



4

DTIC FILE COPY

AD-A199 726

Technical Document 1309
July 1988

**Command, Control,
Communications
and Intelligence
Operational Requirements
Framework: Command
Process Model**

G. L. Ruptier

DTIC
ELECTE
OCT 04 1988
S H D

Approved for public release; distribution is unlimited.

88 10 3 10 4

NAVAL OCEAN SYSTEMS CENTER
San Diego, California 92152-5000

E. G. SCHWEIZER, CAPT, USN
Commander

R. M. HILLYER
Technical Director

ADMINISTRATIVE INFORMATION

The work reported herein was conducted for the Chief of Naval Operations over the period February 1987 - June 1988.

Released by
C. S. Fuzak, Jr., Head
Communications Group

Under authority of
R. T. Shearer, Acting Head
Systems Planning Group

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED		1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY		3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.	
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE			
4. PERFORMING ORGANIZATION REPORT NUMBER(S) NOSC Technical Document 1309		5. MONITORING ORGANIZATION REPORT NUMBER(S)	
6a. NAME OF PERFORMING ORGANIZATION Naval Ocean Systems Center	6b. OFFICE SYMBOL <i>(if applicable)</i> Code 16	7a. NAME OF MONITORING ORGANIZATION	
6c. ADDRESS <i>(City, State and ZIP Code)</i> San Diego, CA 92152-5000		7b. ADDRESS <i>(City, State and ZIP Code)</i>	
8a. NAME OF FUNDING SPONSORING ORGANIZATION Chief of Naval Operations	8b. OFFICE SYMBOL <i>(if applicable)</i>	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8c. ADDRESS <i>(City, State and ZIP Code)</i> Washington, DC 20350		10. SOURCE OF FUNDING NUMBERS	
		PROGRAM ELEMENT NO 65853N	PROJECT NO R0905
		TASK NO	AGENCY ACCESSION NO DN305 162
11. TITLE <i>(Include Security Classification)</i> COMMAND, CONTROL, COMMUNICATIONS AND INTELLIGENCE OPERATIONAL REQUIREMENTS FRAMEWORK: Command Process Model			
12. PERSONAL AUTHOR(S) G. L. Ruptier			
13a. TYPE OF REPORT Final	13b. TIME COVERED FROM Feb 1987 TO Jun 1988	14. DATE OF REPORT <i>(Year, Month, Day)</i> July 1988	15. PAGE COUNT 22
16. SUPPLEMENTARY NOTATION			
17. COSATI CODES		18. SUBJECT TERMS <i>(Continue on reverse if necessary and identify by block number)</i>	
FIELD	GROUP	SUB-GROUP	C ³ I analysis Requirements analysis Decision aids
19. ABSTRACT <i>(Continue on reverse if necessary and identify by block number)</i> The conceptual Command Process Model is described. It provides a framework for the description of top-level warfare requirements and the assessment of Navy Tactical C ³ I programs.			
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input type="checkbox"/> UNCLASSIFIED/UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED	
22a. NAME OF RESPONSIBLE INDIVIDUAL G. L. Ruptier		22b. TELEPHONE <i>(include Area Code)</i> (619) 553-2991	22c. OFFICE SYMBOL Code 16

PREFACE

The purpose of the conceptual Command Process model presented in this document is to provide a framework for the description of Top Level Warfare Requirements and the assessment of Navy tactical C³I programs by the Director of Naval Warfare (OP-07). Previous versions of the model have been used by naval officers in decision-making meetings to determine requirements for Navy tactical C³I systems and deficiencies in meeting these requirements. These statements of requirements and deficiencies form a basis for the assessment of current research, development and acquisition programs.



Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	special
A-1	

CONTENTS

INTRODUCTION	1
Graphic-Functional Descriptions of the Command Process	1
NAVAL WARFARE AND THE COMMAND PROCESS	2
FUNCTIONAL DECOMPOSITION OF THE COMMAND PROCESS	5
CPO: Command Process	5
Nodal Connectivity Functions	6
CP1: Assemble Information	6
CP2: Assess Situation	10
CP3: Develop/Evaluate Alternatives and Select Course of Action	12
CP4: Direct Actions	14

INTRODUCTION

This Command, Control, Communications and Intelligence (C³I) Operational Requirements Framework is intended to serve as a fundamental structure on which Top Level Warfare Requirements (TLWR) and Command Process requirements may be developed. This Framework and the TLWR will provide guidance for the development of C³I system functional requirements and top level alternative system designs ("architectures").

GRAPHIC-FUNCTIONAL DESCRIPTIONS OF THE COMMAND PROCESS

This Framework contains a method of describing generic nodal Command Process functions and subfunctions, and a method describing how nodes are related to other nodes in a notional command hierarchy. The nodal functions can represent the Command Process of any node in a Service or Unified command hierarchy. The functional description of this model was coordinated and iterated with the Navy's ASW Architecture Methodology Development Working Group. A modification of the graphic structured analysis language, IDEF₀^{*}, is used for the function interaction diagrams as shown in Figure 1. The boxes represent processes or activities, and the arrows represent interfaces between processes. As shown below, input data/information enter on the left side, output data/information exit from the bottom side. Controls enter on the top side and govern the way in which the process is done. Some processes control other processes; this relationship is represented by control outputs (leaving from the right side). The index in the lower right corner of the process box serves as a label of the process. The basic connectivity functions represented by the interface arrows are termed *Receive* (input arrows) and *Issue* (output arrows).

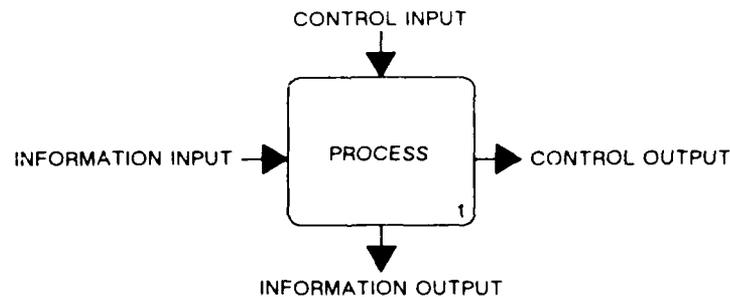


Figure 1. Modified IDEF₀ symbols.

