AD NUMBER

ADB001632

NEW LIMITATION CHANGE

TO

Approved for public release, distribution unlimited

FROM

Distribution authorized to U.S. Gov't. agencies only; Proprietary Information; 14 FEB 1975. Other requests shall be referred to President, Naval War College, Attn: Director, Advanced Research Program, Newport, RI 02840.

AUTHORITY

NAVAL War College ltr, 8 May 1975

# THE UNITED STATES NAVAL WAR COLLEGE




PUBLISHED BY

THE NAVAL WAR COLLEGE

ADVANCED RESEARCH PROGRAM

Security Classification

## DOCUMENT CONTROL DATA - R & D

*Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)*

| ORIGINATING ACTIVITY (Corporate author) | 2a. REPORT SECURITY CLASSIFICATION |
|---|---|
| Naval War College<br>Newport, Rhode Island | Unclassified<br>2b GROUP |

3 REPORT TITLE

Command and Control: a Contemporary Perspective.

4 DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Advanced Research Paper

5 AUTHOR(S) *(First name, middle initial, last name)*

Christopher W. Maillefert

| 6 REPORT DATE | 7a. TOTAL NO OF PAGES | 7b NO OF REFS |
|---|---|---|
| 20 July 1974 | 92 | Numerous |

| 8a CONTRACT OR GRANT NO | 9a. ORIGINATOR'S REPORT NUMBER(S) |
|---|---|
| b. PROJECT NO | |
| c. | 9b OTHER REPORT NO(S) *(An, other numbers that may be assigned this report)* |
| d | 14 FEB 1975 |

10 DISTRIBUTION STATEMENT Distribution limited to U.S. Gov't agencies only: (Proprietary information). Other requests for this document must be referred to, President, Naval War College, Attn: Director, Advanced Research Program, Newport, R.I. 02840

| 11 SUPPLEMENTARY NOTES | 12 SPONSORING MILITARY ACTIVITY |
|---|---|
| | Naval War College<br>Newport, Rhode Island |

13 ABSTRACT

This study focuses on the current paradoxical state of command and control with special emphasis on the Navy. While the technological advances associated with command and control and its subsystem communications have been significant, the goal towards which these efforts are directed has not been specific. Pointed to by its proponents as an excellent method to improve overall Fleet effectiveness, command and control's development has been retarded by organizational biases within the Navy and fragmentation in management authority. The paper begins by giving the background surrounding current thinking on command, control, and communications ($C^3$). It then enumerates certain principles borrowed from control theory and organizational management which have application in a systematic approach to $C^3$. An explanation of current trends to improve naval command and control is given. The study concludes that a principal problem facing future development in this area is the difficulty which the Navy has in changing its "traditional" view of $C^3$. Recommendations are advanced which may aid in the solution of this problem: the definition of command and control as a response mechanism in crisis management; the consolidation of $C^3$ management within the Office of the Chief of Naval Operations, the creation of an adequate corporate memory in the Navy; and finally the creation of a command and control subspecialty for naval officers

DD FORM 1 NOV 68 1473 (PAGE 1)

S/N 0102-014-6600

Security Classification

| 14 KEY WORDS | LINK A | | LINK B | | LINK C | |
|---|---|---|---|---|---|---|
| | ROLE | WT | ROLE | WT | ROLE | WT |
| | | | | | | |

NWC/ARP (CS) - 062S

# COMMAND AND CONTROL:
# A CONTEMPORARY PERSPECTIVE

by

Christopher W. Maillefert, Lieutenant, U.S.Navy

This document is a Completed Study, the product of Naval War College Advanced Research Project No. 062, and is circulated under the provisions of NAVWARCOL INST 3920.2.

NAVAL WAR COLLEGE
Newport, R. I.

# COMMAND AND CONTROL:

# A CONTEMPORARY PERSPECTIVE

by

CHRISTOPHER W. MAILLEFERT
LIEUTENANT, U. S. NAVY

Prepared under the auspices of the Advanced Research Department of the Naval War College.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

C W Maillefert

20 July 1974

Abstract of

COMMAND AND CONTROL: A CONTEMPORARY PERSPECTIVE

This study focuses on the current paradoxical state of command and control with special emphasis on the Navy. While the technological advances associated with command and control and its subsystem communications have been significant, the goal towards which these efforts are directed has not been specific. Pointed to by its proponents as an excellent method to improve overall Fleet effectiveness, command and control's development has been retarded by organizational biases within the Navy and fragmentation in management authority. The paper begins by giving the background surrounding current thinking on command, control, and communications ($C^3$). It then enumerates certain principles borrowed from control theory and organizational management which have application in a systematic approach to $C^3$. An explanation of current trends to improve naval command and control is given. The study concludes that a principal problem facing future development in this area is the difficulty which the Navy has in changing its "traditional" view of $C^3$. Recommendations are advanced which may aid in the solution of this problem: the definition of command and control as a response mechanism in crisis management; the consolidation of $C^3$ management within the Office of the Chief of Naval Operations; the creation of an adequate corporate memory in the Navy; and finally the creation of a command and control subspecialty for naval officers.

TABLE OF CONTENTS

## LIST OF ILLUSTRATIONS

# COMMAND AND CONTROL:

# A CONTEMPORARY PERSPECTIVE

## CHAPTER I

## INTRODUCTION

> By the word 'information' we denote all the knowledge we have of the enemy and his country; therefore in fact the foundation of all our ideas and actions."
>
> Clausewitz, On War

### A. Background.

The foundation of any social system is social action. This action cannot take place in a vacuum. An ebb and flood of information, a constant input/output must be provided. Information flow is the key to the organization and maintenance of any viable system. This applies in all systems, from the "simple" amoeba to the complex interactions of a national government. It is the basis for action and reaction. Information flow is the essence of military command and control. Understanding the whys and wherefores of information processing supplies the substance for setting the requirements and developing the methodology of the whole command and control system. Recognition of the power of information and its appropriate application has, as Clausewitz implied, enormous impact on all our perceptions, strategies, and actions, both in terms of the resources of potential opponents

as well as those of own forces.

In an era of limited resources and increased civilian participation in military affairs, the problems of organizing the armed forces of the United States to serve as a credible instrument of national policy, as well as an effective war-fighting apparatus, are increasingly complex. The role of the Military Establishment has changed in the period since World War II. The traditional mantle of war-fighter remains, now coupled with its use as a tool of statecraft in crisis management and as a force to deter war. This change has wrought new definitions, new requirements, and a quantum increase in the size and functions of the military. According to Morris Janowitz, these changes themselves have "produced a corresponding organizational revolution in the mechanics of civilian control."[1] A new balance has been struck, and it is important that military professionals correctly perceive their altered role in order to continue meaningful military development. Interpersonal communication among the participants in a command and control system is important for it will, it is hoped, be accompanied by sensitization and mutual understanding.

Certain cardinal threads can be identified in the current military fabric. One is the burgeoning of scientific and technical developments since 1940 which have changed the face of warfare. Another is the natural reluctance or near-

inability of military and civilian officials and organizations to change traditional institutions and procedures. Third is the changing nature of the threat to national security and the differing perceptions of that same threat by the players. Finally and most important in discussing the role of information in command and control is the constitutional principle of civilian control of the military.

Civilian control of the military is polarized between Congress, primarily concerned with management forms and efficiency in the use of the tax dollar; and the President in his role as Chief Executive and Commander-in-Chief of the Armed Forces. It is the latter of these on which this paper will focus.

The advent of the attendant speeds of delivery and cataclysmic potential of intercontinental ballistic missiles forced a reassessment of the American Presidency's role in the day-to-day operations of the military. Political responsibility and the scope of the threat demanded increased civilian control and a consequent diminution of military command prerogative in the exercise of force. Particularly affected by this change in policy was the Navy where the tradition of command autonomy had been reinforced by the practical difficulty of communicating between ship and shore.

The precepts for what would later govern the World-Wide Military Command and Control System (WWMCCS) are found

in a policy message concerning defense appropriations sent by President Kennedy to the Congress in 1961:

> The basic policies...lay new emphasis on improved command and control--more flexible, more selective, more deliberate, better protected, and under civilian control at all times.
> ...The invulnerable and continuous command posts and communications centers provided in these recommendations...are only the beginning of a major, but absolutely vital effort to achieve a truly unified, nationwide, indestructible system to insure high level command, communication and control, and a properly authorized response under any condition.[2]

Development of the WWMCCS in the early and mid 1960s was neither rapid nor particularly effective, a fact made abundantly clear by events late in that decade. Lack of progress on the system, especially its communications, is not surprising when viewed in the context of organizational behavior, since its early development occurred in the wake of the Cuban Missile Crisis of 1962.

The quickly deteriorating U.S.-Soviet relations and the very real threat which operational missiles in Cuba posed to national security caused the President and the members of his Executive Committee to take extraordinary action. The planned naval quarantine was to be personally directed from the White House. Thus, according to analyst Graham Allison,

> ...for the first time in U.S. military history, local commanders received repeated orders about the details of their military operations directly from political leaders--contrary to two sacred military doctrines.

> This circumvention of the chain of command and the accompanying countermand of the autonomy of local commanders created enormous pain and serious friction.[5]

The "serious friction" eventually led to a direct and heated confrontation between the Secretary of Defense, acting as the President's agent, and the Chief of Naval Operations on the question of who was to have the prerogative for conducting a "military" operation. Reaction to this episode by the Services, in conjunction with a growing preoccupation with Vietnam throughout the Department of Defense, promoted an ambivalent lip-service to the concept of command and control yet little real progress.

U.S.S. Liberty, an electronic surveillance vessel, was heavily attacked by Israeli forces during June 1967, while she was conducting routine operations in international waters. Seven months later U.S.S. Pueblo, a similarly configured ship, was seized by forces of the North Korean Navy while in international waters. Later, an EC-121 surveillance aircraft was shot down by North Korean fighters over international waters in the Sea of Japan in April, 1969.

The exact details of the incidents do not concern this study. What is worthy of note is that the command, control, and communications systems (i.e., the information process) played an important part in each incident.

The demonstrated inability of the U.S. to react in each

case led to extensive studies by the Military and Congress which came to focus on the failure of the command, control, and communications system as the primary cause.

One reason for such a finding, from the military standpoint, was that in so doing a blow was struck for local autonomy.

Another, perhaps more insidious explanation of these conclusions, is that it was easier to blame a system for a failure than it was to blame men. Inherent complexity by itself can protect an organization's members. If a complex system fails, more money can be spent and it will eventually work. The prognostications for "the next time" would not have been as bright if blame had been leveled at all of the individuals concerned and the U.S. had begun to engage in a national act of self-flagellation as occurred during the Calley case. The performance of machines is much easier to guarantee then that of the individual.

Describing his part in the Pueblo affair before the House Committee on Armed Services, Admiral Sharp, then Commander-in-Chief Pacific Command, stated that Washington had begun to make decisions once he had reported the status of forces in the Far East.[4] These decisions do not seem to have been really designed to take Pueblo out of extremis. Later, General Wheeler, in describing the Washington reaction, testified that "Washington, despite our communications which

are quite good, has no capability of conducting tactical operations."[5]

Admiral Moorer, then Chief of Naval Operations, was even more specific as to what might be needed for information acquisition in a situation such as the Pueblo. He also manifested the traditional attitude concerning the autonomy of the local commander. Replying to a question concerning what instructions had been sent back to the ship, Admiral Moorer stated:

> No, sir. No instructions were sent back. I think it would be rather difficult to give a commanding officer in this position any tactical instructions because you could never keep up with the fast moving situation unless you had a TV or something, and I think any commander would refrain from trying to coach the man on the scene as to what he was going to do.[6]

In their findings the Committee did not seem to be in sympathy with these statements of helplessness. They were most critical of a command and control system which, as they perceived it, existed to preclude such incidents. They spoke of

> ...a military structure capable of acquiring almost infinite amounts of information, but with a demonstrated inability, in these two incidents (referring to the Pueblo and the EC-121) to relay this information in a timely and comprehensible fashion to those charged with the responsibility for making decisions... failure of responsible authorities at the seat of government to either delegate responsibility or in the alternative provide clear and unequivocal guidelines governing policy in

> emergency situations--our military command structure is now simply unable to meet the emergency criterions outlined and suggested by the President himself.[7]

Further, commenting on the role of the national intelligence agencies during the incidents, the Committee cited the

> ...failure of the defense intelligence community to provide essential and available information to potential consumers in a timely fashion (which) necessarily raises serious questions concerning the effective operation and administration of these organizations.[8]

In the wake of public and private outcry, and in an atmosphere of changing force postures, command and control received renewed emphasis. A highlight of the Blue Ribbon Defense Panel of 1970 was the stated need for centralized management in WWMCCS to improve its effectiveness.[9] The Deputy Secretary of Defense, Mr. Packard, requested a special briefing on the whole command and control problem. It was presented September 3, 1971, and generated sufficient interest that in the ensuing months a new directive governing the WWMCCS was produced as a result of a direct personal dialogue between Mr. Packard and Admiral Moorer, Chairman of the Joint Chiefs of staff--not a normal occurrence in the operations of the Pentagon.[10]

What is this "revamped" World-Wide Military Command and Control System? WWMCCS is the aggregate term used in referring to all the command and control systems of the Defense Establishment. It is a system of communications

networks linking command centers and situation rooms, spanning the globe, designed to provide early warning data, intelligence inputs, and other data to furnish a comprehensive picture of a given situation. Theoretically the system would provide the President or designated successors with sufficient warning, with an intelligence capability to facilitate decision making, and with the means of sending his directives to the executing forces involved.

