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Decision-Making and Training Techniques for Command and Control Systems

Part III. A Model for Combat Order Production

Larry L. Lackey, Arthur J. DeLuca, and Trueman R. Tremble, Jr.

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June 1975

Prepared for

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1300 Wilson Boulevard
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The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

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Part III. A Model for Combat Order Production.

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(10) Larry L. Lackey, Arthur J. DeLucas and Trueman R. Tremble, Jr.

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Work Unit DECIDE

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SUMMARY AND CONCLUSIONS

MILITARY PROBLEM

Technological advances have increased the capabilities of commanders for successfully commanding and controlling the execution of tactical operations. These advances have also increased the complexity of command. The concept of the Combined Arms Tactical Training Simulator (CATTS) has been advanced as one means for meeting the requirement to train battalion commanders and selected members of their staffs to conduct tactical operations under the varied and complex conditions of the modern battlefield.

In order to develop this training simulation, the performances required of members of a command group during the execution phase of tactical operations had to be determined. The performance requirements could then serve as a basis for identifying the training experiences that would improve their performance in commanding and controlling ongoing tactical operations. One set of performance requirements involves the production of combat orders. Research on the activities of members of the battalion-level command group in the production of fragmentary orders is presented in this volume of the report.

RESEARCH PROBLEM

A principal objective of Work Unit DECIDE was to identify decision-making skills required to command and control ongoing tactical operations at the battalion level. One aspect of decision making in command and control settings is the production of combat orders. The objective of the research was to model the activities of battalion commanders and their staffs as they produce fragmentary orders during the execution of a tactical operation order, as an initial step for improvement in the production of combat orders.

METHOD

The model for the production of combat orders was derived by analyzing observations and impressions collected from three sources. Relevant literature and military experts provided background information about the activities involved in order production. Observations of an active duty Army infantry battalion during tactical field exercises conducted as part of an Operational Readiness Training Test provided additional data. Transcripts of communications generated during an indoor command post exercise designed for research purposes were also content analyzed.

RESULTS

The model of order production, which was developed, describes the various sequences of performances of a battalion commander or member of his staff as he is engaged in the production of a fragmentary order in combat.

Initially, three functions of the model were identified: Instigation, Decision Making, and Dissemination. Instigation involves the recognition of conditions that initiate behaviors leading to decisions. Decision Making concerns the selection of a course of

action to deal with the situation. Dissemination reflects the transmission of an order to the appropriate recipients.

Five processes which fulfill the three functions were then identified: Sensing, Evaluating, Considering, Deciding, and Communicating. Sensing involves the acquisition of information and the perception of an instigating condition. Evaluating involves an analysis of the instigating conditions relevant to mission accomplishment. Based on the analysis, activities in the process of Considering involve identification of effective courses of action. The process of Deciding refers to the selection of a course of action. Through the process of Communicating, the decision is disseminated to the appropriate recipients.

The result of the final process is an action or an order intended to effect either the internal or the external environment of the battalion. Sequences of performances representing each process were also developed and described.

CONCLUSIONS

(1) The developed model for the production of combat fragmentary orders has potential applicability to a range of combat situations. Further investigation of the model is needed to determine its validity and generalizability.

(2) This model, if validated and applied, can provide a basis for improving the effectiveness of the production of fragmentary orders.

(3) The model can contribute to the development of training materials and programs for improving production of combat fragmentary orders by assisting in (a) specification of performance requirements for members of the command group, (b) identification of requisite knowledges and skills, (c) selection of materials for inclusion in training programs, and (d) the design of training programs, especially training simulations.

PREFACE

This is the third volume of a report that describes work completed by the Human Resources Research Organization (HumRRO) in Work Unit DECIDE, Decision-Making and Training Techniques for Command and Control Systems. This volume reports on research on the production of combat orders. The research was conducted as part of the objective to identify decision-making skills required in commanding and controlling the execution of tactical operations.

Work Unit DECIDE was conducted at the Columbus Office of the HumRRO Central Division, Columbus, Georgia. Dr. Joseph A. Olmstead was Office Director at completion of the research. The principal participants in the research reported in this volume were COL (Ret) Arthur J. DeLuca, Dr. Larry L. Lackey, and Dr. Trueman R. Tremble, Jr., Work Unit Leader.

General military support was provided by the U.S. Army Infantry Human Research Unit, Fort Benning, Georgia, of which LTC Robert G. Matheson was Chief at completion of the work. First Lieutenant Ray S. Costner participated as a data collector during the field study. Specialists Wayne Carpenter and James M. Tripp contributed to the research on decision making especially through their work during an earlier exploratory phase.

HumRRO research for the Department of the Army under Work Unit DECIDE was conducted under Contract DAHC19-73-C-0004. Army training research is conducted under Army Project 2Q062107A745. The DECIDE work was conducted under the sponsorship of the U.S. Army Research Institute for the Behavioral and Social Sciences, with James Baker serving as the technical monitor.

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INTRODUCTION

MILITARY PROBLEM

Technological advances have increased the capabilities of commanders for successfully commanding and controlling the execution of tactical operations. These advances have also increased the complexity of command. The concept of the Combined Arms Tactical Training Simulator (CATTS) has been advanced as one means for meeting the requirements to train commanders and selected members of their staffs to conduct tactical operations under the varied and complex conditions of the modern battlefield.

As the concept of CATTS has evolved, training personnel assisted by a computer system would create simulated tactical situations within which a command group would cope with stresses and problems that realistically approximate those experienced during participation in actual combat. It has been expected that participation in this type of training simulation would improve both the command group's appreciation of conditions characterizing the modern battlefield and their ability to fight under such conditions.

In order to develop this training simulation, it was necessary to determine the performances required of members of a command group during the execution phase of tactical operations. The performance requirements could then serve as a basis for identifying the training experiences that would improve their performance in commanding and controlling ongoing tactical operations. One set of performance requirements involves the production of fragmentary orders. Research on the activities of members of battalion-level command groups in the production of fragmentary orders during combat is presented in this volume of the report.

RESEARCH PROBLEM

A principal objective of Work Unit DECIDE has been to identify decision-making skills required to command and control ongoing tactical operations. One aspect of decision making in command and control settings is the production of combat orders. After coordination with the sponsor of the Work Unit, arrangements were made to focus part of the decision-making research of Work Unit DECIDE on the production of orders during combat. The purpose of such research would be to contribute to improvement in the way in which combat orders are produced.

The research reported in this volume represents an initial step required for improvement in order production. The objective of the research was to identify the activities of battalion commanders and members of their staffs as they produce fragmentary orders during the execution of tactical operation orders.

BACKGROUND

Work Unit DECIDE has been concerned with the commanding and controlling of ongoing tactical operations at the battalion level. So that the earlier work on decision making could serve as a background, the research on combat orders was focused on the production of orders during the execution phase. An examination of the literature related

to order production suggested that, compared to production of tactical orders in the planning phase, the activities involved in producing fragmentary orders during the execution of a combat operation are relatively unspecified. Consequently, the research on order production was planned to specify more precisely the activities involved in producing the latter type of orders.

According to FM 101-5,[1] an order is a form of oral or written communication which conveys information that governs action. There are five types of combat orders: operation orders, administrative orders, standing operating procedures, fragmentary orders, and warning orders:

- A complete *operation order* governs the conduct of an entire tactical operation. It provides for the coordinated action that is planned to implement a commander's decision about the conduct of the operation.
- *Administrative orders* pertain to the administrative support required for the command. Combat service support is covered by administrative orders.
- *Standing operating procedures* are developed in response to routine events and prescribe methods for dealing with such events.
- *Fragmentary orders* are issued to convey brief, specific, and timely instructions of immediate concern to one or more subordinate units. Fragmentary orders could consist of extracts from more detailed orders, change existing orders, or contain new instructions.
- *Warning orders* provide advance notice of an action or order that will be issued in the near future. A warning order provides a subordinate element the opportunity to prepare for future actions.

It is possible to describe a combat operation in terms of two general phases. The first is the planning phase, during which the battalion commander and his staff engage in activities that result in a plan for accomplishment of a tactical mission. After development, the plan is later published or issued as a tactical operation order which assigns missions to subordinate elements and also provides direction about procedures for accomplishing the assigned missions.

The second phase of a tactical operation is the execution phase, during which subordinate elements attempt to accomplish their missions as directed in the operation order, and the commander and his staff take measures to enforce or change the operation order as required by developments in the tactical situation. One such measure is the fragmentary order. That is, through the development and issuance of fragmentary orders, the commander and members of his staff affect the tasks assigned to subordinate elements and, thereby, provide immediate directions for actions that support mission accomplishment.

The operation order, thus, is developed during the planning phase and defines the missions and implementing procedures for mission accomplishment. As the order is implemented during the execution phase, fragmentary orders are produced as means for controlling the immediate activities of subordinate elements, thereby ensuring the effectiveness of the implementation of the order and mission accomplishment. It should be noted that warning orders are also used in the execution of a tactical operation. Compared to fragmentary orders, however, warning orders are used to prepare elements for future actions. They could bear on the current mission or a new one which requires development of an operation order while engaged in the execution of the current one.