^{*}Softech, Inc., "Integrated Computer-Aided Manufacturing (ICAM) Function Modeling Manual (IDEF₀)," Waltham, Massachusetts, June 1981.

NAVAL WARFARE AND THE COMMAND PROCESS

Figure 2 shows a notional naval mission and organization hierarchy. For clear illustration, a command cycle is shown for only one of the command levels, but applies to all command levels as well as warfare areas. (Note that the actual mission and organization hierarchies are, in mathematical terms, graphs and not trees as shown.) In the remainder of this document the command cycle is discussed in a generic sense, without association to any specific aspects of naval warfare.

Figure 3 shows a generic command cycle in the modified IDEF₀ format. This is a basic cybernetic model presented in a military setting. The basic functions of the cybernetic model are Sense, Decide, and Act, where the decision process (Decide) is termed here a Command Process. Figure 4 presents the major Command Process functions. The Sense function (surveillance), while an inherent part of the overall command cycle, is normally considered a distinct discipline from "command and control" (the Command Process) in the Navy context. For this reason, the Sense function will not be discussed further. The Command Process functions will be discussed in detail.

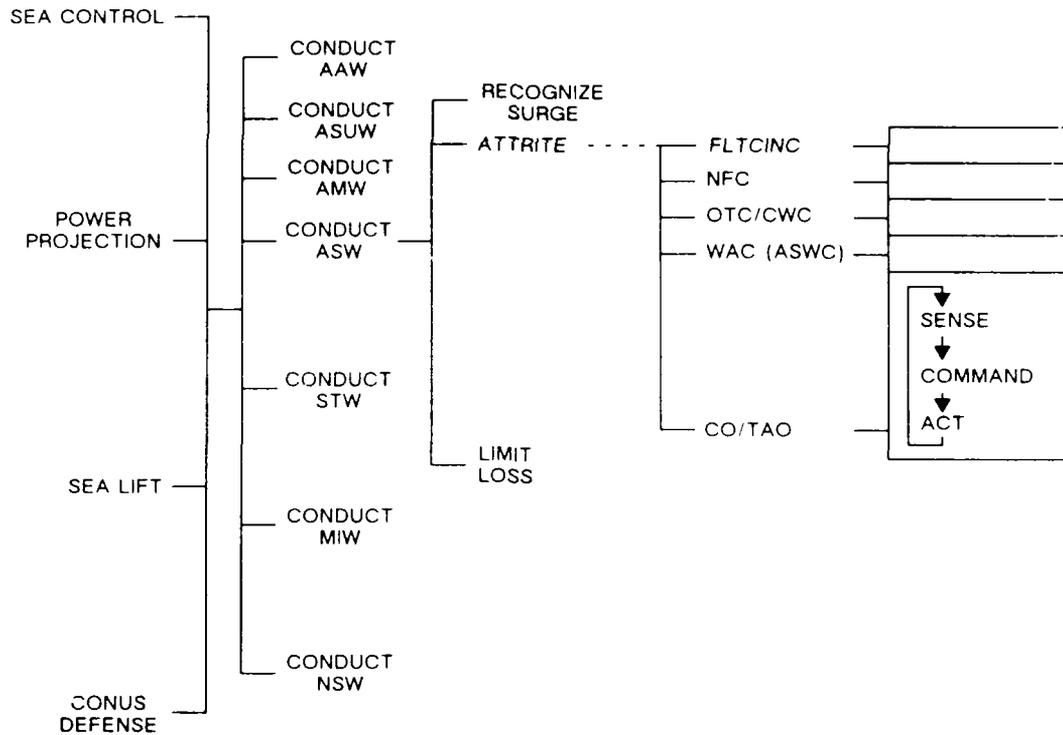


Figure 2. Conduct operations at sea.