The WWMCCS is of great national importance and should act as the overall example in a discussion of command and control and its many ramifications.

B. Command and Control, A Definition.

The preceding description of the WWMCCS implies that command and control, that most provocative phrase, is in reality a glorified communications network. It is, but this is only one part of the overall system.

The Dictionary of Military and Associated Terms (JCS Publication 1) contains two definitions of command and control. They are listed sequentially, the first applicable to the Department of Defense, the second to the members of the Inter-American System:

> Command and control - (DOD) The exercise of authority and direction by a properly designated commander over assigned forces in the accomplishment of his mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures which are

employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of his mission.

Command and control - (IADB) An arrangement of personnel, facilities, and the means for information acquisition, processing, and dissemination employed by a commander in planning, directing, and controlling operations of assigned forces pursuant to the missions assigned.[11]

It is interesting to note that while the second definition is primarily concerned with information action, the first makes no mention of it whatsoever; rather it concentrates on the functional aspect of a grand orchestration in support of mission accomplishment.

Command and control should bear a resemblance to its component parts, "command" and "control." The Dictionary of Military Terms defines these two terms in the following manner:

Command - 1. The authority which a commander in the Military Service lawfully exercises over subordinates by virtue of rank or assignment. Command includes the authority and responsibility for effectively using available resources and for planning the employment of, organizing, directing, coordinating, and controlling military forces in the accomplishment of assigned missions. It also includes responsibility for the health, welfare, morale, and discipline of assigned personnel. 2. An order given by a commander, that is the will of the commander expressed for the purpose of bringing about a particular action.[12]

Control - (DOD, NATO, CENTO, IADB) 1. Authority which may be less than full command exercised by a commander over part of the activities of a subordinate or other organization.[13]

The combination of these two definitions does not yield "command and control." Still missing is the system key, information; why no mention of it? Delving once more into the Dictionary of Military Terms, it is found that "information" is defined only in terms of "intelligence" and in fact there is no meaning assigned to the key term "information processing," the reader is simply referred to the definition of "intelligence cycle."[14]

Noting the discrepancies above and the atmosphere surrounding the birth of modern command and control in the 1960s, some insight is gained into the apparent difficulties involved in defining the concept. First among them is the general reluctance of the military to design a system and promote a concept which they perceive as threatening the time honored concepts of the chain of command and local autonomy.

If command and control is to be viewed as a system for information interaction, the definition of information cannot be confined to "intelligence" connotations. One reason for this is that command and control based solely on intelligence input and disregarding information concerning own forces' status would be to draw conclusions on the basis of partial information. Another more subtle reason, is that while the association of command and control with information is correct, to limit the meaning of information solely to intelligence is to introduce an automatic organizational

bias against command and control as a concept, based on widely shared perceptions of "intelligence."

Competition for resources has long been recognized to result in inter-service rivalry for each's self-perceived "fair share" of the total budget, but it has also led to strong intra-service rivalry for the protection of traditional areas of warfare and "pet" programs. For example, organizational self-preservation in the Naval Aviation community causes it to perceive the Surface, Submarine, and Intelligence communities as a more immediate threat than the Air Force or even an opposing force.

By implication, if command and control is information, and information is "intelligence," to promote command and control is to promote the intelligence community. Hence, it is a gimmick for the "Spooks" to serve themselves a bigger piece of budget pie. This is a threat on the one hand to the already biased military manager, in that the needed funds may come from his program. Alternatively, it is associated with a community, the intelligence community, that is outside the main stream of "traditional" military operations. It is foreign, associated with secrecy, national level programs, and outside civilian agencies. If command and control is just another intelligence function, reason these other interests, let them get their support elsewhere.

Command and control is information, but not by any

means limited to intelligence. Advocates of command and control within the Navy have their own definitions. The former Director of Command Support Programs for the Chief of Naval Operations, defined it as follows:

> In simplest terms Command and Control is the exercise of authority and direction by a Commander over assigned forces in the accomplishment of his mission. Communications is the information transfer process by which the task is accomplished.[15]

Even more precise was the Program Manager of the Fleet Command Support Center, Naval Electronic Systems Command:

> The FCSC (Fleet Command Support Center) system command and control concept embodies the integration of operational, logistic, environmental, ocean surveillance, own forces, ASW, and EW information in a single center and the provision of these data as operational support to the NCC (Naval Component Commander), his subordinate shore-based commanders, and operating forces. In response to higher authority the NCC issues operational orders, allocates resources, monitors the situation, and reports back to higher authority.[16]

Though describing a system which is oriented toward support of naval forces, the latter definition strikes at the heart of the matter. Command and control is considered an information network, interacting with decision making nodal points. The first major hurdle perforce, in understanding the direction in which future command and control systems must go, is to perceive and subsequently accept command and control as an input/output system of non-traditional proportions. It must not be divorced from sensor systems, communications systems,

and automated data processing (ADP) systems, for command and control includes all these subsystems in the aggregate. Achieving this "systems" viewpoint, the basic problems which trouble command and control today can be addressed. A difficulty in the system is an information problem. There are quantitative questions such as how much and how fast and qualitative questions such as the type of information and to whom it should go.

Lacking a broad context in which to consider the continued development of command and control will only result in an increase of organizational barriers within the system, continued duplication of effort, further procurement of incompatible system elements, and worst of all, lack of system responsiveness. Aspects of these problems will be addressed in Chapter II.

In summary, the following is the definition of command and control as used in this paper. Command and control is an input/output system designed to allow the maximum integration of all necessary information to produce a meaningful and realistic context for the commander, at each echelon's nodal point, to make decisions pertaining to the planning, directing, and coordinating necessary for his mission. The system uses communications for the transfer of information and this must be interactive throughout the organization: vertically, horizontally, and when necessary, diagonally. This interaction

is important in the maintenance of order-giving, situation monitoring, and report-back procedures in the operational cycle. Efficiency demands the use of serial and parallel communications.

C. Current Importance of Command and Control.

Reference was made in the first section of this Chapter to the two roles that the military is currently required to assume. New strategies have had great impact on command and control just as new technological advances in command and control have had a significant effect on the mapping out of national strategies and the missions of the services in general.

Three factors can be identified as contributing to the current state of command and control. The first is technology, which has seen such advances during the past ten years, that one authoritative source, the Director of Command and Control Systems for the U.S. Air Force, stated:

> Today's electronic technology makes possible strategies such as flexible response in a way no one thought possible a decade ago...we must exercise great care not to design $C^3$ (Command, control, communications) systems...to inadvertently constrain national strategy.[17]

While the engineering of system components may be feasible, lack of an overall system design may narrow options in the future.

The next factor is an alteration of national strategic policy. Current force planning is undertaken under the aegis of "strategic sufficiency." The following components of

"strategic sufficiency" have been enumerated as: secure retaliatory capability; military flexibility, stability in crisis; and the maintenance of a political balance.[18] While important to all components, decisions involving military flexibility and crisis stability and management have greatest need for precise and finely honed information processing and communication systems. This is largely due to the time-sensitivity involved in preventing the start of conflict or controllingresponse once it has begun.

Centralized control is the third important ingredient affecting command, control, and communications today. It is a reality both from the standpoint of the Constitutional principle of civilian control of the military (i.e., the President) as well as recent efforts by the military to restructure its own operational procedures. The sub-committee on Command and Control of the CNO Industry Advisory Committee for Telecommunications (CIACT) in their final report spoke tersely of the fact that "The decision to engage or not to engage can no longer be left to the 'on scene commander.'"[19]

The other side of the control coin is the importance of the potential adversary's perception of our control of forces:

> Today, no matter how small the incident and no matter where in the world it occurs, the affected party is assured that this force, whatever it may be, is in constant contact with its National Command Authority. Thus

> any incident around the world today must be assumed to be the result of some policy determination.[20]

A specific case of the role of command and control in strategic perceptions is advanced by Roy Beavers in his essay, "SALT I."

> It is too soon to call this new relationship 'detente,' but at the very least it is a relationship in which each side genuinely desires to reassure the other that it harbors no intentions of beginning a major war--nor do the two sides want to run any risk of being misunderstood on this score in the event of accidental or unauthorized events.
>
> ...The strong mutual desire to minimize the chances of accidental nuclear disaster was a manifestation of the fact that uncertainties surrounding the other side's command and control arrangements can be contributing factors to instability and distrust in strategic relationships. A precedent would seem to have been set by SALT I that could lead to further cooperation on this score in the future. It is doubtful that all uncertainties have been resolved for either side.
>
> The United States, for example, has less knowledge of Soviet command and control safeguards than the Soviets have of ours. The Soviet Union, on the other hand, is no doubt aware that some of the voiced doubts about the dependability of the Polaris command and control system in crisis. Such reports have appeared from time to time in the Western press.[21]

What then is the impact on command and control of this centralized control environment. Response is predicated on decisions made at the central node. The commander becomes the hub of the information acquisition, processing, analysis, and transfer functions in order to have pertinent data on

which to base his decision. Greater emphasis must be placed on the transfer process to make the data available and in turn to insure that orders are received by the appropriate units for execution.

The whole structure's vulnerability in case of war is emphasized by the increased importance of the central figure and the requirement to transfer all pertinent information to that node in order to originate a response. This vulnerability is counterbalanced, however, by the assumption that no action is likely to occur from his side unless the commander issues an order. Overall, this is a stabilizing factor which may preclude the outbreak of hostilities or control escalation.

This introduction has attempted to give a background of command and control. Unlike weapons systems, which are hardware-oriented and based on concrete principles easily defined, and thus easily argued pro and con, command and control systems are admixtures of general purpose equipment and processes, achieving definition through their systematic application. Command and control systems are also evolutionary in nature, easily affected by institutional biases and personal definitions.

Presentation of some of the many important aspects and applications of command and control as well as definition of this somewhat elusive term have, it is hoped, set the stage for Chapter II. There, using general principles obtained

from control theory and organizational management, the foundation of a model system will be constructed.

# CHAPTER II

## CONTROL SYSTEMS

### A. Terminology.

Variously referred to as control strategy, control theory, or systems control, the task of defining the elements of control within a social system and the interactions which take place by which control is exerted have been the subject of considerable interest in management circles during recent years. The rise of complex multi-function organizations, generating vast amounts of data, has made comprehension of these systems as entities, and knowledge of the decision-making processes within context of these systems, extremely important. Unfortunately, systems are not usually looked at whole; they are sub-divided, parcelled out.

Prior to discussing the applicability of some of these new insights of control theory to the plight of command and control, certain terms in current usage in this area of study should be clarified to provide a common frame of reference.