[1] U.S. Department of the Army. *Staff Officers Field Manual, Staff Organization and Procedures,* Field Manual 101-5, Washington, 1972.

Based on studies of the flow of information during the development of a plan for tactical operation[1] and on descriptions of command and staff activities in such military documents as FM 101-5, it is possible to infer the performances required to produce a tactical operation order. Except for such guidelines as the estimate of the situation and descriptions of the functions and duties of command and staff officers, however, relatively little information appears to be available about the activities involved in the production of fragmentary orders during combat.

In FM 101-5, for example, the sequence of command and staff actions in making and executing decisions with respect to mission accomplishment are presented. The following 10 actions are enumerated: (a) commander's analysis of the mission, (b) collection of information about the situation, (c) preparation of planning guidance by the commander, (d) development of staff estimates, (e) development of commander's estimate, (f) development of commander's decision, (g) formulation of the concept of the operation by the commander, (h) preparation of plans by the staff, (i) approval of the plan by the commander, and (j) publication of the plan as an operation order. The activities required to implement the decision are then described by a single term, "supervision." According to the manual, supervision is a "continuous action" that is conducted on the basis of the commander's decision and concept of the operation. However, the activities involved in supervision are not described.

The research described in this part of the report was designed to provide information that could contribute to improvement of the production of combat orders by identifying the activities of battalion commanders and members of the staffs (command groups) in the production of fragmentary orders in combat. The research approach involved development of a model that describes the production of a fragmentary order by a member of the command group.

The model was also intended to be applicable to the production of "actions". As used in this report, the term "action" refers to those verbal communications between members of the command group that direct one or more members to perform specified tasks. As defined earlier, fragmentary orders are directed to subordinates. In a general sense, therefore, the model was intended to be applicable to those on-the-spot communications—actions and fragmentary orders—that serve to direct the behaviors of one or more other individuals.

Unless an explicit distinction is drawn in the text, the term "order" will be used to refer to both fragmentary orders and actions. The scope of the research was limited to the development and distribution of orders. That is, the study did not address order production in terms of either the activities associated with implementation of the order or the direct effects of those activities on the tactical situation.

[1] T.G. Ryan. *Studies of Tactical Military Decision Making: II: An Information Network Aid To Scenario Development*, Research Study 69-11, U.S. Army Behavioral Science Research Laboratory, September 1969.

METHOD

This part of Work Unit DECIDE was conducted to develop a model for the production of combat orders. In particular, the research was focused on the production of orders during the execution of battalion-level tactical operations. The initial step in development of the model involved collection of data on order production. The data were then analyzed, and the components of the model were identified.

DATA COLLECTION

General impressions about the activities involved in order production were obtained from literature on decision making, military documents, and discussions with experienced military officers. These impressions were augmented by observations of performances of commanders and staff officers during simulated tactical operations. One set of observations was made during tactical exercises conducted in the field as part of an Operational Readiness Training Test (ORTT). Other observations were made by content analyzing transcripts of communications occurring during indoor command post exercises designed and implemented as part of another research project.

Field Exercises

Description of Exercises

One set of observations was made during tactical field exercises conducted as part of an ORTT for an infantry battalion. An ORTT is administered to evaluate a unit's readiness status in terms of mission training. The test is normally written by a headquarters two levels higher than the unit being tested and is tailored to the resources, requirements, and mission of that unit.

The ORTT which was observed included the planning and execution of both defensive, offensive, and airmobile tactical missions. The field exercises were structured according to scenarios that outlined the events planned for the exercises. These events were unfolded by controllers who directed the activities of simulated aggressor forces. The execution phases of the defensive operation and the attack were observed.

Observation Procedures

Three researchers observed the activities of the battalion commander and members of his staff during the execution of the two operations. During the defense, two researchers were located in the battalion tactical operations center in order to observe the interactions especially among the following members of the command group: the battalion commander, operations officer, intelligence officer, and fire support coordinator. The third researcher, a military officer, monitored the battalion command radio network which provides for radio communications between members of the command group and the maneuver elements of the command. During the exercise involving the attack, all three researchers monitored the radio network because of the mobility characteristic of an attack operation.

Before observing the exercises, the researchers had studied the scenarios. A data collection plan was also prepared. According to the plan, the researchers were to develop

general observations and impressions about order production. To the extent possible, a description of each interaction between the individuals observed was to be recorded in terms of: (a) the participants (initiator and recipient); (b) type of communication (providing information; seeking information; instructions/orders/commands; providing feedback; seeking feedback); and (c) topic of communication. The fluidity, multiplicity, and rate of interactions did not afford the opportunity to collect this information about each interaction.

Research Exercise

Description of Exercise

As part of an earlier HumRRO research project, Work Unit FORGE,[1] an indoor one-sided command post exercise (CPX) was designed and implemented in order to study the relationship between organizational processes and organizational effectiveness. In the study, 10 groups of military officers were assembled and participated as the battalion-level and company-level officers of a light infantry battalion engaged in combat operations in Southeast Asia. The CPX was structured according to 128 problems, which were presented in a standard and systematic fashion for each group.

During the CPX, the communications of the participants were recorded. Typed transcripts of the communications relevant to each problem were made for each group. In the original study, the transcript of a problem was analyzed and scored, first for the effectiveness with which a group has performed the organizational processes, and second, for organizational effectiveness in terms of how well the group had coped with the problem represented in the transcript. One of the processes, it should be noted, was decision making.

A sample of the FORGE transcripts was content analyzed in order to collect additional data about order production. The sample was drawn from the transcripts of the two groups with the highest and the two groups with the lowest mean organizational-effectiveness scores. The sample consisted of those transcripts that included a decision made by the participants who had assumed the role of the battalion commander during the FORGE simulate. A total of 22 transcripts were analyzed.

Content Analysis Procedures

The transcripts were content analyzed by two researchers. They sought to identify such data as: (a) situational conditions under which an order (decision) was made, (b) factors that appeared to have influenced order production, (c) processes involved in order production, (d) errors associated with order production, and (e) differences in the order-production performances of the two effective and the two less effective groups during FORGE.

DATA ANALYSIS

The observations and impressions formed from the relevant literature, the field exercises, and the FORGE CPX were analyzed in the fashion described in this section. Impressions obtained from the literature were first discussed with experienced military officers. They provided suggestions about and examples of the decision-making activities

[1] Joseph A. Olmstead, Harold E. Christensen, and L.L. Lackey. *Components of Organizational Competence: Test of a Conceptual Framework*, HumRRO Technical Report 73-19, August 1973.

of the members of a command group. In this manner, the functions involved in order production, presented later, were derived and then again reviewed with these officers at a later time. These activities provided a framework for development of the model.

The observations and impressions collected during the field exercises (ORTT) were discussed by the researchers, and differences among the three sets of data were reconciled. The observations and impressions were then used to tentatively identify the processes involved in the production of combat orders. The researchers also discussed the types of activities of the members of the command group that were associated with the processes.

The information obtained from the transcripts of the FORGE CPX served two purposes. First, the material in the transcripts was examined to determine whether it supported the processes that had been tentatively identified earlier. Second, the transcripts were used to modify and add to the processes.

After the processes were specified, they were examined to detect inconsistencies and to ensure comprehensiveness and agreement with current literature and military doctrine. Each process was then analyzed in detail to determine the types of activities that would be necessary if the process was performed effectively. This analysis resulted in the categories of activities presented in the model. The processes, their interrelationships, and the categories of activities were next discussed with experienced military officers. On the basis of these discussions, the model was refined.

RESULTS

The principal result of this portion of Work Unit DECIDE consists of a model of order production. The model is limited to the production of fragmentary orders and actions during the execution of combat operations. The model was developed after the research staff had monitored actions of battalion-level officers during the conduct of an ORTT and had analyzed transcripts of interactions during stimulations of a battalion engaged in combat operations (FORGE). Before the model is presented, selected observations from the ORTT and FORGE will be summarized.

SELECTED OBSERVATIONS AND IMPRESSIONS

Observation of a dynamic and complex operation like an ORTT can be quite informative as to the activities that comprise the operation. The data collected from the ORTT and FORGE transcripts as part of Work Unit DECIDE, however, were necessarily impressionistic and somewhat unsystematic due to the preliminary nature of the data-collection techniques and procedures used. For this reason, only those observations that affected the development or amplification of the model of order production will be summarized. These summaries are:

(1) The battalion commander often functioned in an advisory, guiding, and consultative role. Staff officers, having received guidelines from the commander on the concept of the operation, standing operating procedures (SOPs), and so on, often appeared to make and issue fragmentary orders within their areas of responsibility without having directly consulted the commander. The production of such orders by staff officers seemed to represent an effective means for coping with the diverse and multiple problems occurring during combat without necessarily usurping the commander's responsibility or violating his prerogatives. That is, knowledge of available guidelines seemed to enable staff officers to select courses of action congruent with the commander's concept of the operation and still respond to problems in a timely manner regardless of the commander's availability.

