processing.
GENIE = Name of Telecommunication Company.
Geo = Geography.
GIS = Geographic Information System.
IBM = International Business Machine.
IPSS = Integrated Performance Support.
IS = Information System
ISDN = Integrated Service Digital Network.
IT = Information Technology.
LAN = Local Area Network.
MCI = Name of Telecommunication Company.
NASA = National Aeronautics and Space Administration.
NC = Naval College.
NEC = National Electronic Company.
OPS = Operations.
Palapa B4 = The Fourth Satellite Palapa.
PANs = Public Access Networks.

PBI(Penguasa Barang Inventaris) = Naval Headquarters Level.
PC = Personal Computer.
PERS = Personnel.
PERUMTEL(Perusahaan Umum Telekomunikasi) = Telecommunication Company.
PPBI(Penguasa dan Pemilik Barang Inventaris) = Main Command Level
SC = Staff & Command College
SILOP(Sistem Informasi Latihan dan Operasi) = Operation Environment Information Systems.
SIMIN(Sistem Informasi Administrasi) = Administrative Information Systems.
SIOP(Sistem Informasi Perkantoran) = Office Automation.
SISINFOKU(Sistem Informasi Keuangan) = Finance Information Systems.
SISINFOPERS(Sistem Informasi Personel) = Personnel Information Systems.
SISINFOMAT(Sistem Informasi Material) = Material Information Systems.
STRATOPUR(Strategi OPerasi Tempur) = Combat Strategy and Tactics Information Systems.
TELEKOMINDO(Telekomunikasi Indonesia) = The Indonesian Telecommunication.
UPB(Unit Pemakai Barang) = Unit Level.
US Sprint = Telecommunication Company in U.S.
VANs = Value Added Networks.
WAN = Wide Area Network.

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