Command and control is a concept generally recognized as functioning within a systematic framework. A system is a collection of interrelated components of unified purpose. While a universal definition of a system could probably not be arrived at, a key consideration in system interaction is that "the relation is more important than the things related."[1]

Further, as Stafford Beer and other cyberneticists have pointed out, systems generally fall into two categories: static and viable. A static system has lost its dynamism. Entropy will soon render it into its component parts. A viable system, on the other hand, is one that has the ability to respond tc a stimulus, learn from experience, renew itself, continuously adapt, and thus survive. Three attributes are commonly associated with systems of this type: first, they possess an innate complexity; second, they are characterized by a complex interaction with their environment; finally, they possess a complexity of internal connectivity, probably relating to a certain capacity for self-regulation.[2]

To meet the viability criteria, the system depends on information input and output. Input is any part of the environment which affects the system. Output is system effect on the environment.

"Information" is a far more nebulous term. When associated with classical Information Theory (Shannon, 1948), it "expresses the amount of uncertainty about the properties of a message to be sent in terms of bits."[3] The mention of "bits" with information leads the casual observer to identify information with data. There is, however, an important distinction between the two terms. According to G. T. Vardaman, "data are 'bits' or discrete symbolic units; 'information' is shaped data, that is bits put into meaningful form for the

receiver."[4]

For the purpose of this study though, information will concern more than simply the statistical rarity of a signal. It will be equated to Knowledge, as an abstract concept, because "basic to the concept of knowledge is lack of knowledge, such that the less one knows about something, the greater is the amount of information to be gained."[5] Information can therefore be measured in terms of uncertainty, like knowledge. It will be used as a representation of knowledge in physical terms, such as symbols, punched cards, etc., as well as with regard to its effect on the recipient's behaviour, that is its meaning and value.[6]

In its most basic state, the communication process is said to be present "when there exists a relationship between two components such that the delivery of a stimulus by one component evokes a certain response by the other."[7] This definition is too broad for use here. Communication is the most fundamental process in a system and should be viewed in an organizational context as:

> ...the transformation of perceived conditions and events into data, possible manipulation and organization to become information, and transmission of the data or information to others usually for follow-up action.[8]

It is the basis for decision-making and certain sociologists define decisions in terms of communications phenomena such that authority is seen as "flowing" through the communication structure.[9]

Decision-making is the fundamental behaviour pattern in command and control as in other control systems. According to Dick Ramström, two factors characterize the decision-making:

(i) The process is concerned with choosing one of a number of available options.

(ii) Decision implies commitment to a course of action, thus constituting an imperative for the decision-making component.[10]

Theories abound concerning the exact cognitive processes involved in decision-making. The majority contain the following elements: decision-making is a problem-solving activity; it includes definition of a problem, diagnosis, a search for information, the development of options, and the selection of a single course of action;[11] further, a decision is based in rationality and affected by the individual or organization's definition of the situation, an "image" based on available information.[12]

The connection between decision-making, information, and communication is summed up in Figure 1.

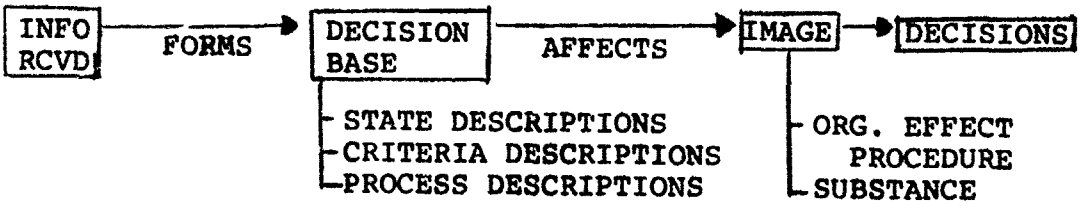


FIGURE 1. SCHEMATIC OF THE DECISION PROCESS[13]

"Control," according to Webster's, is "to exert a restraining or directing influence on events." Seen in this light, it is the summation of all factors which might occur to influence a sequence of events. If control is accorded this property of near infinite variety, a systems approach is the only one which will permit definition and analysis of the processes.

Let control then, represent the cycle of events which takes place at a decision node in response to current decision requirements, as well as the process utilized to change the goals and missions of that node. It is a sequence by which the decision-maker can fulfill his intentions through modification of the behaviour of other parts of the system. This influencing can only be brought about through the medium of communications.

The key elements of the control cycle are summarized in Figure 2.

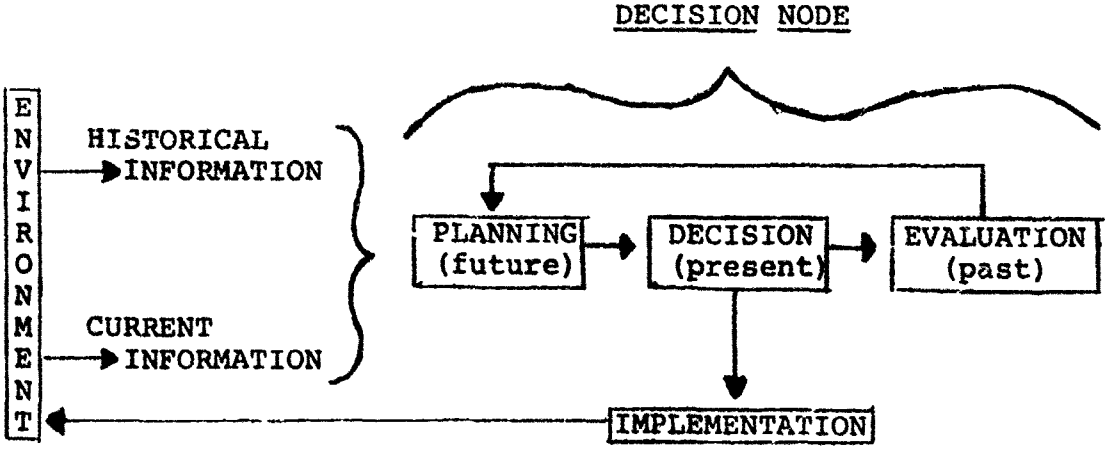


FIGURE 2.

DECISION NODE CONTROL CYCLE AND INTERACTION WITH ENVIRONMENT.

B. Informational Aspects of the Control Process.

Implicit in the control cycle is its dependence on information, the input/output elements, and communications, the transfer of that information. Man lives in an era of information explosion. Operating on the hypothesis that a command and control system must, in an overall sense, be all things, to all men, at all times, the image of a massive sensory system providing data on the totality of the environment is evoked. Two factors, however, militate against this total knowledge approach. First in the recognition that collecting such quantities of data is tantamount to the duplication of that environment. The second concerns the interaction of this mass of information with a control point. In discussing the effects of such a situation, Stafford Beer advanced the following:

> A situation to be controlled is of immensely high variety, and if this variety is allowed to impinge directly on the control center (whether a management group or computer) two quite disastrous results will follow.
>
> The first is that in order to sort out such vast input, the controlling center must itself be enormously large.
>
> (Second)...If a homeostat in an equilibrial state is bombarded with wave after wave of input data, it will go into an oscillation from which it will never recover.[14]

The goal of information processing in the design of a control system must be to provide negative feedback. Contrary to positive feedback, which provides an answer to all

uncertainties in the environment, the principle of negative feedback postulates the establishment of certain information parameters and criteria. Feedback is then provided only on data not meeting the stated criteria.

A drop in the total amount of information entering the system will take place, though, as this principle applies to command and control in the military, the sum of the information will still be enormous. Further reduction in information quantity flowing between control points within the system can be achieved by establishing "importance filters."[15] These filters are envisaged as differing sets of information requirements attuned to the function of the particular control point.

Viewed in this context, information processing has a dual function: to provide requested material to interested parties (individual response) and to form the data base for the control points (automatic response).

Thus far information processing has been described in more or less quantitative terms. Of equal importance to the decision-maker is the content of this information because:

> The object of management is <u>not</u> to obtain quick delivery of parcels of data--those data which it has always received in the past--in ever greater volume and at ever greater speeds. The management requirement is quite another: it is to obtain very few very highly digested data at those moments alone when the system calls for a decision.[16]

This is intuitively applicable to the military commander faced with a rapidly changing situation. His immediate requirement is for the fullest and timeliest information, yet his processing capabilities will quickly be glutted if that which he receives is not tailored to his requirements and capacity.

Furthermore, this information must be in a recognizable format. Contrary to his need, transformation of the information takes place as it is transferred within the organization. It is condensed and summarized, or, in military terminology, standardized as it progresses through the chain. For each given situation then, the details are reported in a regular format, dispensing with all appearances of novelty and evoking a routine rather than a problem-solving response.[17]

A possible example of this standardization of information prompting a routine response is provided by the sequence of events preceding the seizure of Pueblo. According to Congressional testimony, indications of heightened tension in North Korea were apparent prior to mission approval. Further portents were available during the course of the mission from Radio Pyongyang warning of dire consequences if the "spy mission" did not terminate. This was only the second such mission conducted in that area by a U.S. Navy surveillance vessel, yet the increasing volume and tenor of the North Korean threats were processed routinely, evoking neither awareness nor problem-solving behaviour from the organization

until it was too late. It would seem that incremental changes in the quality of the situation were not in a recognizable format that would have permitted identification.

How can this be avoided? Part of the answer lies in the proper categorization of information as it comes into the system. It is this process of information classification which allows the application of criteria thereby allowing the relevancy of the information to be determined. This relevancy, in turn, is one of the mainstays of the rationality of the decision base.[18]

In summary, any discussion of information must include all sides of the information triangle. One point of the base is information quantity including both the amount of information flow and the error rate within the system. The other base point is information content, the ability to discriminate differences in a long series of events. Together they support the prime consideration, the utility of the information in the control cycle.

C. Automation.

No discussion of information processing and command and control can neglect the revolution which has taken place during the past 20 years in the field of ADP. Command and control is indeed heavily dependent on automation to process the enormous amounts of raw data entering the system from the environment, integrating and correlating it, and controlling

the communications channels for the transfer of information. Automation acts as the bridge connecting the informational aspects of control with the structural aspects.

The computer has had an especially significant impact on the military, allowing the development of weapons and platforms of almost infinite capability. As a consequence the military commander is now responsible for almost instantaneous precision response to counteract these new threats. Here he is aided by the automation of sensory data inputs and machine controlled response.

Has a revolution actually occurred, or is it merely the potential for revolutionary change that the computer offers? Observation of the usage to which the military has put the computer in the command and control area reveals a notable specificity of function. Automation is used to mechanically expand the individual's span of control by having the computer carry out tasks that had traditionally been done with his eyes, hands, and brain. It is the "automation of human limitation."[19]

Recent years have seen a proliferation of function-specific ADP systems. Functions are translated into the traditional mission areas of the military services and further divided into subcategories within a particular service. Lack of a coherent unified policy for automation has allowed these components to create automated systems

independent of one another. Once in being, the ADP system itself can be used to insulate that particular area and perpetuate organizational preoccupations.

The result for a command and control system is a lack of interoperability and stardardization. Overall system response is fragmented and duplication of effort will occur since the components cannot communicate with one another.

The requirements for centralization and economy in the allocation of resources should gradually push the automation of command and control functions in the direction of a generalized information processing network. This will allow individual interaction with the system. Data will no longer have to be supplied to the system at time of use. Instead, individuals will be able to query the system for data prior to manipulation. Moreover, this information, in the form of a data base, will reside within the system rather than simply in the memory of a particular computer.

As automation proceeds in this direction, individuals will suffer less of the burden of information processing and data management and be able to devote more effort to actual problem-solving. This will be the point at which the command and control structure, which is currently patterned on human abilities, will undergo a transformation,to accommodate itself to this new system capability.

The classic cycle is the operational commander asking

what an automated command and control system can do for him? This prompts the ADP people to ask in return what the commander wants the system to be able to do. Lack of knowledge on the part of both perpetuates this exchange, resulting in the generation of few requirements and little system progress.

Definition of requirements for this general information processing system must originate at the highest operational levels. If generated by members of the component services or functional areas, it will reinforce the existing barriers through individual automation. If generated by the technicians, reshaping of the environment to fit existing systems is risked. The central authority must define the goal and the method for its attainment.