(2) SOPs and other guidelines seemed to serve as decision rules. That is, staff officers often seemed to refer problems to known guidelines and then to select solutions congruent with the guidelines. Such guidelines, thus, seemed to limit as well as define acceptable courses of action.

(3) The close proximity of the command group within a Tactical Operations Center (TOC) appeared to create conditions that could affect the order production process. Information exchanges, for example, could be facilitated by the proximity of personnel within the TOC. Individuals not directly involved in such an exchange could gain information by overhearing a conversation. Such conditions also afforded the opportunity for members of the command group to voluntarily contribute to the solution of a problem. However, it was noted, that information processing could be adversely affected due to information overload, distraction from relevant information, reduced accessibility of information, and the ineffective storage or retrieval of information.

(4) The major proportion of verbal interaction either among members of the command group or between the command group and other elements did not directly consist of orders. Rather, the major proportion seemed to involve eliciting, transmitting, or clarifying information.

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(5) It appeared as if different types of conditions could occasion or instigate a fragmentary order. The following types of conditions were among those observed: (a) receipt of a report about a problem situation, (b) an observed or reported deviation from specified guidelines, and (c) direct observation and identification of a problem. The observations of this study suggested that staff officers more frequently developed fragmentary orders in response to either of the first two conditions and that the battalion commander produced orders in response to any of the conditions.

(6) Verbal orders may be transmitted in a fashion that could reduce their effectiveness. On several occasions, for example, orders were communicated in a fragmentary manner within the context of information not directly pertinent to the order itself.

(7) Messages transmitted among several individuals (or levels of the organizational structure) were often transformed so that they did not completely or accurately reflect the original message. The modifications observed seemed to reflect such factors as the frame of reference and background of the communicator or his primary concern when handling the transformed message.

MODEL OF COMBAT ORDER PRODUCTION

The observations and impressions formed from the ORTT and FORGE transcripts served as background for a rational analysis and identification of activities involved in the production of fragmentary orders during the execution phase of a combat operation. That analysis has resulted in a model that systematically describes activities involved in order production.

Overview of Model

The model of order production describes various performances of the commander or selected members of his staff as he is engaged in the production of a fragmentary order in combat. Depicted in Figure 1, the model describes order-production activities in terms of five components: (a) functions, (b) processes, (c) categories of activities, (d) inputs, and (e) outputs or results of order production performance. Each of these components will be reviewed in this section; the processes and categories of performances are presented in greater detail in a later section. For convenience in presentation of the model, the individual involved in the production of an order will be referred to as an information processor, or IP.

Functions

According to the model, three functions are sequentially fulfilled when an order is produced. The first function, referred to as Instigation, involves the recognition or detection of conditions that initiate behaviors leading to decisions. Conditions that will instigate decisions are characterized by a discrepancy either between the current and desired (ideal) conditions or between projected and ideal conditions. A discrepancy can arise from either or both of two sources. First, it could be command-imposed; in these cases, the discrepancy could be attributed to a change in the IP's definition of ideal conditions. Second, a discrepancy could be situation-generated, resulting from a change in the situation away from ideal conditions.

The second function consists of those activities involved in the identification and eventual selection of a course of action for dealing with the discrepancy. This function is labeled Decision Making.

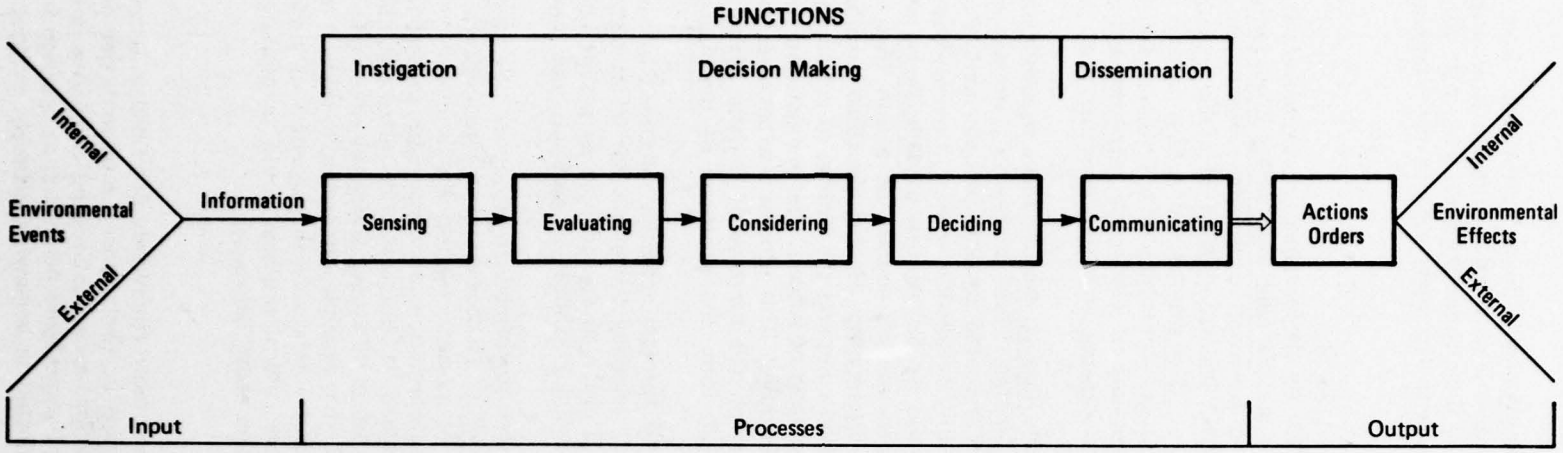

Figure 1. **Model of the Production of a Combat Order**

Decisions about actions for coping with discrepancies do not necessarily lead to orders. That is, orders are produced only if a decision is encoded into media appropriate for communication and if the encoded decision is then communicated. The third function, referred to as Dissemination, involves those activities that result in the communication of the decision.

Processes

The three functions just described are fulfilled by performances that represent five processes identified in the model. These processes are: Sensing, Evaluating, Considering, Deciding, and Communicating. In the model, orders are based on decisions about courses of action for dealing with recognized discrepancies. The recognition of a discrepancy, therefore, is an initial occurrence in the production of a combat order. The process of Sensing subsumes those performances involved both in acquisition of information and in the detection of a discrepancy based on the information. The model suggests that in terms of decision making and order production, sensing activities continue until an instigating condition has been recognized.

After the detection of a discrepancy through Sensing, performances regarding the discrepancy center on the function of Decision Making. Three successive processes are involved. The first is Evaluating. The activities represented by this process involve an analysis of the discrepancy to determine its criticality to mission accomplishment. Based on the results of this analysis, activities represented by the process of Considering are undertaken. These activities result in the identification of courses of action that, if enacted, would likely minimize or eliminate the discrepancy. Having identified possible actions for dealing with the discrepancy, the IP then compares the courses of action and selects the one perceived to have the greatest likelihood of success. The comparision and selection performances comprise the process of Deciding. This process also involves the identification of the appropriate recipient of an order. The function of Decision Making, thus, is modeled in terms of those activities that form the processes of Evaluating, Considering, and Deciding.

Dissemination, the third function, is achieved through activities subsumed by the process of Communicating. These activities include selecting the means for transmitting the decision, coding information, distributing the decision as an order or an action, and reviewing the transmitted order to obtain feedback about its receipt and current appropriateness.

The model suggests that the processes are performed in sequence: Sensing, Evaluating, Considering, Deciding, and Communicating. Moreover, upon communicating an order, the IP re-initiates sensing activities. As presented later, the sequences of activities in a process could be interrupted so that information processing with respect to a particular item is ended before an order is produced. It should also be noted that the model is not intended to imply that the behavior of an IP would always be observed to conform with the sequences specified in the model. It is possible, for example, that an IP may have to cope with several discrepancies within a relatively short period of time. Under such conditions, the recognition of a more critical problem could temporarily suspend activities related to the solution of a problem identified earlier.

Categories of Activities

In a later section of this report, each process is more completely described in terms of the sequences of categories of activities comprising it. Each process represents one or more sequences of behaviors. Moreover, the performances comprising a process are modeled as categories of activities (i.e., in terms of generalized behaviors) as opposed to specific behaviors. The same process could be reflected in somewhat different performances appearing in somewhat different sequences.

Input and Output

Information about environmental events is an implied component of the model. Such input could describe events in the environment either external (e.g., enemy movement) or internal (e.g., own casualties) to the battalion. Information about an event could be directly acquired by the IP; alternatively, he could receive it from other individuals through oral or written reports.

The output or result of the processes in the model is a fragmentary order or action. It would be possible to define this output in terms of the effects that occur when an order is acted upon, obeyed, or followed. In the model, however, the activities that occur between receipt of an order and its enactment are not comprehensively described.