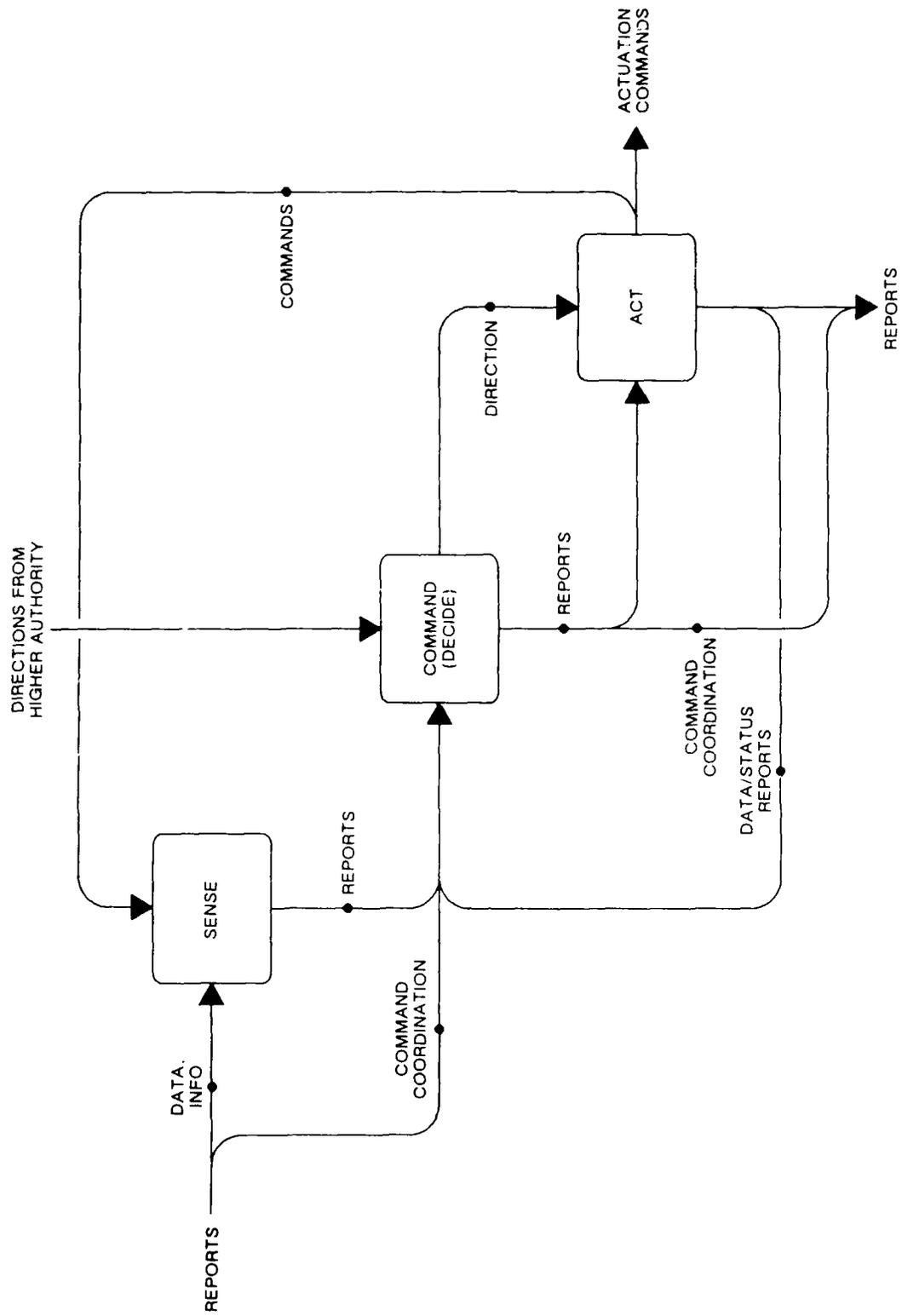


Figure 3. Military command cycle.

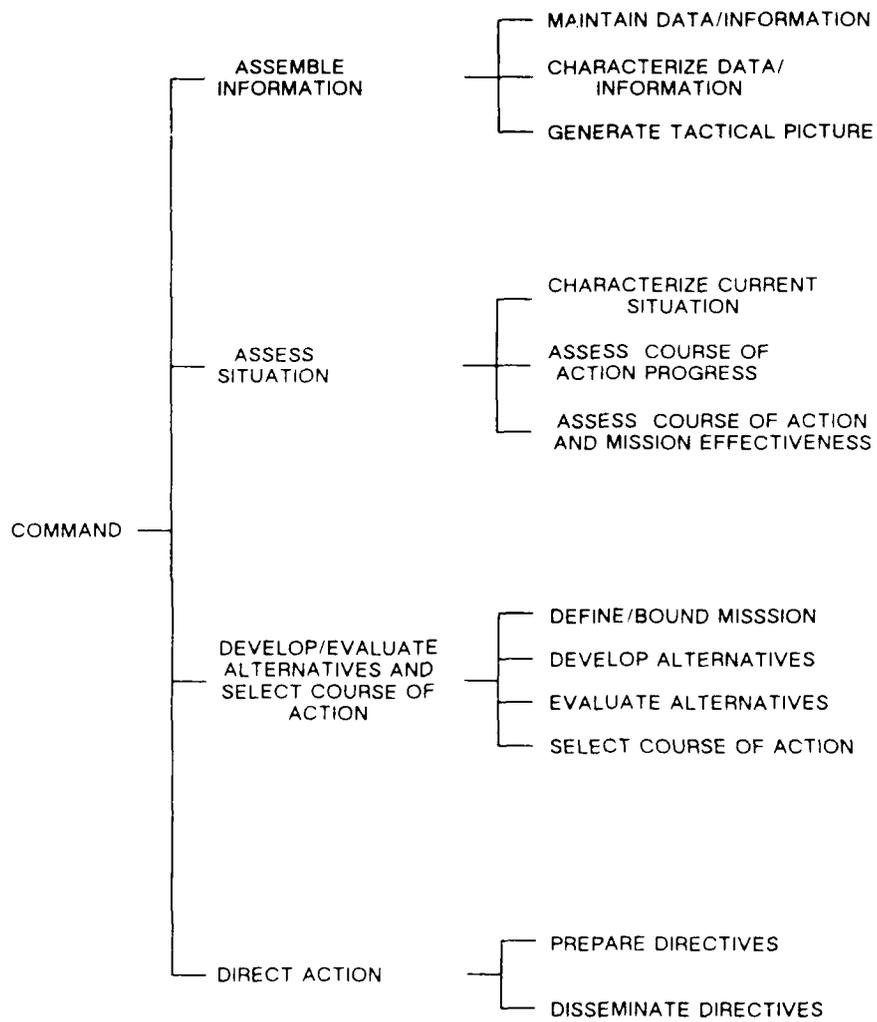


Figure 4. Command process functional decomposition.

FUNCTIONAL DECOMPOSITION OF THE COMMAND PROCESS

CPO: COMMAND PROCESS

The overall Command Process function assembles and maintains data/information; formulates an assessment of the strategic, operational, or tactical situation; develops and evaluates alternative courses of action; selects which course of action to take; and directs actions to implement the selected course. Figure 5 shows the context in a notional command hierarchy. In this context, subordinate forces include platforms, weapon systems, surveillance systems, navigation and IFF transducers, electronic warfare systems (including C3 CM), and others. Figure 6 shows the Command Process detail for a generic node.

CP1, Assemble Information, maintains data/information relevant to command and control of own forces. Data and information types include track data on friendly, neutral, and enemy forces within the area of interest; environmental data; preprocessed data from surveillance sensors and systems; and navigation and IFF systems data. Nonreal-time information, such as friendly force plans, and capabilities of friendly, neutral, and enemy systems and platforms, are also maintained as part of this function. Characterization and combining (sorting, formatting, fusion and correlation) of the data/information from the multisource inputs are also performed within this function. The status of forces is determined and a tactical picture is generated for further assessment.

CP2, Assess Situation, attempts to determine the nature of the situation in the area of interest: estimation of the intentions of enemy commanders, type and strength of potential opposing forces or of their attacks, sorting feints from attacks, and determining the effectiveness of own forces in executing directed actions. This is accomplished by characterizing the current situation, assessing progress and effectiveness in reaching planned goals and milestones and the probability or expectation of ultimately achieving success, and assessing mission effectiveness. The assessment process is interpretive in that it attempts to describe the larger "truth" from which the pieces of data and information were assembled. More than one situation may fit the available information; these possibilities are reported with associated confidence or likelihoods.