D. Structural Aspects of Control.

The process of control is an interaction with the uncertainties within a system in an effort to reduce their number or degree. Decisions are the language of control and "the structure of an organization may be considered as a device designed to assist in making decisions."[20] This decision activity may be looked upon as problem-solving in nature since the choice of one course of action from among several is de facto a solution.

The command structure must provide a basic pattern for communications and coordination to facilitate problem-solving. This, in part, explains the pyramidal structure of the military

for as Ramström describes it, quite apart from authority relations and the principle of "unity of command," the problem-solving process lends itself to a pyramid-shaped structure.[21] Is this functional structure compatible with the pyramid delineated by the chain of command? Subtle distinctions may be present, but ones with powerful ramifications.

The problem-solving nature of the organization will require the interaction of information. Does this informal problem-solving mechanism, which contains the information, fit over the template of the organizational chart? Or more precisely, is there adequate information in the formal organization to make a decision? This is quite important because as Beer points out:

> According to the formal organization chart, decisions are taken by the "responsible" people--who are just those whose labels authorize them to decide. According to cybernetics, this is impossible in a system which is to survive. Decisions are always taken by the node or plexus of nodes, in a network, which has the information...It is knowledge, momentary knowledge, in an element (or sub-system) of a system that really confers authority to act, not the arbitrary allocation of responsibilities.[22]

Beer is speaking of management systems in general, not specifically the military, where political, even moral, responsibilities prohibit the decentralization of authority. His argument favors delegation of this authority to the levels possessing information so that they may act. Restrictions on the military, however, dictate a different approach, though

still utilizing the principle that knowledge confers the authority to act. The formal structure must be modified to ensure that the needed information is present at the proper level so that the designated decision-maker has basis both in fact and principle to act. Hence the organizational structure must perform a regulatory function on the flow of information.

The above discussion raises two issues: centralization and communications. What is the interaction between them as applied to command and control? Centralization of control is the current trend. It is driven by the principle of civilian control and the cost effectiveness derived from consolidation in command.

A centralized control structure will have a much greater communications requirement, with greater redundancy, to insure that information is received at the proper level and that directives are sent out. As more information concentrates at the top, there will be an increase in the amount of labor, both man and machine, required to process it. On the other hand, the control point is more assured that action or reaction will take place only at its direction.

The communication requirements of the centralized scenario are more than the mere provision of sufficient channel capacity to ensure the error-free transmission of a message to and from the control point. The physical constraints are probably the least difficult to overcome. More subtle are the barriers

involved in communicating the proper semantic content from sender to recipient in the face of differing language, attitudes, and behaviour: the psychological hurdles. It must be borne in mind that a decision is based on the "image" which the decision-maker maintains of the situation. Achieving the correct "image" is more important than receiving an error-free transmission. It is not hard to imagine a situation improperly described to the decision node which results in the right answer to the wrong question. These are communication problems which deal not so much with the process as with elements in the command organization such as staffing and leadership.

E. General System Design.

Having discussed certain aspects of the control process in isolation from one another, an application of these principles to a command and control system will allow them to be viewed in context.

The system is assumed to be a mechanism for the processing of information in support of command, thus furnishing the substance for adequate control of subordinate units in accomplishment of a mission. Secondly, the system is assumed to take advantage of all current technology and its development program will be of sufficient flexibility to incorporate technological advances as they occur instead of "freezing" system components at inception.

The first step in the creation of a command and control

system is the setting of a system objective by the central control point. Once this has been accomplished the task of determining information requirements which will support the objective can be undertaken.

If, for example, this system is to support a tactical commander, the stated objective might be to provide him with a continuous assessment of the tactical situation and permit timely and effective decision-making.[23]

The Stanford Research Institute identified ten major classes of information which would support such an objective:

a. Military situation.

b. Own force characteristics and resources.

c. Enemy force characteristics and resources.

d. Environmental data.

e. Operational plans.

f. Planning factors.

g. Standard operating procedure.

h. Problem-solving algorithm.

i. Reference material.

j. Experience retention aids.[24]

Having decided upon the categories of information, the next step is to define information processing operations. The first of these is data collection. This would best be accomplished through negative feedback or what might be termed exception reporting. Rather than reporting on the whole of the

environment continuously, it would be more reasonable to establish an environmental baseline, periodically reporting exceptions to that "normalized" situation. This process will, to a large extent, dictate both subordinate reporting routines and sensor utilization.

The second stage in the information process will be concerned with its generation and organization. Basic to this link in the chain, is to identify the location of the data bank and processing equipment. Will it, in the case of a shipboard commander, be more advantageous to maintain ADP facilities ashore with a remote query capability, or on board occupying valuable space? Some assistance in answering this question is obtained by studying the dynamic characteristics of the information classes noted above. How much of the information is static? How much requires periodic update? How much is of a "real time" nature necessitating constant update? Affecting the answer to these questions are the associated considerations of data life and "time lateness." This is also the stage to consider information aggregation weighed against the normal proliferation of different reports within the system.

Information handling procedures are to be addressed next. Standardization of procedures and proper formatting of the information within the system will increase efficiency as

well as furnishing a better guarantee of interoperability with other systems. Identification of individuals needing access to the system as well as which components may control input functions should also be made.

The fourth state is the actual processing and analysis of the information. The staff structure is the key to efficiency at this point. Provision must be made for analytic tools such as input/output consoles. Efficient interaction among the various staff elements and system components to provide for the correlation of information and the generation of alternate courses of action must be created.

The final stage is the presentation of the information and various courses of action to the commander. The proper display of this information, as well as the processing which occurred in earlier stages, will largely determine the "image" of the situation on which the commander will base his decisions. Important at this stage are considerations such as the efficiency of particular graphic decision aids.

The above factors have all been associated with the input portion of the control cycle. Output is viewed as the course of action chosen by the commander and the method of communicating his directives to subordinate units. The degree of control centralization within the system, the quantifying of the information categories and processing operations enumerated above, and the specification of the interconnectivity desirable

among subordinate units will define the overall communications requirements of the particular system.

F. Summary.

This Chapter has discussed various informational and structural factors which exert influence on the design and operation of a control system. The information flow associated with the problem-solving process lends itself to a pyramid-shaped structure. Taking this into consideration with the political and economic factors alluded to earlier, future emphasis on centralized control at echelons throughout the politico-military chain is almost assured.

Chapter III will address current trends in naval communications, command, and control in light of the above discussion of control theory and organizational behaviour.

## CHAPTER III

## CURRENT TRENDS IN NAVAL COMMAND, CONTROL AND COMMUNICATIONS

### A. Climate for Change.

Recommendations from groups such as the Blue Ribbon Defense Panel and the Chief of Naval Operations Industry Advisory Committee on Telecommunications[1] have added impetus to movements aimed at centralizing the control structure in the Department of Defense. Their findings were based on the soundness of the principle of centralization in operations as well as the economies to be gained through centralized management functions. Both bodies cited fragmentation in DOD's efforts to formulate a coherent unified approach to command, control, and communications as a principal obstacle to efficiency.

In DOD, the WWMCCS Support Council was created to provide extraordinary management to accelerate lagging system development.[2] The first steps towards formulating a "system architecture" utilizing a "top down approach" were taken in the hopes of identifying overall system requirements.[3] The principal difference between this approach and the ones it succeeded was for the first time requirements were to be set forth at the control center rather than simply relying on a filtering process to pass requirements up the chain of command. It should not be inferred that the control point would blindly

establish a set of specifications. What it did mean was the control point would undertake a study of all command levels and their requirements, and generate a unified policy which would allow for interoperability among system components.

The Navy established the Office of Command Support Programs within the staff of the Chief of Naval Operations (OPNAV) in 1971. Its creation was probably in response to the concurrent interest that command and control was receiving from Mr. Packard; its goal, "to pull together the Navy's $C^3$ programs."[4] One of the objectives of the office was to create a Navy World-Wide Command Support System[5] which would be fully integrated into WWMCCS. Similar to actions taken in DOD, the Navy also established the position of a telecommunications architect within the Command Support Programs Office whose function was to improve the Navy's efficiency in this area.[6]

In recognition of the many and varied communications problems associated with joint operations, the Joint Chiefs created the Joint Tactical Communications Office (TRI-TAC).[7] Traditionally, a commander had "owned" his communication system. This was one reason for the Services' individual approach to the development of new systems. Another, was the fact that the development of new systems would take longer and be more expensive if extensive inter-service consultation had to take place prior to service approval.

TRI-TAC was established in May 1971 with the following

objectives:

(1) Interoperability among tactical communications systems and other Department of Defense telecommunications systems.

(2) Placement of new equipment in the field in a timely manner.

(3) Elimination of duplication.

(4) Performance of the above functions economically.[8]

One of its principal responsibilities is to act as the architect for joint tactical communications systems. The keystone to this overall plan was the development of a family of hybrid, analog/digital, automatic transportable switches of modular design. These switches would act as automated translating devices to enable existing systems to communicate with one another.

These efforts towards centralized management are laudable because they are aimed at increasing operational and cost efficiency. In the act of consolidation, however, further fragmentation has taken place. As noted above, there are now three architects, each responsible to a different master in a slightly different way.[9] On the basis of differing organizational biases and perceptions alone, interaction between the three should prove awkward.

Further impeding centralization in command, control, and communications is OPNAV's management approach. The control

system should not be divorced from the environment with which it must interact. Sensors, for example, cannot be developed independent of the information processing capability which will transform raw sensory data into meaningful information or the means by which that information is transferred to the appropriate decision node.

The classic scientific approach to a complex problem is to divide it into more manageable parcels for reassembly upon solution. This does not imply a fragmentation of the responsibility to solve the problem. The current OPNAV task structure seems to do just this. The Director of Command Support Programs does "pull together the Navy's $C^3$ programs," but only the shore-based programs.[10] The development of shipboard and airborne systems is the bailiwick of their particular mission sponsors. More lamentable still is the recent transfer of responsibility for reconnaissance and surveillance from Command Support Programs to other elements within OPNAV as the result of a staff reorganization. This has the net effect of further fragmenting efforts to create a coherent systematic approach to control systems. The Command Support Programs office can do little more than react to initiatives in certain areas of command and control taken by other elements of the OPNAV structure.

The need for centralization, however, has been recognized by the Fleet. A recent reorganization of the staff of

Commander-in-Chief, U.S. Atlantic Fleet has cast the role of communications, command, and control in proper perspective. The change created the position of Deputy Chief of Staff for Operations, Command and Control which will be filled by an officer of flag rank.

B. Technology.

Technology provides the building blocks for the command and control systems. It can be divided into three categories for discussion: sensor systems, communications, and information processing.

Sensor systems currently range from the individual lookout to advanced technology surveillance satellites able to scan large portions of the globe in a single orbit. The sensors themselves measure physical characteristics from seismographic, to acoustic, to nearly every portion of the electromagnetic spectrum. Their resolution can range from gross to fine grain, depending on the mission requirements. Moreover, sensors may be integrated into a decision node such as the radar installed on a task force commander's flagship or aboard a remote platform such as a satellite.

Recent trends indicate increased use will be made of remote multi-sensor collection systems such as satellites, very high altitude aircraft, and remotely piloted vehicles. Greater emphasis is being placed on high resolution sensors.

The value of the sensor system to the commander is largely

dictated by data accuracy and system responsiveness. A requirement for higher resolution from a remote sensor necessitates a higher data rate between the platform and its collection terminal. Data accuracy calls for a further increase in the transfer volume because error detection methodology must be incorporated into the actual transmission of the data. Finally increased responsiveness in a remote platform calls for increased attention in the communications concerned with the command and control of the platform itself. The cumulative effect of these trends is greatly increased reliance on communications.

In general, current requirements call for naval communications of increased volume, reliability, inter-connectivity, covertness and resistance to disruption by Nature or an adversary. It is hoped that a fully operational Fleet Satellite Communications System will provide this capability.