The following section presents more detailed descriptions of the processes and the categories of activities subsumed by each. Flow charts which show alternative sequences of activities are included to increase the ease of following the narrative descriptions of each of the categories of activities.

Processes and Categories of Activities

A flow chart showing the categories of activities is presented for each of the processes. In each of the flow charts (Figures 2-6), each category of activities is numbered to facilitate association of the activities depicted in the chart with their text description. The categories of activities have also been numbered consecutively across the five figures. To increase the continuity of the presentation of the model, each figure, in turn, references the succeeding process. In addition, the last critical activity of the preceding process is summarized in the figure for the next process (except for Sensing).

Differences in the activities of the battalion commander and those of selected members of his staff are noted in the figures, in the arrows that reflect the sequences of activities. These arrows are keyed in the following way: (a) a single line arrow shows the activities of the battalion commander, (b) a dashed line arrow is used for the battalion staff activities, and (c) a double line arrow indicates the activities of any member of the command group. Inspection of the figures suggests, however, that few distinctions between a commander and his staff are represented in the model. This convergence underscores a point made earlier and incorporated in the model: although a battalion commander has responsibility for the success of his organization, the performances of the commander and other members of the command group in the production of fragmentary combat orders are similar in many respects.

Sensing

The activities that take place as part of the process of Sensing fulfill the function of Instigation. In fulfilling this function, sensing activities also set the conditions for the occurrence of all successive processes in the model. These activities involve the acquisition of information. In addition, Sensing includes the interpretation of information so that (a) relevance of the information to mission accomplishment is assessed and (b) discrepancies between observed conditions—present or anticipated—and ideal conditions are detected. Recognition of a discrepancy terminates Sensing with respect to that discrepancy; activities grouped under the process of Evaluating are then initiated. The categories of activities that form the process of Sensing are presented in Figure 2.

The initial category of activities (Category 1) in the process of Sensing is the same for an IP regardless of his position as commander or staff officer. These activities involve the acquisition of information about the internal and external environments of the battalion. This initial category can be represented by any set of information-acquisition activities. These activities may be active, in the sense that the IP seeks out information

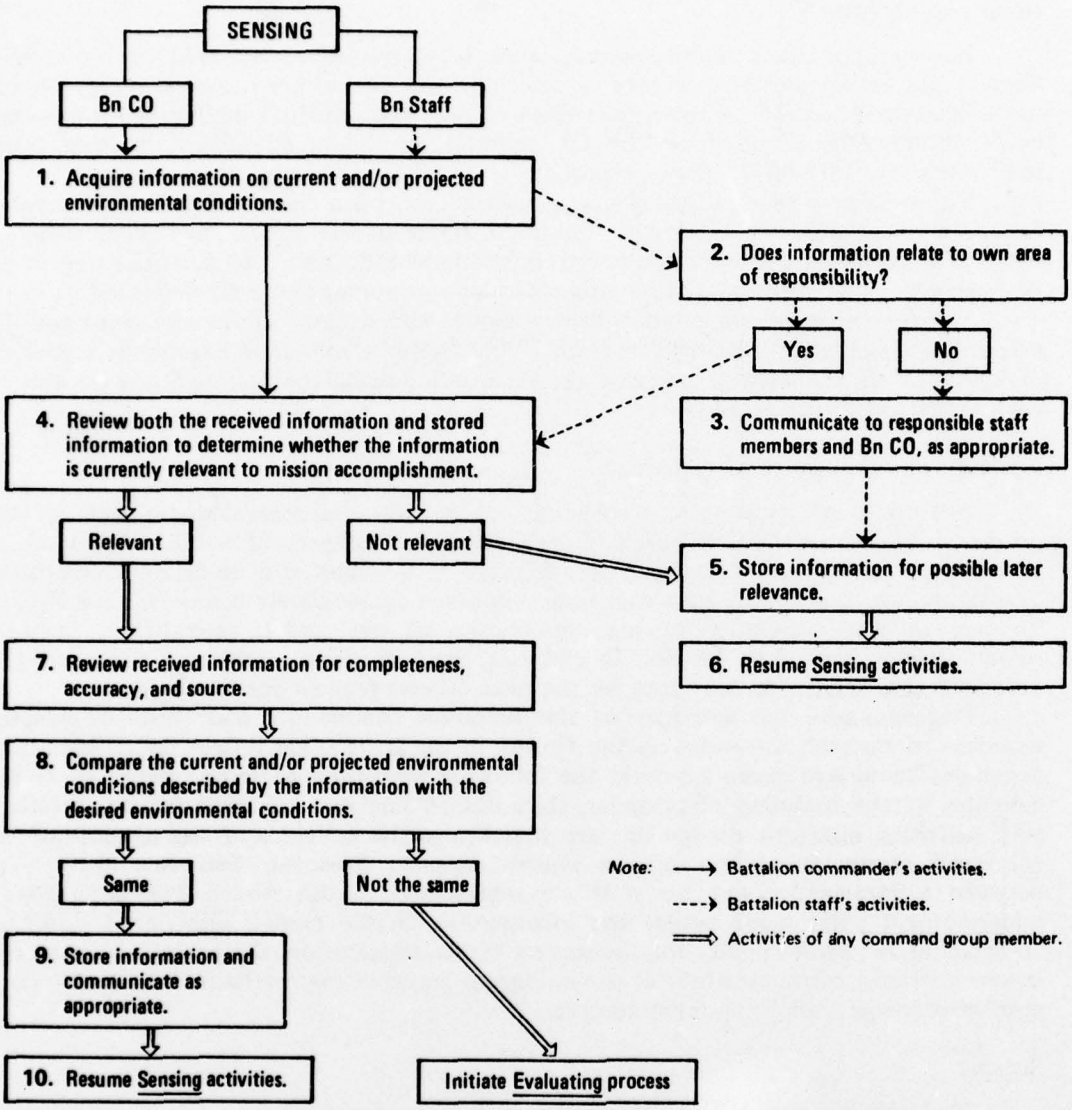

Figure 2. **Categories of Activities in Sensing**

on his own initiative, or passive, in that the IP receives information transmitted on the initiative of someone else in the organization.

If the IP is a staff member of the command group, he assesses the acquired information to determine whether it falls within the assigned area of his staff position (Category 2). Depending upon the outcome of this assessment, his Sensing activities would differ from those of the battalion commander. That is, if the information does not pertain to his area of responsibility, the IP communicates it to the appropriate staff officer or to the commander if it is judged to be relevant to him (Category 3). The IP would then store the information for possible use at a later time (Category 5).

If the staff officer determined that the information is directly relevant to his area of responsibility, his basic sensing activities would not differ from those of the

commander. That is, the IP reviews it to determine whether it is currently relevant to mission accomplishment (Category 4). The review should take into account stored information, since it provides a framework for the identification both of events in the present situation and the development of trends through time. Information that is not perceived to be currently relevant is stored for later retrieval and use (Category 5). When information is stored due to its lack of relevance to either the IP's area of responsibility or the current situation, the IP re-initiates information-acquisition or sensing activities (Category 6).

If it has been determined that the information is relevant, the IP engaged in activities that result in a more thorough interpretation. He first seeks to determine and, if necessary, insure the completeness and accuracy of the information (Category 7). These activities may involve additional interaction with and validation of the source of the information. After the completeness and accuracy of the information are established, the current or projected environmental conditions (observed conditions) it represents are compared with the desired environmental conditions (Category 8). The outcome of the comparison activities is critical to order production. Any difference between observed and desired conditions constitutes a discrepancy.

If a discrepancy is recognized, activities representing the first process in Decision Making, Evaluating, are initiated. If no discrepancy was detected, the information would be stored for later use and communicated to other positions in the organization as appropriate (Category 9). Sensing activities are also resumed (Category 10).

Evaluating

The process of Evaluating is initiated after the IP recognizes a discrepancy. This process, which partly fulfills the function of Decision Making, involves categories of activities (see Figure 3) related to assessing and appraising the discrepancy. Activities grouped under the remaining processes in the model are especially dependent upon two products of evaluating: the identification of critical factors associated with a discrepancy and a judgment about the criticality of the discrepancy itself.

In the model, no explicit distinctions are drawn between the evaluating activities of the commander and the staff officer (see Figure 3). Upon detecting a discrepancy, the IP engages in activities (Category 11) to confirm and validate his earlier interpretation of the information that represents the discrepancy. These activities may involve discussion with other members of the organization to confirm the earlier interpretation and/or to resolve any ambiguity. The IP's activities then center on specifying critical factors associated with the discrepancy (Category 12). Critical factors are a subset of the factors present in the tactical situation and consist of factors that (a) contributed to or caused the discrepancy or (b) could be manipulated to cope with the discrepancy. This specification both increases the IP's understanding of the discrepancy and, as presented later, provides a basis for identifying means for coping with it.