CP3, Develop/Evaluate Alternatives and Select Course of Action, involves interpreting a superior's orders and conceiving, examining, and evaluating alternative courses of action. The process uses the assessment of the strategic and operational situation, and the mission and objectives, developed in the assemble and assessment processes (CP1 and CP2). The interpretation of orders includes the establishment of goals and limits of loss. The evaluation of alternatives includes the estimation of the probability of achieving objectives, and the possible risks associated

with the various alternatives. The selection process involves the weighing of objectives against possible outcomes and risks for alternative actions; and the selection of a course of action (including contingencies). Once an operation is initiated, decisions are made regarding the necessity of pursuing an alternative, preplanned contingency, or of initiating a replanning process, based on the assessment of course of action progress and effectiveness (CP2).

CP4, Direct Actions, involves the implementation of decisions, primarily through the preparation and dissemination of directives, plans, requests, etc.

NODAL CONNECTIVITY FUNCTIONS

The basic nodal connectivity functions are Receive and Issue commands, requests, and reports. The Receive function obtains "messages" and the Issue function provides for the dissemination of "messages." These functions are actually interface functions which relate the Sense, Command, and Act functions, and the nodes in the organizational hierarchy.

CP1: ASSEMBLE INFORMATION

This function provides for the development and maintenance of the node's dynamic and static strategic, operational and tactical data/information bases. It characterizes the data/information and generates a description of the tactical picture. The details of this function are shown in Figure 7.

CP11, Maintain Data/Information, obtains processed sensor data and information from various sources; plans and force status information; and general data/information about the environment and friendly, enemy, and neutral forces. (This also includes information and indicators of enemy wartime/deceptive modes of operation which may be available in advance.) It provides for the structuring, formatting, association, validation, and the determination of the accuracy and consistency of the data/information maintained. Data/information gathered is generally controlled by own-force plans.

CP12, Characterize Data/Information, associates and classifies the received data/information, determines confidence levels, and discriminates between objects and events, and among object types. In addition, force resource (including support) status is determined.

CP13, Generate Tactical Picture, integrates the position and movement of own force and enemy units from all-source sensor information. A tactical picture is generated that is composed of the position, velocity, identity, status, and salient characteristics of all objects in the area of interest along with estimates of the quality of those parameters. In addition, the best knowledge of the environment and its effects is generated. Projections into the future may also be made as requested. In some cases, the current tactical picture can provide the required data for the generation of certain types of commands for the direction of specific actions by specific resources in function C4.

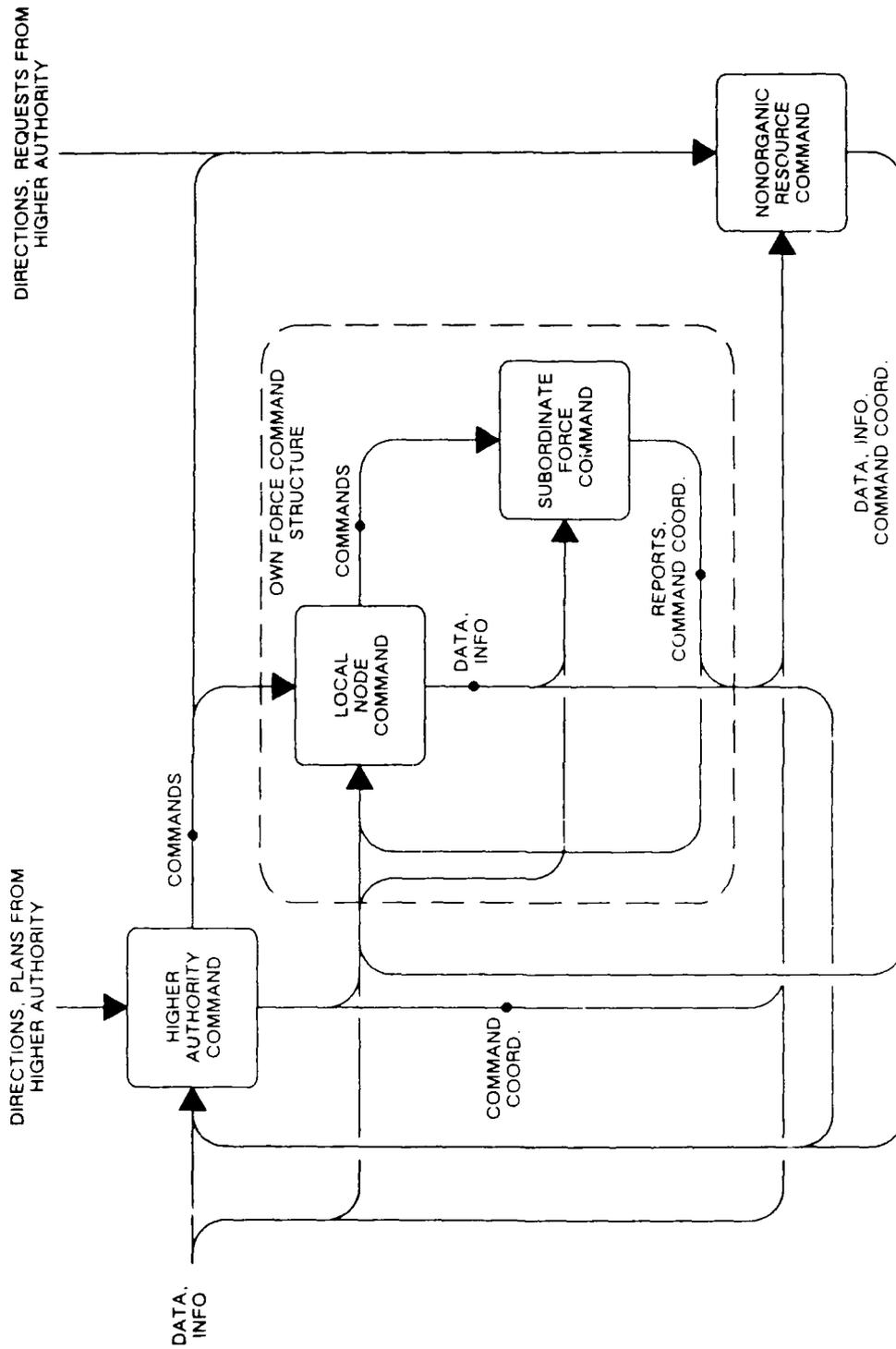


Figure 5. Force command context.