The greatest strength of satellite communications will be the inter-connectivity of the system. Because a satellite transponder is visible to many parts of the globe at once, many parties will be able to communicate with one another who had hitherto been isolated. Utilizing frequencies in the ultra-high and super high frequency spectrums, the very high data rates necessary for bulk information transfer will be attainable. Concurrently, these higher frequencies permit the use of spread-spectrum techniques which allow some degree

of protection against jamming as well as provide a certain degree of covertness.[11]

Tested to a certain extent using TACSAT I and LES 6, the fully operational Fleet Satellite Communications System will provide a backbone, allowing communications between sensors and ADP facilities, between shore-based detection and tracking locations, between a force commander and his forces, and between the tactical components themselves. Automatic, high-speed, computer-to-computer, digital information exchange will be available for the first time for ship-to-shore use.

The interconnectivity of the system may give rise to "command jumping" in the event of a crisis. This can have serious repercussions if some intermediate echelon with important information is overlooked. On the other hand, it provides the first opportunity for "parallel conferencing," an application which might change the whole face of crisis management.[12*]

Developments are also underway to improve the processing of messages at the terminals. All-satellite communications still means the ship must transmit a message to a communication station where it is manually relayed to the Automatic Digital Network (AUTODIN) or other dedicated circuitry for transmission to its destination. There it must be further processed to direct it to the cognizant action office.

---

*A discussion of "parallel conferencing" appears in Chapter IV.

Conversely, a message destined for a ship is transmitted via AUTODIN to the appropriate naval communication station servicing the ship where it must be manually processed for placement on the fleet broadcast or shore-to-ship circuit. These problems are characterized as "Ship-Shore-Interface" and "Staff Internal Routing."[13]

The Naval Communications Processing and Routing System (NAVCOMPARS) is designed to solve the problem of ship/shore interface while the Local Digital Message Exchange will try to alleviate Staff Internal Routing difficulties.

LDMX System Goals

- Preparation, routing, and formatting of messages.
- Validation, segregation, and transmission of messages.
- Receipting, editing, and internal distribution of messages.
- Filing, recalling, or re-transmission of messages.
- Readdressing of messages.
- Furnishing statistics.
- Remote message entry and distribution capability.
- Reproduction and distribution of over-the-counter copy.

NAVCOMPARS System Goals

- Perform all LDMX functions.
- Automatic functions performed by fleet centers to include:

. On-line termination of ship-shore circuits.

. Maintenance of a real-time fleet locator.

. Servicing messages for the Fleet.

. Formatting, screening, and distribution via any of several transmission media.

. Broadcast control.

- Screening board assistance in times of crisis.[14]

The advent of the Fleet Satellite Communications System and the automated distribution systems enumerated above will revolutionize naval communications in terms of capacity, speed, and protection for error, important areas in the exercise of the command function.

C. Computers.

Many of the improvements in communications noted above will come about through the use of computers, but this is not the only area where automation will have great impact. Information pertaining to all aspects of operations may be stored in the memory of a computer, easily updated and retrieved for use.

A traditional source of difficulty in keeping abreast of events is the vast amount of information supplied to the decision node in a myriad of reporting formats. Many reports are duplicative, others supply a very small item of routine information, but are still incorporated into a complete independent report. The widespread usage of ADP will, for the

first time, allow the Navy to institute a composite reporting system. Many different items of information will be included on one message, which when processed by ADP facilities will separate and file all this different information into the appropriate categories for easy retrieval and use.[15]

An area of greatly increased interest is the use of the computer for data correlation. The variety of sensors and their different inputs have created a need for correlation at centralized nodes to weed out redundant contacts and formulate the broadest valid information base. This new use for the computer had its roots in the development of a method to correlate aircraft flight data in 1954.[16]

As more sensors were placed on one platform, it was recognized that a need existed for automated facilities to process and correlate the raw data. This was the first step towards what eventually became the Integrated Operational Intelligence Center (IOIC), designed to process and correlate data obtained by the RA-5C reconnaissance aircraft.[17]

The IOIC experience validated the use of the computer as a generalized correlation mechanism. This has led to the development of automated graphic terminals of simple design into which varied sensor and locational information, including maps, may be introduced and manipulated.

D. Naval Mission Definition.

The redefinition of the Navy's missions, underway since

1970, is of profound importance to the development and definition of command, control, and communications.

Categorization of these missions will, according to VADM Stansfield Turner, "force the Navy to think in terms of output rather than input."[18] He goes on to enumerate five reasons for the need to think in these terms. The first is that it will allow the citizenry to rationally decide what resources should be allocated to the Navy by assigning some value to the Navy's contribution to national objectives.[19] Second, tactical commanders will be able to concentrate more clearly on objectives.[20] Third, the subdivision of today's massive Navy organization into output functions will establish priorities for the allocation of resources within the Navy.[21] Fourth, an understanding of missions will assist in selecting the best among several competing systems. Finally, stressing missions will help guarantee that members of the organization focus on the whole rather than one of its parts.[22]

This rationale and its subsequent application to specific Navy missions and tactics is the type of systematic appraisal which will eventually translate itself into concrete requirements for weapons systems and support programs alike.

E. Ocean Surveillance Methodology.

"Ocean surveillance as a warfare function is a relatively new concept, although its roots are historical. For example, one of its components--reconnaissance--has long contributed

to tactical information needs albeit on a mission oriented basis."[23]

One of the basic elements in the commander's assessment of a situation is target location and the validity which he places in that information. As the surveillance function has gained in importance, three general categories have arisen which may be useful in determining surveillance requirements and employing the sensors at hand. They are:

a. National interests...considered to encompass essentially all Ocean Surveillance information types on a world wide basis...recognization that national authorities must be able to share specific Ocean Surveillance resources in an emergency.[24]

b. General Surveillance Needs...essentially non-strategic missions...somewhere between the national interests at one extreme and strictly tactical needs at the other...with an emphasis on large-area coverage for such purposes as operational resource allocation and situation monitoring.[25]

c. Tactical Operations...force allocation and operations...the more tactical the case of a specific user, the more improved timeliness of data and better location accuracy would be implied; in many tactical situations a high probability of target detection, intercept, and identification is seen as

mandatory--simply because of the potential threat severity and the resultant quickened pace of operations.[26]

These three categories are graphically depicted in Figure 3.

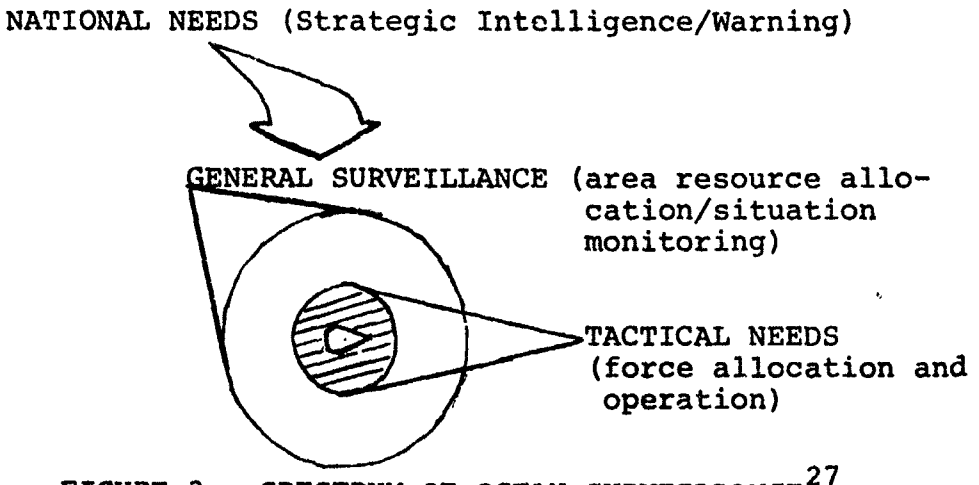


FIGURE 3. SPECTRUM OF OCEAN SURVEILLANCE[27]

The management of surveillance assets and the use of the data is currently in a fragmented state. This is due, largely, to lack of definite requirements and neglect in determining the methods by which this data is to be collected. Movements currently afoot to clarify the role of command support will as a corollary clarify the role of surveillance at both the general and tactical levels.

F. Threat Analysis.

The key to command support is threat analysis which encompasses not only an estimate as to the capabilities of

opposing forces but also those of own forces as well as pertinent environmental information. It is a summarizing process which leads to an overall description of a situation upon which the commander can act. As the adjective implies, this analysis must be keyed to the threat: the tactical, or immediate threat; the general, or area threat; or the national, or overall threat.

This analysis should take place in proximity to the decision nodes. Three types of support organizations, roughly equivalent to the three categories of surveillance needs, are envisioned: at the national level (which will remain outside the scope of this discussion); a facility ashore supporting the Naval Component (area) and Numbered Fleet Commander, and an afloat facility in support of distinctly tactical operations.

G. Fleet Command Support Center.

The Fleet Command Support Center (FCSC) is viewed as a solution to a number of problems that the Navy now faces with its afloat forces. The first of these is the recognition that sensor and sensor platform technology have made perpetual surveillance a possibility. One method for neutralizing an opponent's efforts to locate a friendly force electronically is not to radiate. This, of course, does not lend itself to efficient information transfer.

A second problem is the expansion of the threat envelope

or tactical zone. This has been brought about with the advent of stand-off weaponry. The target task force continues in its attempts to cope with this threat utilizing sensors and communications which are line-of-sight limited.

The third problem is the "unique approach" which the military generally takes to solve its "one time" problems. This has resulted in a proliferation of independent systems with little or no interoperability.

A fourth problem, crucial in the creation of the FCSC, concerned the physical limitations placed on the amount of equipment which could be installed on a warship.

The only method to increase support in the face of the constraints outlined above was to locate the support activity ashore. Efforts at proving the feasibility of such a policy were made during the ADMIXTURE and ROPEVAL exercises conducted by elements of the Pacific Fleet in 1971.[28] The experiment centered around the creation of a small Command Support Center ashore whose function was to correlate and integrate information destined for afloat commands and transmit it to them in a concise and timely fashion.

The success of the experiment and the responsibility of the Navy to provide a command, control, and communications system fully compatible with the WWMCCS led to the formulation of the Navy Command Support System. The goal was to create a fully integrated system which would extend from the tactical

unit up the chain to the national system. The FCSC was conceived as the nexus between the Fleet and the WWMCCS.

According to the proponents of the concept, the FCSC is a location which will assist in:

- Providing all source information by receiving, processing, analyzing, correlating, integrating, displaying, and evaluating in real time the information required to support tactical operations.
- Providing tailored information and management support, responsive to the on-going tactical situation to the at-sea commander within a useful time frame.
- Providing tailored situational information to higher command in a useful time frame.
- Allowing timely and responsive management control over support systems (information, communications, logistics).
- Providing tactical coordination between commanders.[29]

These functions with their emphasis on information and communications stand in stark contrast to the accepted notion of command and control noted in Chapter I.

The full system is expected to be operational in 1978 and will include three installations. At that time the FCSCs will be linked to units at sea via the Fleet Satellite Communications System. The computers of the FCSC will be interconnected with other nodes of the WWMCCS to furnish near

instantaneous data retrieval from distant locations. This computer-to-computer exchange will allow the components to limit their local data base.

The FCSC is an all-source depository. It is not in and of itself a function. It is not designed to replace traditional staff operations, though the traditional staff structure may undergo some modification to make it more compatible with FCSC operations. Systematically centralizing effort and information, it is a location where a commander can obtain an all-source view of a situation, make the requisite decisions, and communicate these to subordinates. This is Command and Control.

Basically the FCSC is a network of subsystems which fall into two categories: mission-oriented and integration-oriented.[30] Mission-orientation refers to those subsystems which act upon the information entering the FCSC from the supporting systems and control the assets which will modify the environment in the direction which the commander desires. The integration-oriented subsystems are those which facilitate the input and interface of all the supporting systems including the display function.

There are six mission-oriented subsystems.[31] The first is Sensor and Source Direction and Coordination. Its function is to control input into the FCSC by managing information flow and reallocating sensor resources as new

requirements are received. Communications Direction and Coordination is the function through which area communications assets are centrally controlled and monitored by one individual. Some observers have noted that this may be the single most innovative function in the FCSC.[32] The third subsystem is Electronic-Warfare/Cover and Deception Direction and Coordination which assists in the control and coordination of electronic warfare and cover and deception plans with operations. Next is the Tactical Coordination subsystem designed to provide otherwise unavailable tactical information to the at-sea forces. The Tactical Coordination subsystem also acts as an information filter compressing data and preventing duplication. The fifth subsystem is Operational Simulation which allows realistic training as well as providing gaming facilities and other aids in planning. The final mission-oriented subsystem is Logistics Coordination which will aid in the management of resources and coordinate logistic support from other facilities, but only under extraordinary circumstances. It is not designed to replace the routine logistics support functions carried out elsewhere.