The criticality of the discrepancy for mission accomplishment is then evaluated (Category 13). In making this evaluation, the IP takes into account the various aspects of the discrepancy such as (a) its type (e.g., mobility), (b) its sources (e.g., heavy enemy resistance, lack of fire support), and (c) the degree of the discrepancy (e.g., how far is the element from where it should be). The criticality of the discrepancy is then judged in terms of the extent to which the discrepancy is perceived to impact on mission accomplishment. The model represents three types of judgments that may be made about the criticality of the discrepancy: (a) not critical, (b) uncertain, or (c) critical. The types of activities pursued by the IP vary with the type of judgment made about criticality.

If the discrepancy is evaluated as noncritical to mission accomplishment, the information is stored for later retrieval and use (Category 14). With respect to this

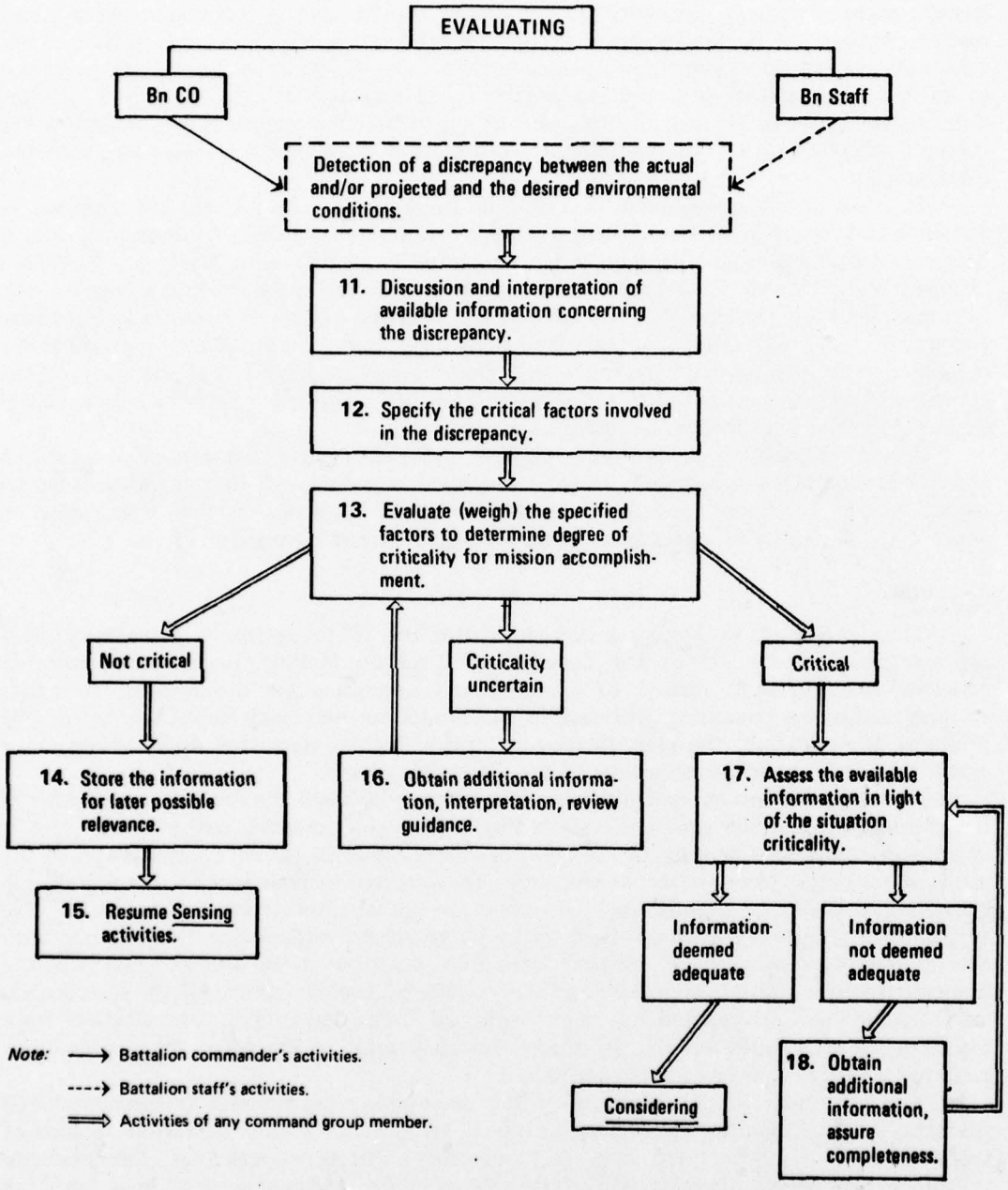

Figure 3. **Categories of Activities in Evaluating**

information, further activities involved in the production of an order are not undertaken and the IP re-initiates Sensing (Category 15) unless other information is currently being processed through operation of the model.

A judgment of uncertainty about the criticality of the discrepancy arises under such conditions as: (a) the IP lacks necessary experience, (b) the IP has failed to interpret the available information, or (c) the IP has not applied organizational guidance appropriately.

According to the model, the IP engages in information-acquisition activities that tend to offset these conditions (Category 16). Such activities continue until the IP is able to reduce his uncertainty and determine whether the discrepancy merits further attention.

The IP continues to process the information if he has judged it to be critical. Activities again center on an assessment of the information that serves to ensure its adequacy. This category of activities (Category 17) was incorporated in the model in order to emphasize that all available information should be reviewed in terms of the situation. If the information is not judged to be adequate, additional steps should be taken to acquire information that will offset any inadequacy (Category 18). After adequate information has been obtained, the process of Evaluating is terminated, and categories of activities representing Considering are initiated.

Considering

The process of Evaluating focused on specifying the critical factors associated with a discrepancy and then evaluating the criticality of the discrepancy itself. These data form the basis of the activities undertaken as part of the second process involved in Decision Making, Considering. The categories of activities that represent Considering (see Figure 4) involve the identification of critical factors that can be controlled. Courses of action that could minimize or eliminate the discrepancy are then formulated. In the model, the categories of activities for Considering do not vary with the organizational position of the IP.

As the initial category of activities (Category 19), the IP assesses the critical factors that contribute to the discrepancy. As part of the assessment, the extent to which the factors can be controlled by the organization is determined. The term "control" is used to refer to the inability to change, alter, or manipulate a factor. After having determined the controllability of factors contributing to the deficiency, the IP then reviews available guidance on how to deal with the controllable factors (Category 20). Such guidance may take the form of SOPs, the commander's concept of the operation, tactical doctrine, policies, and previous instructions. The IP's subsequent activities depend upon his appraisal of the sufficiency of the available guidance.

If the available guidance is insufficient, the IP would then determine whether additional guidance can be found (Category 21). In the execution phase of a combat operation, the multiplicity of events would be likely to limit the amount of time that could be invested in locating additional guidance. Therefore, although the IP felt that the available guidance was insufficient, a decision could be required concerning seeking such additional guidance (Category 22).

Consequently, if sources of additional guidance are not readily available, the criticality of the discrepancy is likely to motivate the IP to proceed with the activities involved in the production of a combat order (see Category 27, described later) without having obtained additional guidance. If a source of further guidance is readily available, the IP would be more likely to consult it (Category 23). Depending upon the source of guidance, the IP may or may not retain responsibility for coping with the discrepancy (Category 24). If he continues to participate in the resolution of the discrepancy, the categories of activities described later would be undertaken (Category 27). If he is barred from further participation, the IP would store the information acquired up to this point (Category 25) and would then resume Sensing activities (Category 26).

If the initial guidance for coping with the deficiency is sufficient, the IP seeks to determine who or what position in the organization is able to control the critical factor already identified as controllable (Category 27). That is, examination of these factors would probably reveal that, due to his position or capabilities, the IP has different degrees of control over different factors. Some factors, for example, may be completely under the control of the IP; on others he may have control only with the consent of a