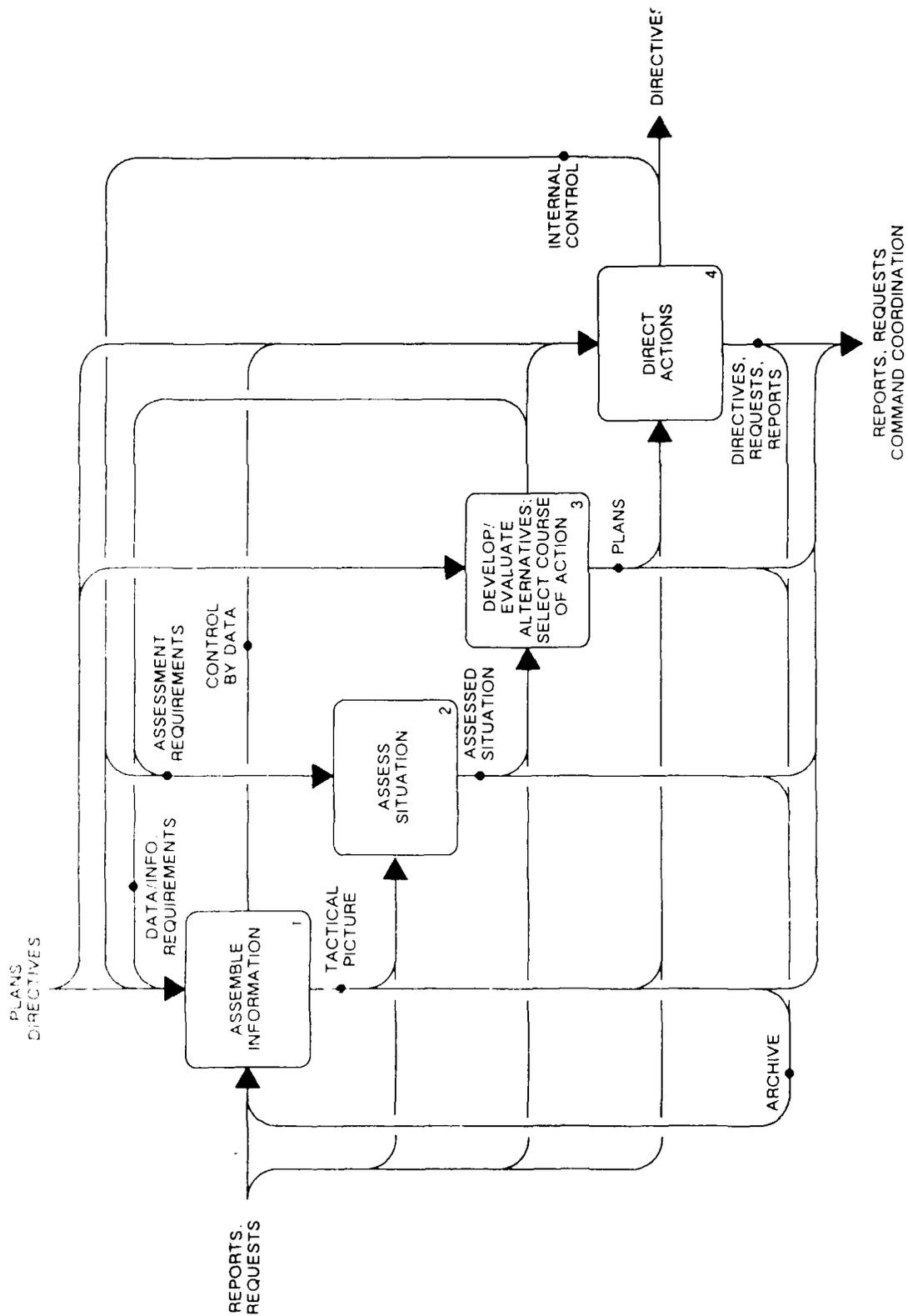


Figure 6. CPO: Local node command coordination.