There are two integration-oriented subsystems. One is Support System Unification which provides a temporary "holding pattern" for input data prior to its processing. It is also the system's executive as it controls data

formatting and subsystem machine functions. The other subsystem is Integrated Information Display which supplies the interface between the commander and the data collection and information processing systems of the FCSC. It is the prime analysis tool, processing incoming data, utilizing alpha numeric and graphic input/output consoles and large screen displays.

The already existing support systems with which the FCSC interacts are: communications; information/surveillance; command and control; intelligence; and logistics. These systems provide the input and output mechanisms which the control center acts upon.

H. Tactical Flag Command Center (TFCC).

Just as difficulties exist in threat analysis and control at the general area level, so they exist, albeit to a lesser degree, at the Task Force/Task Group level. Moreover, these problems are compounded by the actual use of advanced weapons systems and the speed factor inherent in tactical operations. Even our most modern flagships are not equipped adequately to support a commander tasked with a multi-mission role in the face of a multi-faceted threat.

Information input into the shipboard control cycle is currently provided from many sources, the Naval Tactical Data System, Ocean Surveillance Information System, Ship's Signals Exploitation Space, the Navy Intelligence Processing

System, Navy Casualty Reporting System, to name just a few. There is not, however, any single location where all this data is stored or at least displayed for the afloat commander's use. All the requisite information is available, but this information loses much of its value due to a lack of local processing capability.

The Tactical Flag Command Center may be a solution to many of these problems. Like the FCSC, it is an effort to centralize information at a decision node and relies on existing support systems to provide the input. It is not a duplication of the FCSC afloat, but is tailored to the needs of the afloat commander as well as designed to complement FCSC operations.

The TFCC concept consists of:

- An information processing system to support the requirements of the Commander, preferably achieved through upgrading existing facilities.
- Provisions for interfacing the facility and the information processing system with other command support systems within the flagship and through communications with other ships and shore facilities.
- Automated displays which present overviews of tactical situations and on which can be called up the various types of data, information, and intelligence required by the commander.

- A communications system interface by which the commander will be able to direct and control assigned forces, coordinate operations with other commanders or make reports to higher commands.[33]

The exact configuration of the TFCC has not yet been decided upon. The issue around which much of the controversy revolves is not whether this type of system is needed, but whether further ADP facilities should be placed on board existing flagships.

Citing the already heavily burdened surface platforms and evincing great optimism in the reliability of the Fleet Satellite Communications System, one group has proposed that the TFCC display real-time data,but rely on what is termed the Remote Interrogation-Information Exchange System (RIIXS) for the remainder of the data processing.[34] The RIIXS is conceived as having three parts:

1. Numbered Fleet Commander interrogating terminal and display.
2. ADP facility ashore.
3. Transmission path.[35]

Adding such items as personnel and administration to the existing functions of the FCSC, this group sees the TFCC as little more than an appendage of the shore facility.

The opponents are generally not as optimistic about the reliability of communications nor do they foresee an

environment which will permit constant communications. Their concept includes limited ADP facilities onboard the flagship to allow a small data base to be built up and limited information processing to take place.

I. Summary.

Political, economic, and technological factors together are dictating a policy towards increased centralization in command, control, and communications. This centralization coupled with the advances which have been made in the field of automation guarantee more thorough threat analysis and quicker response times. It is to be hoped that these two results will negate some of the advantages held by an opponent's use of standoff weapons in an expanded tactical zone.

Concentration on Naval Mission definition and the further development of command support centers are in consonance with the principles presented in Chapter II. Continued emphasis on these areas will eventually facilitate the determination of concrete requirements and a true advance will have been made.

There are, however, some immediate obstacles to this progress. The identification of these problem areas and proposals for their solution are the topic of the concluding chapter.

# CHAPTER IV

## CONCLUSIONS

> There is nothing more difficult to carry out nor more doubtful of success, nor more dangerous to handle than to initiate a new order of things. For the reformer has enemies in all who profit by the old order, and only lukewarm defenders in all those who would profit by the new order. This lukewarmness arises partly from fear of their adversaries, who have the law in their favor; and partly from the incredulity of mankind, who do not truly believe in anything new until they have experience of it.
>
> Machiavelli, The Prince (1513)

Even a cursory study of the history of warfare underscores the importance of innovation and efficiency in command, control, and communications to both victors and vanquished. Use of a system of signal flags and central command in the rear surely played a part in the many successes of the Mongols.[1] Development of a vocabulary signal book is cited as a contributing factor to Nelson's victory at Trafalgar as it greatly aided the control and coordination of his forces.[2] Absence of an efficient control system and inattention to communications has proven its importance in reverse. Jellicoe's failure to take the initiative at Jutland has been attributed to a faulty command and control system which left him ignorant of the true status of forces on both sides. Japan's excessive use of a rigid code system during World War II facilitated

Allied intercept and exploitation of critical communications, a direct and dramatic consequence of which was the successful assassination of Admiral Yamamoto of the General Staff, a loss the Japanese felt keenly.

These examples are just a fraction of numerous similar events that have occurred throughout the course of military history. The point is that sensitivity to a changing environment and adaptive practices in command, control, and communications can be crucial determinants in a force's success or failure.

The increasing complexity of life in modern times has caused systematic analysis to become a basic tool in understanding the nature of objects, their interrelationships, and the reasons behind events. Although nothing would seem to be "above" analysis, there remains a certain amount of mystique, and desire for same, surrounding the martial arts. Commenting on the then fairly new attempts to understand the nature of the military system, Rear Admiral Henry Eccles, a noted military scholar, stated that, "The concepts of organization, of command, and of decision are so intertwined that any analytical separation amounts to oversimplification."[3] Further on, the reader finds a somewhat grudging acceptance of "centralization (which) is justified when it is recognized that this will provide the optimum efficiency."[4] Finally, caution is urged concerning two important components of command and control, "In

both intelligence and communications we find that technology develops its own special logic and pressure, which tends to obscure the major considerations of political policy and of strategy."[5] These statements were made in 1965, and suspicion of the centralization and automation of command and control has continued to the present.

While conducting a study for the Navy in 1968, the Stanford Research Institute found that, "Lack of enthusiastic support from certain second and third echelon commands when confronted with automatic data processing equipment is due partially to the feeling that it would result in a reduction of the commander's authority without a commensurate reduction in responsibility."[6] The same somewhat dated questions are still being posed today: Is technology eroding the prerogative of the Commanding Officer? Is there creeping inflexibility in centralized decision-making? Just how serious is the threat to Command Authority?[7]

These questions are rhetorical exhortations to return to the past; expressions of a philosophy grounded in naval "tradition," mixed with more than a little distrust of technicians and politicians. But increased civilian participation in military affairs and the centralization of control are matters of policy now; they are reality, and this demands a revised outlook by both operational commanders and resource managers alike. If the exercise of such intangibles as

"command," "control," "prerogative," and "authority" has evolved into something different from what it was fifteen years ago, it is incumbent on the Navy to reassess its approach to command and control in continuance of its responsibility to support National Command Authority. A "tradition" is not immutable and should not stand against the compelling moral and legal obligations which the Navy bears to adapt and provide the most effective military organization possible under prevailing circumstances.

The process of redefining the role of command, control, and communications within an altered mission framework and divining the substance of future efforts is an ongoing one. Several areas stand out as those requiring the most immediate attention: the nature of command and control as a response mechanism in crisis management; the consolidation of $C^3$ management in the Office of the Chief of Naval Operations (OPNAV); the trade-offs between force levels and $C^3$ levels; the issue of a corporate memory in the Navy; and finally the creation of a command and control subspecialty for naval officers.

A. A Response Mechanism in Crisis.

According to Herman Kahn, "The problems of command, control and communications which are very great in sustained high intensity nuclear wars, are much reduced in slow motion exchanges that are limited and deliberate."[8] Moreover, the nature of command and control in war seems qualitatively

different from that required during the period preceding the outbreak of hostilities, i.e., the crisis.

Crisis management is the term generally associated with the actions taken by a national government during periods of international tensions, in the course of which the superpowers may confront one another. Recent times have witnessed demonstrations of national resolve, up to a point, simultaneously counter-balanced by actions to avert the actual outbreak of hostilities.

The use of naval forces in the managing of a crisis, for example during the Cuban Missile Crisis of 1962, has been incorporated as part of the Naval Presence mission. It is assumed that the Navy will continue to be employed as an instrument of national policy during crisis for the foreseeable future. To this end, communications, command, and control systems must be able to provide a direct link between the on-scene commander and the policy-maker. This requirement arises from the need for both parties to share a common perception of a rapidly unfolding situation, to clarify the exact goals which the crisis manager wishes to be achieved, and ultimately to eradicate, through direct interaction, any ambiguities concerning the constraints placed upon the actions of the commander.

Rational response in a crisis situation cannot be based on incorrect or incomplete knowledge at either end of the

chain. Chapter II pointed to the fact that all information undergoes some degree of transformation as it travels within the organization. A direct link between the decision-maker and the policy executor would, to the greatest extent possible, preclude misunderstandings.

While direct access is attractive, the concept of "parallel conferencing" is even more so, because it has the added benefit of preventing a potential information loss which might accompany direct access "command jumping." It allows direct contact while permitting other commanders in the chain the option of expressing alternative courses of action, presenting additional information, and remaining abreast of the latest developments, all on a real-time basis.

Kahn offers the following operational requirements for a command and control system adequate to deal with a crisis:

I. Prepare for crisis by:
   A. Gathering data.
      1. Know whom and how to ask for information.
      2. Determine allocation of effort in gathering information.
      3. Gather and accept data.
      4. Process it.
      5. Store it in a retrievable condition.
      6. Request more information and cross-check information already obtained.
   B. Disseminating data.
      1. Display relevant data.
      2. Distribute timely information to proper recipients.
      3. Answer questions.
      4. Perform other library-type activities.
   C. Developing and using evaluation indicators.
      1. Preliminary decisions.
      2. Warning and reaction (unified concept).
      3. Immediate coordination.

II. Assist decision-making during crisis in:
   A. Administration.
      1. Know whom and how to ask for information.
      2. Provide for emergency teams.
      3. Provide "battle stations."
      4. Coordinate internal and external information and activities.
      5. Facilitate special conferences and consultation.
   B. Planning.
      1. Update or devise alternative emergency plans.
      2. Make preliminary evaluations and collect comments.
      3. Same for contingency plans.
      4. Cover as much of the peacetime planning cycle on both emergency and contingency plans as seems desirable.
      5. Help decision-makers choose emergency and contingency plans.
   C. Execution.
      1. Monitor activities.
      2. Provide continuous evaluation and prognostication.
      3. Make creative suggestions.
      4. Aid bargaining and communication with opponent.[9]

In summary then, "Know whom and how to ask for information" must be accompanied by the physical capacity to do so. From the standpoint of technology, "parallel conferencing" is possible. If one of the nation's prime objectives is the avoidance of war, then it is imperative to recognize it as such and provide the very best tools available for the management of crises. The prime considerations in the design of such a system are provisions for clarity and flexibility, not the jealous guarding of prerogatives by intermediate and lateral commands.

B. Consolidation of $C^3$ Management in OPNAV.

"Retention and Readiness" was the subject of a recent CNO memorandum.[10] Certainly not a new topic, it once again

focused attention on the precept that readiness is a prerequisite for naval effectiveness. In what areas, these flag officers were asked, did they need more responsiveness from OPNAV to attain a higher degree of readiness?

This question, as it pertains to command, control and communications, raises yet a broader issue: from a management viewpoint, can OPNAV, as currently structured, actually be responsive to readiness in an overall sense? The generation of cohesive overall policy to guide $C^3$ management and development seems difficult at best. This is a result of the fragmentation of both authority and responsibility for $C^3$ within OPNAV.