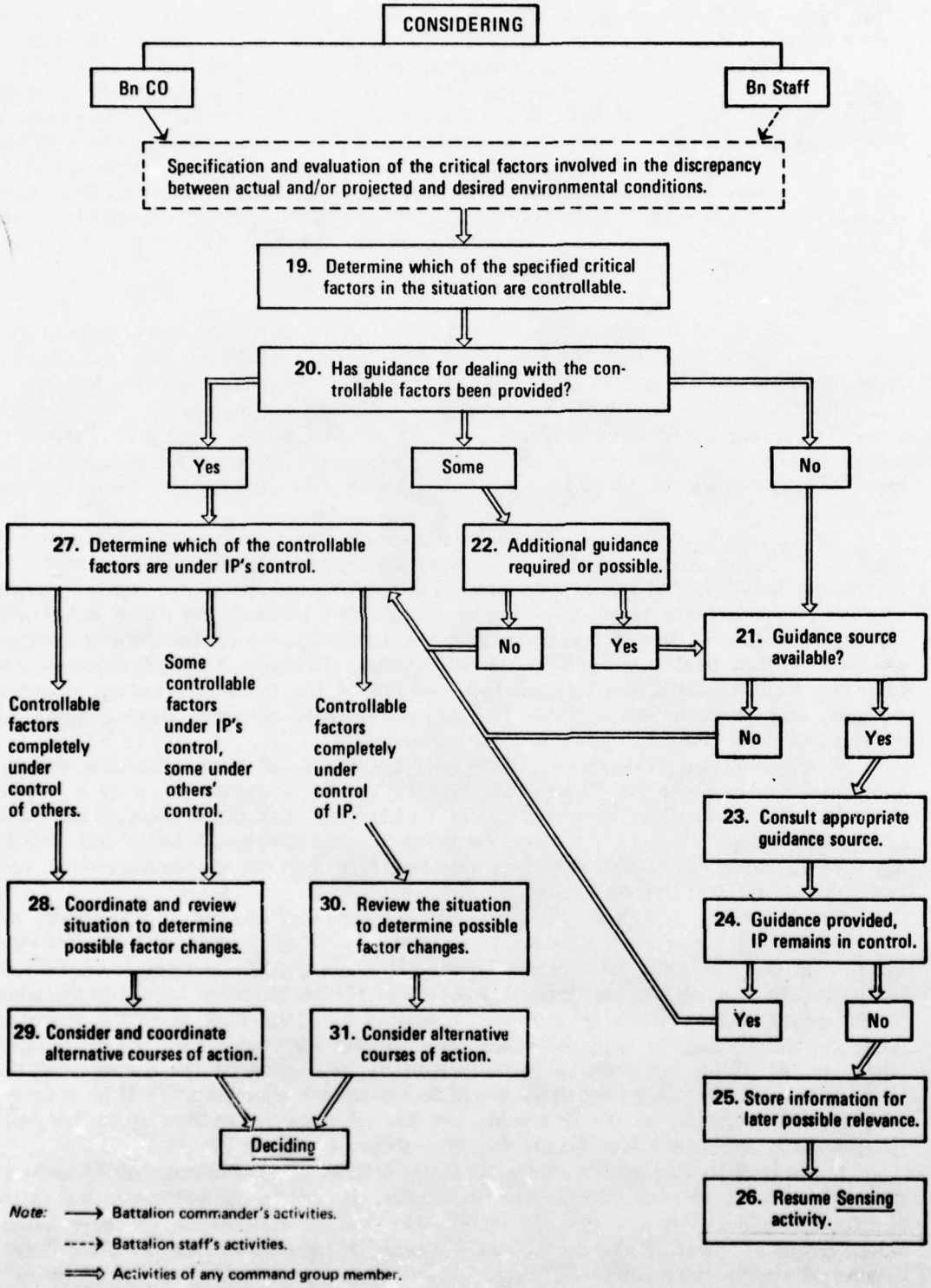

Figure 4. **Categories of Activities in Considering**

higher-ranking officer. Only the commander will have control over another set of factors. The succeeding activities of the IP are dependent upon his appraisal of his control over the critical factors.

The model represents three types of situations differentiated by degrees of control of the IP over critical factors. In one type of situation, all factors are under the control of others. In the second type, control is distributed between the IP and other individuals in the organization. In both of these types of situations, a substantial level of coordination needs to be achieved with those having control over the factors critical to solving the discrepancy. In particular, the IP needs to review the situation with other individuals having control in order to determine what factor changes can and may be made (Category 28). Courses of action that would potentially affect the critical factors and thereby minimize or offset the detected discrepancy are then considered (Category 29). In doing so, the IP should coordinate with those having control over the critical factors involved in the courses of action under consideration.

The third type of situation in the model occurs when the IP has control over all of the controllable factors critical to the discrepancy. In this situation, he also engages in activities in which the situation is reviewed in order to identify possible changes in them (Category 30). However, since the IP has control over the factors, the necessity to coordinate with other members of the organization is somewhat reduced. Finally, the IP would formulate courses of action for dealing with the discrepancy through changes in the factors (Category 31).

In all three types of situations it is likely that at least some of the specified critical factors in the situation may be considered uncontrollable from the viewpoint of the IP (e.g., if he has REDEYE missiles, enemy air may be considered a controllable factor; otherwise, it may be viewed as uncontrollable). All courses of action considered that might eliminate or minimize the identified discrepancy should allow for such uncontrollable critical factors to the greatest possible extent.

Upon formulating possible courses of action, the process of Considering is terminated. The function of Decision Making is then fulfilled through the categories of activities that represent the process of Deciding.

Deciding

The process of Deciding takes place after the IP has identified potentially effective courses of action. The activities that represent Deciding (see Figure 5) involve selecting one of the courses of action. According to the model, selection is based on the IP's expectations, developed through past experience and training, that the selected actions would improve the discrepancy in the environment.

The initial activities in the process of Deciding involve appraisal of the potential effectiveness of each of the courses of action that were identified as part of Considering (Category 32). That is, the IP examines the alternative courses of action and assigns a probability of success to each. In the model, "Probability of Success" refers to the IP's subjective or personal expectations about the likely effectiveness of actions in minimizing or eliminating a discrepancy.

The probability of success assigned to a course of action reflects rules that the IP has developed through experience. That is, through instruction, training, and his past personal experiences, the IP has developed rules or concepts about the relationships between environmental factors and the actions available to him. Rules concern both the effects of the IP's actions on conditions in the environment and the conditions that could modify such relationships. In assigning probability of success, the IP relies upon such rules. It is assumed in the model that (a) the activities in the processes of Evaluating and Considering would enable the IP to identify environmental factors that would affect the

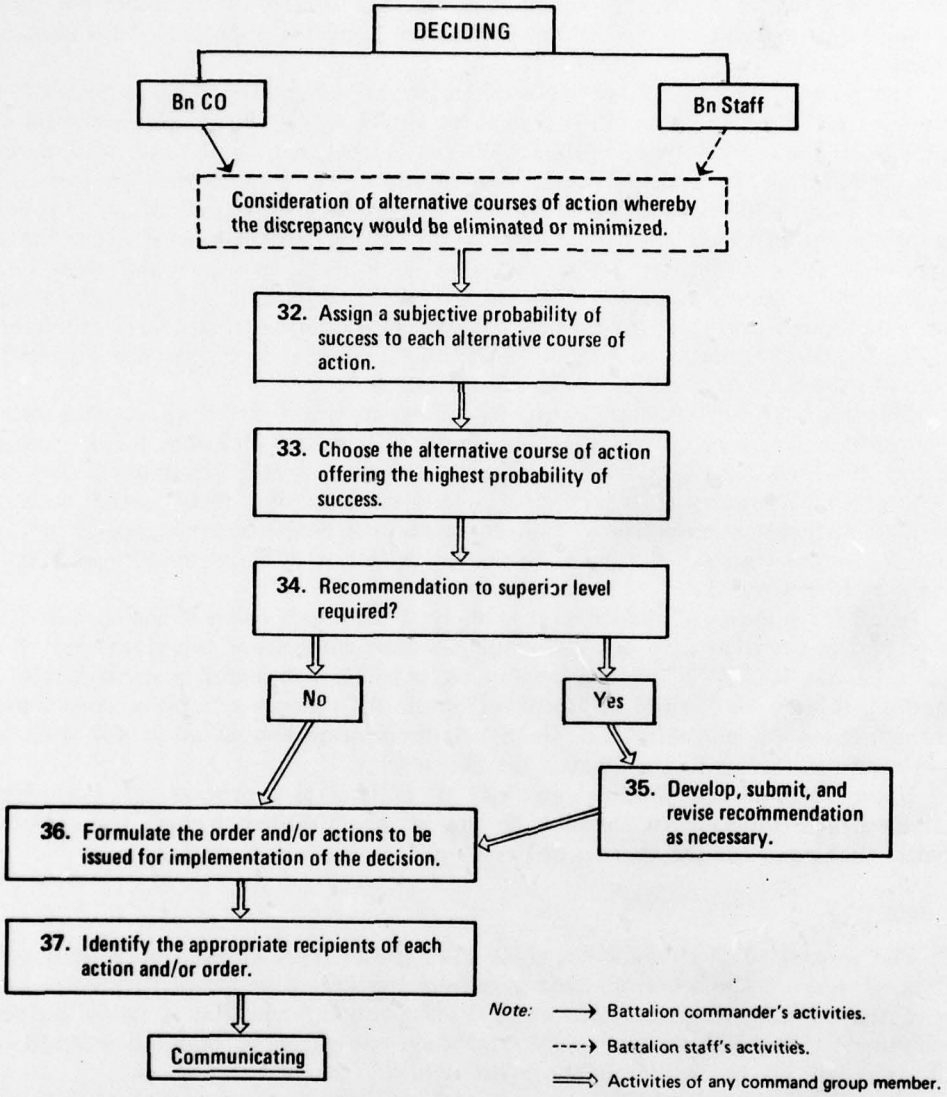

Figure 5. **Categories of Activities in Deciding**

reliable and valid application of a rule and (b) the effective decision maker would modify a rule and/or its application according to the presence of such factors.