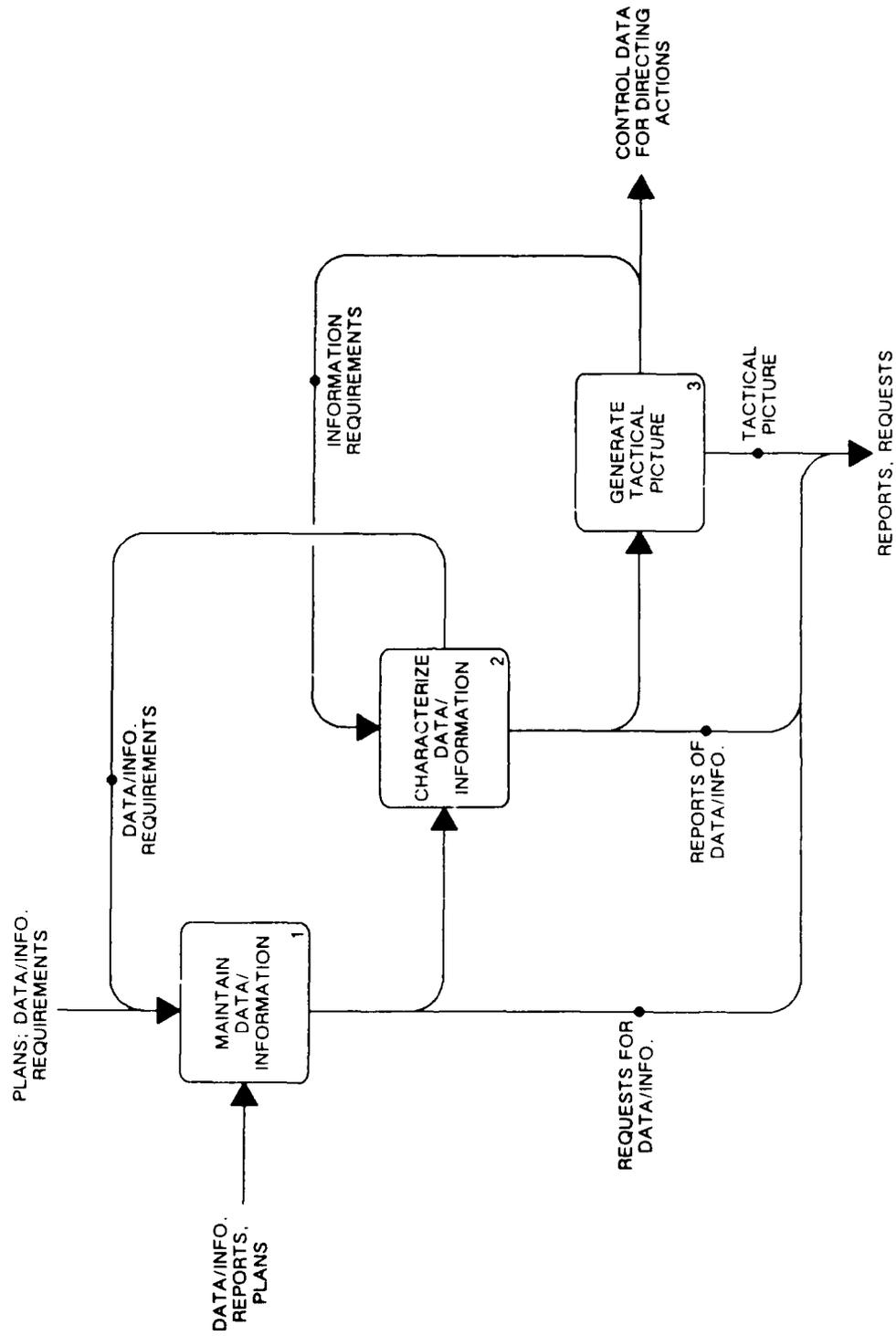


Figure 7. CP1: Assemble information.

CP2: ASSESS SITUATION

This function interprets the information provided by CP1 in the context of the mission and the contingency selected. An assessment of the situation requires a characterization of the impact of enemy, friendly, and neutral situations and the environmental situation in the area of interest for the assigned mission. Course of action progress assessments support function CP3 (Develop/Evaluate Alternatives and Select Course of Action). Course of Action (COA) and mission effectiveness assessments also support function CP3. In addition, they provide feedback to higher authority once a mission has been completed or aborted, and status reports during the mission. In the course of performing these functions, decisions are made regarding the adequacy of the assembled data/information, and actions are taken to correct deficiencies and provide refinements. This process is shown in Figure 8.

CP21, Characterize Current Situation, attempts to give meaning to the current tactical picture in terms of capabilities, advantages, and intentions. A characterization of the enemy's situation involves an evaluation of tactics and operational effectiveness, the state of operational capability and readiness, and intentions. A characterization of friendly force situation involves an evaluation of tactics and operational effectiveness, the state of operational capability and readiness, intentions, and vulnerabilities. A characterization involves an evaluation of any neutral activity in the area of interest and its impact on the performance of the mission. A characterization of the environmental effects involves an evaluation of the atmospheric, geophysical, and oceanographic effects as they relate to the mission. Additionally, highlighting of significant information is performed to compare postures, identify outside influences, and identify advantages or weaknesses of the situation.

CP22, Assess Course of Action Progress, provides an assessment of the progress made toward achieving the objectives of the selected course of action (and selected contingency) in order to support the direction (redirection) of forces. This is done by comparing the known current situation with a set of conditions according to prescribed criteria which are used to determine if the plan of action is succeeding. Any deviance from the acceptance criteria is assessed. This assessment is issued to CP3 to support the decision of whether to switch to a preplanned alternative (contingency).

CP23, Assess Course of Action and Mission Effectiveness, assesses the degree to which the current plan of action is adequately accomplishing the mission. It provides the anticipation necessary to avert blindly following a plan which is no longer likely to succeed, due to changes in the intermediate outcomes, the addition of previously unknown information, or the alteration of assumptions. When the situation falls outside of planned (anticipated) limits, function CP3 is alerted to the need for reinitiation of the process described by function CP3. Function CP23 performs an assessment of the mission when the mission or an intermediate objective of the mission has been accomplished, suspended, or aborted. This involves an assessment of goals and objectives that were met, reconstruction of events, and lessons learned which may be of value in future missions or engagements. During the mission, this assessment provides a progress report to higher authority.