In Chapter III it was noted that while the task of the Command Support Programs Office has been "to pull together the Navy's $C^3$ programs," for all practical purposes, its authority extends to shore based programs only. Programs in other mediums belong to their respective mission sponsor (Submarine, Surface, and Air Warfare) as these components have assumed more of the responsibilities and appearance of program managers. Even reconnaissance and surveillance program responsibilities have been removed from Command Support Programs and now reside in Anti-submarine Warfare.

The CNO's problem in issuing unitary binding policy is compounded by the complex reporting structure within OPNAV. In 1973, eighteen independent offices reported

directly to him. This total seems in excess of one individual's span of control. An indicator that this may in fact be the case is that needed program reform from the top down is normally undertaken after an outside organization such as the CNO Industry Advisory Board for Telecommunications publicizes the Navy's deficiencies, not before. A combination of intra-organization squabbling among mission sponsors and others near the top over budgets, and differing perceptions of reality, coupled with fragmented authority, make hopes for genuine cohesive guidance from the present organization rather remote.

The overall restructuring of OPNAV into a more "readiness-oriented" organization is beyond the scope of this paper. However, we can look to the functional organization of the Joint Chiefs of Staff and the new Atlantic Fleet organization, both of which have readiness as a prime concern, to provide examples of how the authority and responsibility for $C^3$ can be managed. Readiness is a prime responsibility of the Operations portion of the staff. Recognition of the vital role which $C^3$ plays in the maintenance of readiness has caused JCS to place authority for command, control, and communications directly beneath Operations. In the Atlantic Fleet, authority for Operations and Command and Control resides in the same individual. Centralized policy guidance, resource allocation, and the generation of meaningful integrated

requirements pertaining to the readiness of command, control and communications are provided for under the broad aegis of Operations. Perhaps it is time for OPNAV to reinstitute a structure which includes a body concerned primarily with operations and readiness to improve its efficiency and responsiveness.

C. Force Levels Versus $C^3$.

The old bromide "You can't get something for nothing" is becoming "You can't even get a little for a lot" when applied to today's Defense expenditures. The corridors of the Pentagon are littered with the bones of programs which succumbed during the annual budget struggle.

The creation of a more responsive and readiness-oriented organization within OPNAV will, it is hoped, be accompanied by a greater integration of command, control, and communications requirements into the overall staffing function. As the budget apportionment process takes place it must include a continuous process of program evaluation in an effort to determine which have the greatest potential for contribution to overall Fleet readiness. $C^3$ has been dealt with separately, because it is viewed as distinct from the debate taking place at stage center as to which weapons systems will provide the U.S. Navy's force levels. This isolation is artificial and must be abolished if the discussions concerned with force levels are to be fully integrated and meaningful.

The "Hi-low Mix" is a concept accorded a great deal of interest today. A reduction of resources available to the Navy has prompted an effort to determine what ratio of costly complex platforms to lower cost basis platforms is necessary to fulfill the requirements of the four Naval Mission Areas. It is imperative that the Navy obtain the maximum value for the dollar spent for the sake of its own level of readiness as well as to maintain its credibility with Congress and an increasingly skeptical public. The objective of this platform mixture as with all others is synergism: determining a composite wherein the effectiveness of the Fleet will exceed the sum of the parts. The investigation into possible ratios has centered around the configuration and number of the platforms themselves. Little has been done in the area of contrasting superior $C^3$ in a particular situation with superiority, for example, in platform numbers. When this occurs, it will be found that alternative investment in $C^3$ does have a place in the force level debate precisely because it has the potential of being the true synergistic factor.

The proponents of increased resource allocation in the area of command, control, and communications can often be their own worst enemy when they discuss the merits of their systems as contrasted with those of a weapons system. Certain apologists claim that $C^3$ systems are "different" from weapons systems, that it is difficult to physically demonstrate

their capabilities, thus making "fly offs" impractical. Little wonder that platform and weapons systems sponsors are suspicious of the $C^3$ advocates. If the former can measure "effectiveness" in a system as complicated as a destroyer, then it is mandatory that "effectiveness" factors be determined for $C^3$ systems.

Potentially meaningful tools for evaluating the performance of command, control and communications exist in the form of war gaming facilities, the Operations Simulator subsystem in the Fleet Command Support Center, and Fleet exercises to observe the results of varying mixes of platforms and $C^3$ capabilities. On the basis of these comparisons and the changing nature of the threat itself, more efficient overall resource allocation decisions can be made. The goal, after all, is not the most numerous Fleet, but the most effective. The stating of an objective, the determination of measures of cost and effectiveness, and the establishment of a criterion are as valid management principles with respect to the management of command, control, and communications systems as they are to aircraft and ships. $C^3$ must compete using the same ground rules as the rest of the Navy. When this happens it should not be too difficult to demonstrate the overall increase in Fleet effectiveness which the cost, for example,of one Spruance class destroyer, reallocated to command and control, might bring about.

D. A Corporate Memory.

The Navy, as a corporate entity, does not seem to learn well from its mistakes. The individuals involved learn, but naval officers are rarely in a particular job for more than three years. After that, they are off for something new and different. Their departure takes from the job much of the needed experience and skill acquired via trial and error during those past three years.

Continuity in the area of communications, command, and control is, by and large, currently provided by civilians, both those in direct Navy employ and the contractors who supply the systems. This is not an adequate substitute for a corporate memory which records the successes and failures of the organization and the background data which led to both, so that interested parties can share in the evolutionary process. A corporate memory can be a most valuable management tool if applied to the education of the organization's members. It is preferable to another method to retain this knowledge which would be longer individual tour length, a stop gap measure at best.

It is said that the body of Man's knowledge doubles every ten years. If this is only partially correct, an automated corporate memory will be the only viable means to retain, in totality, the vast quantity of information essential for the continued development of the Navy.

A proposed solution is the revamping of the archive system into a centralized interactive information repository from its current status as simply an address to which the annual command history is sent. The proper application of information processing and automation could transform the archive from a useful tool of the scholar reconstructing history into an active learning device capable of reproducing valuable experience gained during the history of the particular job or office. This too, should be an important aspect of an information-oriented $C^3$ system.

The task of orienting the archives in such a manner would be a large one, but it is felt that in the long run the advantages will outweigh any short term difficulties. Just as standard subject identification codes are in regular use today to aid commonality in filing, an expansion of just such a methodology, coupled with automation, would eventually make it feasible to cross reference new ideas and approaches with a central historical data base prior to their implementation.

E. A Command and Control Subspecialty.

Turning now from the organization to the individual, it must be recognized that coupling the rapid advance of technology with the changes necessary to maintain the continued adequacy of the Navy's $C^3$ systems should not necessarily come from outside the organization. The naval officer confronted by such a challenge must meet it through increased awareness

of requirements and greater knowledge of the systems and principles involved.

The subject is too critical to simply rely on traditional "on-the-job training." The answer to the dilemma lies in the creation of a $C^3$ subspecialty which would embrace selected members of both the line and restricted line communities. The majority should be drawn from among the "operators" since they, as the future operational commanders, will themselves be the prime beneficiaries of increased understanding of the functioning of $C^3$ systems.

Over-specialization may have been the cause for the failure of some of these subspecialty educational programs to pay the expected dividends. Rather than concentration on learning a large body of very detailed knowledge, the proposed program for $C^3$ subspecialty training should emphasize the importance of analysis and the development of a systematic mental framework with which to approach the problems associated with control systems.

The generation of such expertise must come from graduate-level education in much the same way as other subspecialty courses of instruction are currently conducted at the Naval Postgraduate School Furthermore, the foundation for such a course of study already exists in the form of the Operations Research, Communications Management, and Computer Systems Management curricula.

Training is only the first step. Additionally, a clear avenue for advancement up to and including flag rank must be incorporated into a career pattern for this new sub-specialty if the program is to attract and retain officers of the high caliber required.

Efficient command, control, and communications are vital and integral portions of naval operations. If the findings presented in this paper are in any way indicative of future trends, the Navy must recognize that the role of a viable $C^3$ system will increase rather than diminish in importance. If the challenge is to be adequately met, modes of thought and behaviour which foster such developments as the "automation of human limitation" must be discarded in favor of systematic approaches which will allow the full potential of automation to be realized.

$C^3$ must no longer be looked upon as a "poor cousin" by its advocates and opponents alike. Discussion of the advantages to be gained through a vigorous program of development as well as demonstrations of $C^3$ capabilities must be introduced into the center ring to make the determination of future force levels more meaningful.

A fully interactive information system is not political. Its functions reflect inputs from both the environment upon which it will act and the guidance provided by the central decision-maker whom it must ultimately support. The political

implications associated with command and control are constructs resulting from the individual and organizational biases of components within the system. The means to combat obstructionism in the development of this necessary $C^3$ capability is to sensitize the individuals with whom the system will interact to the new realities pertaining to the role the military must play in the overall orchestration of national policy.

## NOTES

### CHAPTER I

1. Morris Janowitz, The Professional Soldier, (New York: The Free Press, 1971), p. 347.

2. John F. Kennedy, quoted in George I. Thompson, "$C^3$ - Essential Element in Politico-Military Planning (U) Unpublished Thesis, U. S. Naval War College, Newport, R.I.: 1973, p. 3. Confidential.

3. Graham T. Allison, Essence of Decision (Boston: Little, Brown, 1971), p. 128.

4. U.S. Congress, House,Committee on Armed Services, Inquiry into the USS Pueblo and EC-121 Plane Incidents. 91st Congress, 1st sess. (Washington: U.S. Govt. Print. Off., 1969), p. 835.

5. Ibid., p. 913.

6. Ibid., p. 709.

7. Ibid., p. 1619.

8. Ibid., p. 1621.

9. Blue Ribbon Defense Panel, Report to the President and the Secretary of Defense, The Department of Defense (Washington: July 1, 1970).

10. Nelson P. Jackson, "The World-Wide Military Command and Control System: A Management Reorganization Perspective," Unpublished Thesis, Georgetown University, Washington, D.C.: 1972, p. 2.

11. U.S. Department of Defense, Dictionary of Military and Associated Terms, JCS Pub 1 (Washington: 1972), p. 66.

12. Ibid., p. 66.

13. Ibid., p. 76.

14. Ibid., p. 267.

15. F. J. Harlfinger, "Command, Control, and Communications in the Navy Now and in the Future," Signal, February, 1974, p. 607.

16. John C. Olson, "Fleet Command Support Center System," Signal, February 1974, p. 17-21.

17. Lee M. Paschall, "$C^3$ and the National Strategy," Signal, April 1974, p. 10-14.

18. A. H. Quanbeck and B. M. Blechman, Strategic Forces, Issues for the Mid Seventies (Washington: The Brookings Institution, 1973), p. 6-11.

19. Chief of Naval Operations Industry Advisory Committee for Telecommunications, Subcommittee on Command and Control, Final Report (Washington: 1973), p. iv. Confidential.

20. Paschall, p. 8.

21. Roy L. Beavers, "Salt I," U.S. Naval Institute Proceedings, May 1974, p. 216-224.

Chapter II

1. Stafford Beer, Decision and Control (New York: John Wiley, 1966), p. 243.

2. Ibid., p. 257.

3. Dick Ramstrom, The Efficiency of Control Strategies (Stockholm: Almquist & Wiksell, 1967), p. 77.

4. G. T. Vardaman and P. B. Vardaman, Communication in Modern Organizations (New York: John Wiley, 1973), p. 321.

5. John Paul Froelich, Information Transmittal and Communicating Systems (New York: Holt, Rinehart, Winston, 1969), p. 4.

6. Ramström, p. 58.

7. Ibid., p. 59.

8. Stephan R. Michael and Halsey R. Jones, Organizational Management (New York: Intext Educational Publishers, 1973), p. 315.

9. Theories attributed to Dorsey and Barnhard in Jay Jackson, "Normative Regulation of Authoritative Behavious," William J. Gore and J. W. Dyson, eds., The Making of Decisions, New York: The Free Press, 1964), p. 221.

10. Ramström, p. 47.

11. Michael and Jones, p. 263-73.

12. Beer agrees that decisions are based on rationality, but states emphatically that they are not "logical", being derived from biological necessity rather than intellectual processes, a subtle point. (Beer, p. 1.)