After a probability of success has been assigned to each course of action, the one having the greatest probability is selected (Category 33). Depending upon his position in the organization, the IP may not have the authority to select a course of action himself. Rather, his selection may only serve as a recommendation that requires the approval of a higher authority (Category 34). Under such conditions, the IP engages in activities that allow his recommended solution to be approved. Such activities could involve the development, submission, and, if necessary, modification of the original recommendation (Category 35).

Upon selecting (and, if necessary, having had approved) a course of action, the IP then formulates the order and/or action through which the decision will later be transmitted and implemented (Category 36).

Selection of the term "formulation" was for the purpose of emphasizing that effective orders will be based on a considered approach, that is, the order which will be communicated should be reviewed prior to transmission. The purpose of such review is to insure that all appropriate information is included and that the selected format of the information most effectively communicates that which is intended.

As discussed earlier, the recipient of the decision represents a primary difference between actions and orders. That is, orders are transmitted to subordinates; actions are directed to other members of the command group.

In the event that the IP is to carry out a designated action on his own, appropriate modifications would be made to the remaining categories of activities, both for this process and for the succeeding one, Communicating. This self-designation as the one to perform an action may occur with some frequency in the command group, and may or may not eventuate in an order.

The appropriate recipients are also identified as part of the process of Deciding (Category 37). It is obvious that communication of a decision to inappropriate recipients could render the decision ineffective. This category is included as an explicit review step in that recipients of the action and/or order would be tentatively identified as part of the activity involving formulation of the order. The appropriate recipients of an order consist of those who are expected to enact it; in addition, individuals having a coordinating function should receive the order as a means of minimizing complications.

Along with the products of the processes of Evaluating and Considering, the selection of a course of action, formulation of the decision to be issued as an order (e.g., specifying information to be included, appropriate format), and identification of the appropriate recipients of the decision fulfill the function of Decision Making. The third function in the model, Dissemination, then becomes prepotent as activities in the process of Communicating are initiated.

Communicating

In the model, the function of Dissemination underscores that a decision is not produced as an order until it is disseminated to one or more other members of the organization. The categories of activities representing the communicating process (see Figure 6) are broader than the oral or written transmission of the order. Communicating includes activities involved in preparing the order or action for transmission and in insuring its likely effectiveness when acted upon, as well.

The model accentuates two categories of communicating activities that precede transmission of the order and serve to prepare it for transmission (Categories 38 and 39). The initial category involves determining the appropriate mode for transmitting the order. Radio, telephone, or direct verbal delivery are typically used to communicate fragmentary orders. In many instances, selection of a mode for delivery is likely to be routine and/or affected by such factors as distance, time, communications security, and exigencies in the tactical situation. Once a mode of communications has been selected, the IP's activities center on communications security (Category 39). The need to preserve security may have been taken into account in the preceding category of activities. The present activities, however, center on identifying and preparing those elements of the order that should be coded for security reasons, given the selected mode of communications.

After the order is prepared, it is transmitted or communicated to the recipients (Category 40) identified as part of the process of Deciding. The order may be transmitted by the IP or he may relay the order to another person who then transmits it for him.

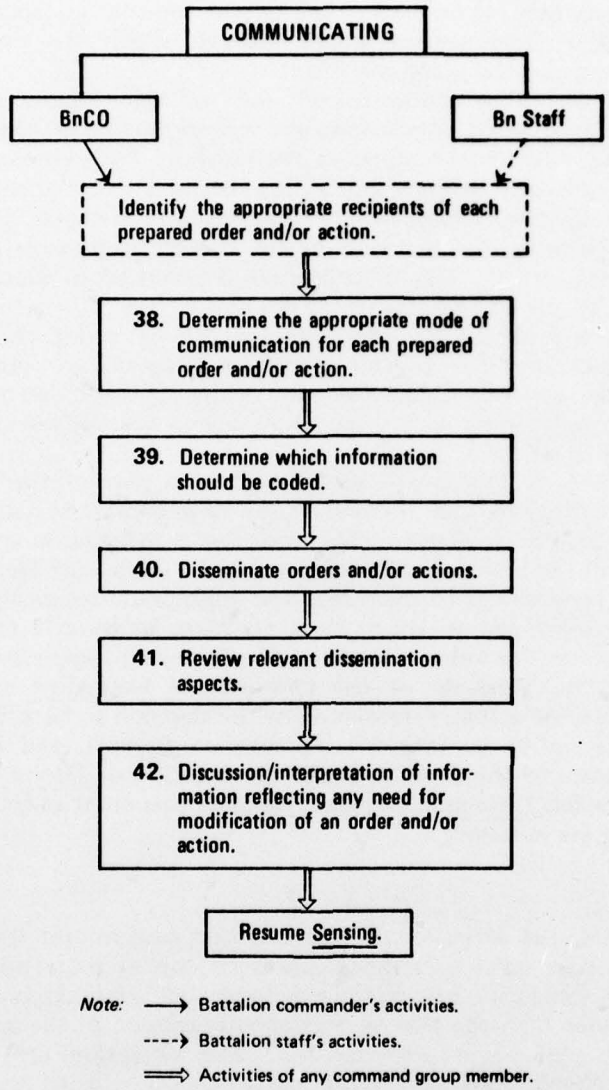

Figure 6. **Categories of Activities in Communicating**

According to the model, order production is not terminated until the IP engages in two categories of activities that serve to insure the likely effectiveness of the order, and that may involve interaction with the recipients of the order.

As one category of activities (Category 41), the IP reviews the distribution of the developed order. Four aspects of distribution deserve special attention. Two concern the recipients of the order. As part of this category of activities, the IP checks to determine whether all of the appropriate persons/positions in the organization received the order. In this manner, the appropriateness and thoroughness of the order's distribution can be assessed and, if necessary, improved. The third and fourth aspects of distribution concern accuracy and completeness. An order is distributed accurately and completely to the extent that the recipients correctly understood the order and received all parts of the order.

The final category of activities (Category 42) results in feedback about the applicability of the order and, if necessary, modifications in the order to insure its likely effectiveness. These activities involve discussion and interpretation of the order with its recipients. In this manner, the IP can determine whether the tactical situation has changed and, if so, whether execution of the order would continue to have the intended effects on mission accomplishment. Modification of the order or additional actions/orders may be required if the situation had changed during the production of the order.

In the model, Communicating involves preparation of the order for transmission, dissemination of the order, and information interchange to insure the intended effectiveness of the order. These activities fulfill the function of Dissemination. Upon their completion, the production of an order is completed as well.

Upon terminating the Communicating process, the IP resumes Sensing activities. Alternatively, the IP may re-initiate activities involved in processing acquired information, which had been temporarily suspended during the Communicating process.

DISCUSSION

The model for the production of fragmentary orders during combat systematically describes processes and sequences of activities which occur during its operation. The descriptions of activities in the model were developed to provide a structure for improving the order-production process. Implications about order-production activities and recommendations for application of the model should be evaluated in view of certain restrictions.

EVALUATION OF THE MODEL

As will be discussed later, the model could be used to improve order-production behavior. Due to the limited data base from which the model was developed, further testing of the model prior to general application would be in order.

The model was developed by rationally analyzing order production after having observed this phenomena in a limited number of cases, which cannot be assumed to be representative of all such situations. These data, which consisted of impressionistic observations, were then used in a rational analysis of the order-production process in order to identify performances which were involved. These identified performances were then systematically described and presented in the model. In effect, the model suggests that order production occurs through activities such as those summarized. Further investigation of the model is necessary to establish its validity.

The restrictions described also impact in several ways upon decisions concerning application of the model. First, the model was intended to describe general-level performances which could be represented by any of a variety of different behaviors. Information acquisition, for example, could occur through map reading, communication with another individual, or direct observation of an event. The model, therefore, should not be expected to describe the exact behaviors of an IP during the production of a fragmentary order. The model is intended only to describe the categories represented by specific behaviors. Second, the model is limited to the processing of information about a single event. In this sense, the model is not comprehensive of the various and changing events with which a commander or staff officer may have to cope within a relatively short period of time.

A final consideration bears on the purpose of the model. It was developed to systematically describe the activities involved in the production of fragmentary orders, as a means of identifying ways for improving the effectiveness of order production. The model prescribes activities that are conducive to the effective production of combat orders. Such a prescriptive model should not necessarily be expected to accurately describe all activities performed during the production of an order. However, a valid model should provide guidelines for improving the effectiveness of order production.

In summary, the model was developed by analyzing the production of combat orders after having observed a limited sample of situations in which fragmentary orders were produced. The model also describes generalized behaviors involved in the production of a single order. The model is prescriptive in that it describes activities conducive to the production of effective orders. Based on these considerations, it is concluded that further investigation is required to validate the model and to determine the extent of its applicability.

IMPLICATIONS FOR ORDER PRODUCTION

The model has certain implications about the nature of performances involved in the production of fragmentary orders. Based on these, recommendations about ways of improving order production could be developed. The development of specific recommendations, however, would be more appropriate after the model has been further investigated and after its validity has been established. For this reason, only the more direct implications of the model will be specified.