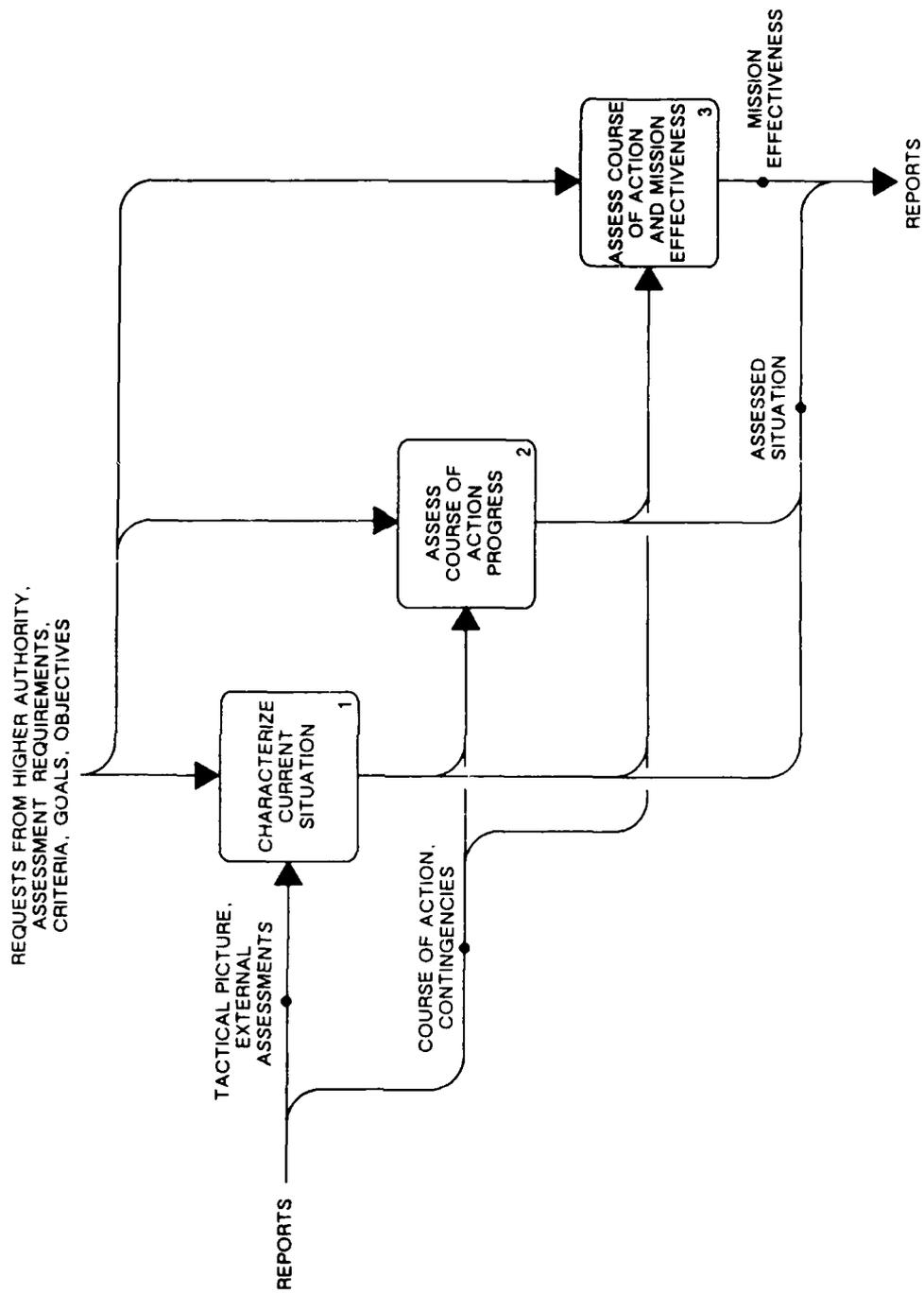


Figure 8. CP2: Assess situation.

CP3: DEVELOP/EVALUATE ALTERNATIVES AND SELECT COURSE OF ACTION

This function involves the conception, examination, and evaluation of alternative courses of action, and selects one along with associated contingencies. The development of alternatives is guided by direction from higher authority. Guidance includes mission objective, mission timing, projected environment, theater rules of engagement, available external assets, and potential threat. The selected course of action with contingencies includes such items as the movement, support protection, coordination, and control of the subordinate forces. In addition, based on assessments made in function CP2, decisions are made regarding the necessity to select an alternative contingency, or to reinitiate the process. Figure 9 shows the details of this function.

CP31, Define/Bound Mission, bounds the problem to be solved and limits the options for consideration. It interprets the directives from higher authority within the framework of the general background of the operation, the superior's mission and the capabilities and limitations of assigned resources. It establishes specific goals and objectives, and characterizes the generally expected development of the situation. The constraints of established procedures and rules of engagement are set by higher authority.

CP32, Develop Alternative Courses of Action, uses the assessed situation determined in CP2, along with the direction (mission directive) from higher command authority, to support conception of alternative courses of action. For each alternative, both friendly and enemy force operations are postulated. In this process additional information or guidance may be requested. The CP32 process includes the planning, prioritization, and tentative assignment of organic and nonorganic resources.

CP33, Evaluate Alternative Courses of Action, involves a review of the advantages/disadvantages, suitability, feasibility, and acceptability of each alternative and the estimation of the probability of success and the risks associated with each alternative. This process may involve iteration with the development of alternatives, CP32. The final step is ranking of the alternatives.

CP34, Select Course of Action, receives the ranked alternatives from CP33 and the assessment of the current situation from CP2. Strategy/tactics and associated course of action (including contingencies) are selected which are appropriate to the current situation. Establishing the plan of action and contingencies includes specification of COA progress and effectiveness assessment criteria. This involves setting thresholds or tolerance limits that, if exceeded, will be cause for selecting alternative contingencies within the plan of action, or for deciding to "replan" or update the current plan (reinitiate the entire process described by function CP3). The selection process involves the determination of the warfare area and support tasks and requirements, and force asset utilization. After coordinating with subordinate commanders and other relevant commands, reviewing their plans, and evaluating the force readiness posture, the final plan of action is determined.