13. Ramstrom, p. 103.

14. Beer, p. 383-84.

15. Ibid., p. 388.

16. Ibid., p. 444.

17. March and Simon quoted in C. Vickery, Information Systems (Hamden, Conn.: Shoestring Press, 1973), p. 35.

18. Ramstrom, p. 231.

19. Beer, p. 446.

20. Michael and Jones, p. 277.

21. Ramström, p. 209.

22. Beer, p. 435-37.

23. Grumman Aerospace, Task Force Command and Control Study (U) (Alexandria, Va.: Defense Documentation Center, 1971), V. I, p. 2. Secret.

24. Stanford Research Institute and Computer Command and Control Co., U.S. Navy Command Information Systems (Washington: Department of the Navy, 1968), p. 47.

Chapter III

1. Including its subcommittee on Command and Control.

2. N. Jackson, p. 6.

3. Interview with Colonel Kenneth A. Plant, USAF, WWMCCS Support Council, Office of the Joint Chiefs of Staff, Washington, D.C.: 17 April 1974.

4. Harlfinger, p. 6.

5. This later became the Navy Command Support System.

6. "Naval Telecommunications Systems Architecture," Signal, January 1974, p. 13.

7. U.S.Joint Chiefs of Staff, Tactical Command and Control Planning Guidance and Procedures for Joint Operations (Washington: Dept. of Defense, 1972).

8. Urban A. Lees, "Joint Tactical Communications Office: Architect for Tactical Communications," Signal, December 1973, p. 7-9.

9. The "system architect" for the WWMCCS is part of the staff for Operations within the Office of the Joint Chiefs of Staff and responsible to the WWMCCS Council which is chaired by the Deputy Secretary of Defense as well as to the chain of command within JCS. The Naval Telecommunications Architect is part of the Navy's Command Support Programs Office, whose director reports to the Chief of Naval Operations. TRITAC is a semi-independent joint effort responsible to the Assistant Secretary of Defense for Telecommunications.

10. Interview with Rear Admiral Leslie Sell, USN, Director, Command Support Programs, Office of the Chief of Naval Operations, Washington, D.C.; 15 April 1974.

11. James B. Wheeler, "Fleet Satellite Communications, " Signal, February 1974, p. 38-40.

12. T. G. Belden and J. W. Schwartz, Application of Communications Satellites to the Military Command Structure (Washington: Institute for Defense Analysis, 1969), p. 4.

13. R. G. Howe, "LDMX/NAVCOMPARS Systems," Signal, February 1974, p. 8-10.

14. Ibid., p. 9.

15. Interview with Mr. Robert Fuller, System Design Corporation, Norfolk, Va.: 20 April 1974.

16. W. E. Dombert. "The Reconnaissance Data Block Comes of Age." Signal, April 1973, p. 13-18.

17. The aircraft is equipped with photographic, side-looking radar, passive ECM, and infrared sensors. Charles W. Knopf, "Integrated Operational Intelligence Center," Signal, February 1974, p. 31-33.

18. Stansfield Turner, "Missions of the U.S. Navy," Naval War College Review, March-April 1974, p. 2-18.

19. Ibid., p. 3.

20. Ibid.

21. Ibid.

22. Ibid.

23. Janko Jackson, "A Methodology for Ocean Surveillance Analysis, " Unpublished Thesis, U.S. Naval War College, Newport, R.I.: 1974, p. 1.

24. Ibid., p. 4-5.

25. Ibid., p. 7-8.

26. Ibid., p. 9-10.

27. Ibid., p. 11

28. L C. Bowersox, Jr., "A Long Range View of Command, Control, and Communications in the Navy," Signal, February 1974, p. 12-14.

29. Ibid.

30. Olson, p. 14.

31. Ibid., p.19-20.

32. R. G. Grubb and W. S. Harsany, "Command and Control Functions of the Fleet Command Support Center (U), Unpublished Thesis, Naval Postgraduate School, Monterey, Ca.: 1973, p. 33. Secret.

33. Romulus Fratila, "Tactical Flag Command Center," Signal, February 1974, p. 28-30.

34. John C. Lawlor, Jr., "Remote Interrogation-Information Exchange System," Unpublished Thesis, Naval Postgraduate School, Monterey, Ca.: 1973.

35. Ibid., p. 5.

CHAPTER IV

1. David Zook and Robin Higham, A Short History of Warfare (New York: Twayne, 1' 6), p. 70.

2. Ibid., p. 115.

3. Henry E. Eccles, Military Concepts and Philosophy (New Brunswick, N.J.: Rutgers Univ. Press, 1965), p. 19.

4. Ibid., p. 120.

5. Ibid., p. 200.

6. Stanford Research Institute, p. 24-25.

7. D.J. Marshall, "Communications and Command Prerogative," U.S. Naval Institute Proceedings, January 1974, p. 28-33.

8. Herman Kahn, On Escalation (Baltimore: Penguin Books, 1968), p. 147.

9. Ibid., p. 256-257.

10. Memorandum from Chief of Naval Operations to all Flag Officers, "Retention and Readiness," Washington: 24 May 1974.

# BIBLIOGRAPHY


Air Force Systems Command and Rand Corp. Report of the Proceedings of the AFSC/Rand Symposium of May - July 1970. Santa Monica, Ca.: Rand, 1971. Secret.

Allison, Graham T. Essence of Decision. Boston: Little, Brown, 1971.

Anti-Submarine Warfare Systems Project Office. ASW $C^3$ Sensor/ Interfaces: Baseline Documentation.(U). Washington, D.C.: 1973. Secret.

Armbrister, Trevor. A Matter of Accountability. New York: Coward, McCann, 1970.

Ashby, H. Ross. An Introduction to Cybernetics. New York: John Wiley, 1963.

Beavers, Roy L. "SALT I," U.S. Naval Institute Proceedings, May 1974, p. 216-224.

Beer, Stafford. Decision and Control. New York: John Wiley, 1966.

Belden, T. G. and Schwartz, J. W. Application of Communications Satellites to the Military Command Structure. Washington: Institute for Defense Analysis, 1969.

Blue Ribbon Defense Panel. Report to the President and Secretary of Defense. The Department of Defense. Washington: July 1, 1970.

Boeing Co. A Very High Altitude Airplane System for Ocean Surveillance: Multimission Adaptability (U). Seattle: Boeing, 1971. Secret.

Bowersox, E. C. Jr. "A Long Range View of Command, Control, and Communications in the Navy." Signal. February 1974, p. 12-14.

Carteaux, Thomas L. "Is there a Need for a National Reconnaissance Command?" Unpublished Thesis. Air University, Maxwell AFB, Ala: 1972.

Chief of Naval Operations. General Operational Requirement No. 31: Command and Control. Washington: 1968. Secret.

Chief of Naval Operations Industry Advisory Committee for Telecommunications, Subcommittee on Command and Control. Final Report. Washington: 1973. Confidential.

Dombert, W. L. "The Reconnaissance Data Block Comes of Age." Signal, April 1973, p. 13-18.

Eccles, Henry E. Military Concepts and Philosophy, New Brunswick, N.J.: Rutgers Univ. Press, 1965.

Fratila, Romulus. "Tactical Flag Command Center." Signal, February 1974, p. 28-30.

Froelich, John P. Information Transmittal and Communicating Systems. New York: Holt, Rinehart, Winston, 1969.

Gillette, Leibholz, Tuttle. Naval Communications Long Range Study: 1982-1992. Washington: Naval Research Laboratory, 1971. Secret.

Gore, William J. and Dyson, J. W., eds. The Making of Decisions. New York: Free Press, 1964.

Greenwood, Ted. "Reconnaissance, Surveillance, and Arms Control," Adelphi Papers No. 88. London: Institute for Strategic Studies, 1972.

Grubb, R. G. and Harsany, W. S. "Command and Control Functions of the Fleet Command Support Center (U)." Unpublished Thesis. Naval Postgraduate School, Monterey, Ca.: 1973. Secret.

Grumman Aerospace. Task Force Command and Control Study (U). Alexandria, Va.: Defense Documentation Center, 1971. 3 v. Secret.

Haas, J. E. and Drabek, T. E. Complex Organizations. New York: Macmillan, 1973.

Harlfinger, F. J. "Command, Control, and Communications in the Navy Now and in the Future." Signal, February 1974, p. 6-7.

Howe, R. G. "LDMX/NAVCOMPARS Systems." Signal, February, 1974, p. 8-11.

Interview with Mr. Robert Fuller, System Design Corp., Norfolk, Va.: 20 April 1974.

Interview with Col. Kenneth A. Plant, USAF, WWMCCS Support Council. Office of the Joint Chiefs of Staff. Washington, D.C.: 17 April 1974.

Interview with RADM Leslie Sell, USN, Director, Command Support Programs, Office of the Chief of Naval Operations. Washington, D.C.: 15 April 1974.

Jackson, Janko. "A Methodology for Ocean Surveillance Analysis." Unpublished Thesis. U.S. Naval War College, Newport, R.I.: 1974.

Jackson, Nelson P. "The World-Wide Military Command and Control System: A Management Perspective." Unpublished Thesis. Georgetown University, Washington, D.C. 1972.

Janowitz, Morris. The Professional Soldier. New York: Free Press, 1971.

Joint Service Office for Tactical Command and Control, and Communications. Annual Report of Significant Joint $TC^3$ Problems. Washington: 1970. Confidential.

Kahn, Herman. On Escalation. Baltimore: Penguin, 1968.

Kropf, Chas. W. "Integrated Operational Intelligence Center." Signal, February 1974, p. 31-33.

Lawlor, John C. Jr. "Remote Interrogation-Information Exchange System." Unpublished Thesis. Naval Postgraduate School, Monterey, Ca.: 1973.

Marshall, D. J. "Communications and Command Prerogative." U.S. Naval Institute Proceedings, January 1974, p. 28-33.

Memorandum from Chief of Naval Operations to all Flag Officers. "Retention and Readiness." Washington: 24 May 1974.

Michael, Stephan R. and Jones, Halsey R. Organizational Management. New York: Intext Educational Publishers, 1973.

"Naval Telecommunications System Architecture." Signal, January 1974, p. 13.

Olson, John C. "Fleet Command Support Center System." Signal, February 1974, p. 17-21.

Paschall, Lee M. "$C^3$ and the National Strategy." Signal, April 1974, p. 10-14.

Quanbeck, A. H. and Blechman, B. M. Strategic Forces, Issues for the Mid-Seventies. Washington: The Brookings Institution, 1973.

Ramstrom, Dick. The Efficiency of Control Strategies. Stockholm: Almquist & Wiksell, 1967.

Stanford Research Institute and Computer Command and Control Co. U.S. Navy Command Information Systems. Washington: Dept. of the Navy, 1968.

Thompson, George I. "$C^3$ - Essential Element in Politico-Military Planning." (U) Unpublished Thesis. U.S. Naval War College, Newport, R.I.: 1973. Confidential

Turner, Stansfield. "Missions of the U.S. Navy." Naval War College Review, March-April 1974, p. 2-18.

U.S. Congress. House. Committee on Armed Services. Inquiry into the USS Pueblo and EC-121 Plane Incidents. 91st Congress. 1st sess. Washington: U.S. Govt. Print. Off., 1969.

U.S. Department of Defense. "Concept of Operations of the World-Wide Military Command and Control System (WWMCCS)," DOD Inst. 5100.30. Washington: 2 December 1971.

_____. Dictionary of Military and Associated Terms. JCS Pub 1. Washington: 1972.

U.S. Joint Chiefs of Staff. Joint Strategic Objectives Plan FY 1975-1982 (U), Annex E Command and Control. Washington: February 1973. Secret.

_____. Tactical Command and Control Planning Guidance and Procedures for Joint Operations. Washington: 1972. 3 v.

Vardaman, G. T. and Vardaman, P. B. Communication in Modern Organizations. New York: John Wiley, 1973.

Vickery, C. Information Systems. Hamden, Conn.: Shoestring Press, 1973.

Wheeler, James B. "Fleet Satellite Communications." Signal, February 1974, p. 38-40.

Zook, David and Higham, Robin. A Short History of Warfare. New York: Twayne, 1966.



END - 3 - 75