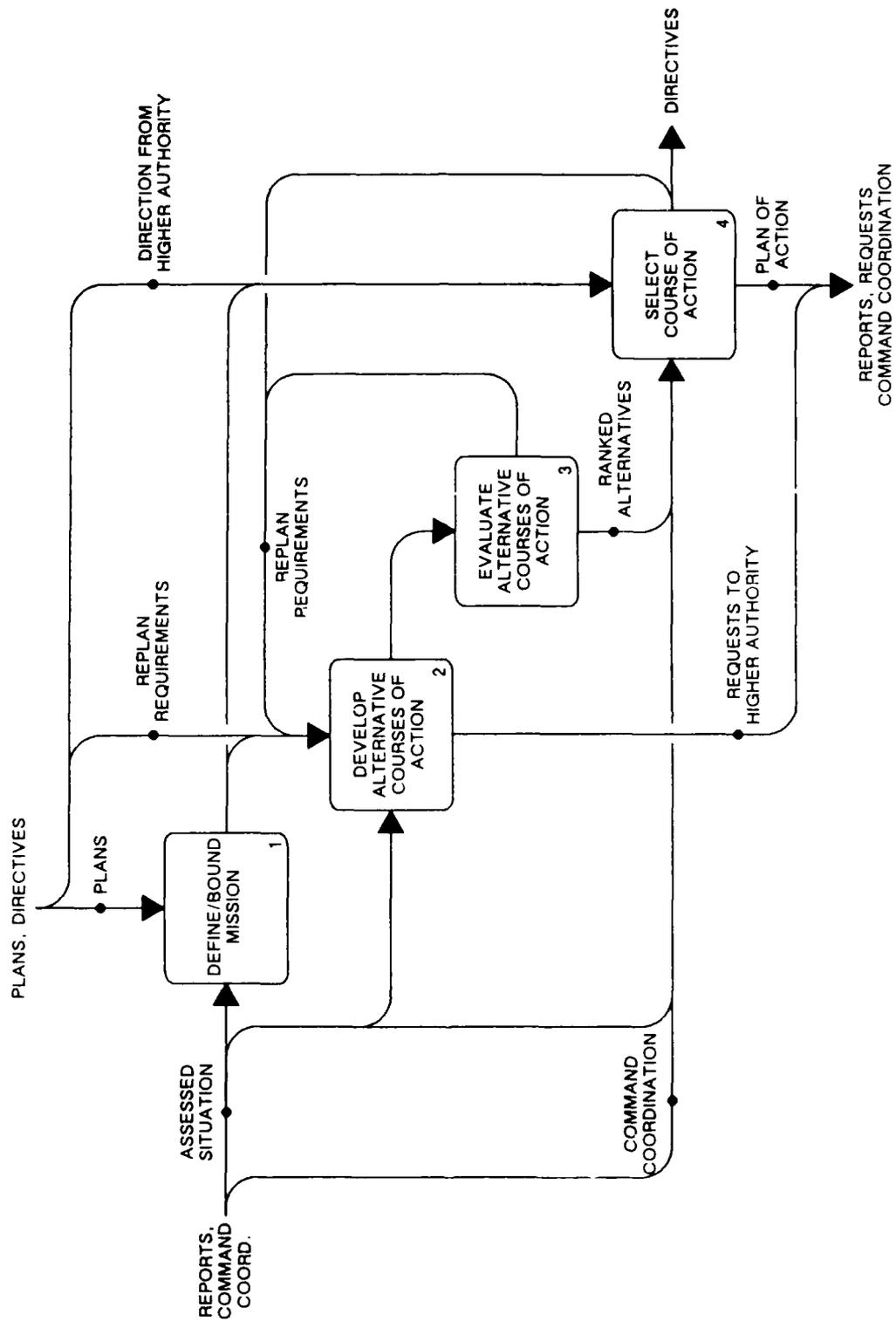


Figure 9. CP3: Develop/Evaluate alternatives and select course of action.

CP4: DIRECT ACTIONS

This function provides for the preparation and dissemination of plans, force direction orders, and support requests for the prescribed course of action and selected contingency. This involves the direction of force units, surveillance assets, weapons, force countermeasures, and nonwarfare operations. This function is detailed in Figure 10.

CP41, Prepare Directives, translates the course of action and contingency selected into force direction orders, plans, and requests for "external" command or nonorganic support. This involves the specification of details for the currently active evolution of the plan of action. Then the directions and requests are formatted appropriately.

CP42, Disseminate Directives, directs the distribution of plans, force direction orders, and support requests. This includes determination of appropriate distribution, identification of, and selection from among, communications means for each recipient, and distribution via selected means.

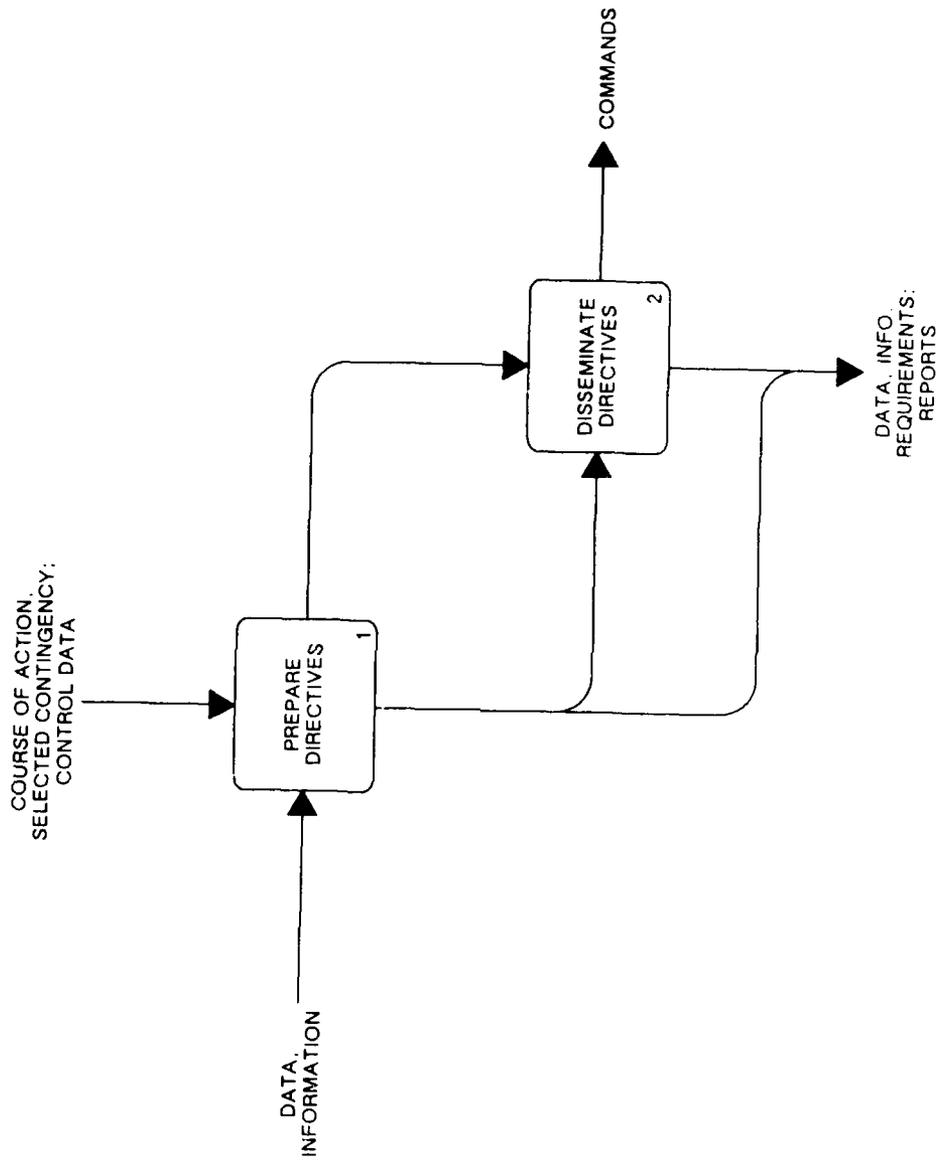


Figure 10. CP4: Direct actions.