Perhaps the most basic implication of the model is that an analytical problem-solving approach is conducive to the production of effective fragmentary orders during combat. According to such an approach, the IP is receptive to the discovery of discrepancies between conditions observed in his environment and the ideal conditions. Upon recognizing a discrepancy, he then analytically evaluates the information to (a) determine its criticality to mission accomplishment, (b) identify factors that can be operated upon to deal with the discrepancy, and (c) formulate potential courses of action. The courses of action are then assessed so that the one with the greatest probability of success is selected and communicated as an order. Throughout these activities, the IP remains open to the possible need for additional information prior to selection of a course of action. The IP also reviews the distribution of an order to insure that it was disseminated appropriately, thoroughly, completely, and accurately.

This approach is similar to one of the two categories of responses identified by Powers and DeLuca[1] in their research on thought processing by the battalion commander and members of his staff. The two categories of responses differed in terms of the techniques or processes underlying them and were referred to as "automatic" and "analytical" responses. The automatic response was defined as " . . . an activity in which the stimulus automatically activates systems that lead to prepatterned behaviors because of training and experience" (p. 11). Analytical responses involve examination of various courses of action in order to select the one that is most likely to meet the requirements of the situation.

While the analytical approach is emphasized in the model, the possibility of order production through an automatic approach should not be precluded. In fact, it seems that automatic responses may be especially likely when the decision maker has a preplanned reaction to a specific event or when the information received is conducive to short-circuiting the methodical evaluation of the situation (e.g., a communication about a problem suggests a decision). It should also be noted that orders produced through the activities represented in the present model may appear as if they were produced automatically. Due to the IP's familiarity with a situation that requires only minimal interaction with other members of the organization, for example, activities in the model, that would otherwise be performed more overtly, may be performed at a cognitive level in a relatively short period of time.

Compared to an analytical approach, an automatic approach to the production of fragmentary orders has value in that reaction time to a time-critical situation would be likely to be relatively shorter. The value of a shorter reaction time, however, can be offset by inappropriateness of the order. That is, automatic orders are produced without thoroughly assessing the current situation. If the situation is composed of critical factors not readily perceived, the automatic order may not result in actions that would most

[1] Theodore R. Powers and Arthur J. DeLuca. *Knowledge, Skills, and Thought Processing of the Battalion Commander and Principal Staff Officers*, HumRRO Technical Report 72-20, July 1972.

effectively deal with them. Additional deficiencies which may occur in the automatic production of an order were proposed by Hammell and Mara[1] and are described in the following paragraph:

"a. Stereotype - Overgeneralization of a particular response in a number of situations to the point that it becomes predictable to an enemy.

b. Preservation - Tendency to persist with a course of action after it is reasonable to make a new response or interpretation.

c. Incompleteness - The degree to which the decision maker avails himself of all relevant information on the tactical situation.

d. Untimeliness - Tendency to make a premature move or delay too long, i.e., not use an appropriate amount of time."

As compared with the automatic order, the analytical approach reflected in the present model is more likely to result in accurate identification of critical factors which are then taken into account in formulating and selecting courses of action. Through the accurate identification of the critical factors, deficiencies in the decision-maker's performance, such as those just described, are less likely.

A second implication is that the analytical approach is appropriate for staff officers as well as commanders. An often noted difference between the functions of a commander and the members of his staff lies in the extent to which their respective actions are proceduralized. In the model, however, an IP, regardless of his position, fulfills the same three functions in producing a fragmentary order. Moreover, the model draws few explicit distinctions between the categories of activities represented by the five processes. These similarities are the basis for the second implication.

These similarities, however, should not be construed to imply that differences in the responsibilities and performances of the commander and staff officer are not recognized in the model. Several categories of activities allow for such differences. The following activities, for example, are likely to differ for the commander and staff officer: (a) reviewing information to determine whether it is relevant to one's area of responsibility, (b) seeking guidance to determine the extent to which critical factors can be controlled, (c) coordinating with others having control over means for dealing with a discrepancy, and (d) recommending a course of action for approval prior to its final selection. Each of the activities just mentioned is more likely to be incumbent upon a staff officer due to his organizational position and relatively lesser experience.

Differences in the ways and frequencies with which commanders and staff officers perform activities represented in the model would probably support the notion that the staff officer's role is more restricted by procedural guidelines. The model implies, however, that organizational guidelines for his behavior should not result in the staff officer's producing fragmentary orders in an automatic and unsystematic fashion. Rather, the model implies that, within the limits of his prerogative, the staff officer, as well as the commander, should adopt an analytical approach to order production.

In the model, fragmentary orders are produced by an IP after having processed information about environmental discrepancies. The model implies, however, that fragmentary orders are organizational products and not the products of individuals working in isolation.

According to the model, the IP engages in sequences of activities that represent the processes of Sensing, Evaluating, Considering, Deciding, and Communicating. The information-processing activities representing these processes could be descriptive of an

[1] T.J. Hammell and T.D. Mara. *Application of Decision Making in Team Training Research to Operational Training: A Translative Technique*, General Dynamics, Electric Boat Division, Groton, Connecticut (Contract N61339-68-C-0242), for Naval Training Device Center, Orlando, Florida, Technical Report (NAVTRADEVCON 68-C-024201), April 1970.

individual decision maker functioning in any setting. Inspection of the model suggests that, with respect to order production, the activities of the IP are, to a large extent, shaped by inputs from the organization of which the IP is a member.

In the process of Sensing, for example, the IP detects a discrepancy when conditions in the present or future environment are observed to differ from ideal conditions. The source of the IP's concept of "ideal" is not thoroughly addressed in the model. It is likely, however, that the assigned mission of the organization and the requirements for mission accomplishments would be (and indeed should be) principal determinants of this concept. If the mission is a source of the IP's definition of the ideal, his recognition of a discrepancy is dependent upon understanding his organization's mission and the requirements for mission accomplishment.

The process of Evaluating involves an assessment of the criticality of a discrepancy. This assessment is also based on mission accomplishment. With respect to Considering, the courses of action are developed after having obtained guidance for dealing with critical factors and coordinating with those having control over these factors. The model also indicates that, under certain conditions, a course of action is selected as part of Deciding only after a recommended course of action has been approved. Finally, Communicating involves the use of communication modes provided by the organization.

In the model, information processing is also based on interaction with other individuals in the organization. The interaction largely involves acquiring and transmitting information. The importance of information exchange to order production is also suggested by the observations and impressions summarized earlier as part of the results. It appeared, for example, that the greatest proportions of communications in the observed simulated tactical operations involved the acquisition and transmittal of information. Problems in effectively transmitting information were also noted.

The organization of which the IP is a member and interaction with other individuals in the organization are basic components of the order-production model. Otherwise, the model implies that orders are produced by the processing of information by individuals. Examination of the model reveals that information processing occurs within each process in the model.

The term "processing" is used here to refer to all activities concerned with the acquired information up to the point that information is transmitted. These activities include reviewing, channeling, selecting courses of action, and storing and retrieving information. Storage involves the accumulation and saving of information. Retrieval involves an ability to recover intact that information which has been stored.

The storage and retrieval of information are two especially important information-processing activities represented in the model for order production. At several points in the model, stored information is compared with current information about a discrepancy. Such comparisons facilitate an early identification of discrepancies and the development of trends over time. Inefficiency in either storage or retrieval could interfere with the effectiveness of such activities.

Information processing involved in order production could also be substantially affected by the situation in which it occurs—combat. That is, it is possible to view combat as a crisis situation.[1] Such situations have been characterized as (a) unexpected, (b) threatening to high-priority objectives of the organization, and (c) requiring a short reaction time.[2] It has been found that, in crisis situations, nonmilitary organizations tend

[1] Olmstead, Christensen, and Lackey, *op. cit.*

[2] C.F. Herman. "Some Consequences of Crises Which Limit the Viability of Organizations," *Administrative Science Quarterly*, vol. 8, 1963.

to place little value on information about potential threats.[1] As a result, an organization could be unprepared to deal with the threat when it is eventually detected. Due to the crisis-like circumstances under which fragmentary orders may be produced, the possibility of training commanders and staff officers to process information under such conditions merits consideration.

A fifth implication concerns the complexity of order production and the sequential nature of the activities involved in it. In the model, order production involves sequences of activities that successively fulfill the functions of Instigation, Decision Making, and Dissemination. An inappropriate or ineffective order could result from errors occurring at any point during the sequence. Errors in any of the following would seem to be especially detrimental to the production of fragmentary orders: (a) identification of discrepancy, (b) assessment of the criticality of the discrepancy or factors comprising it, (c) identification of controllable factors, (d) formulation of courses of action, (e) assessment of the probability of success of the actions, (f) identification of appropriate recipients, (g) development of the order, or (h) communication of the order.

The model implies, thus, that the production of fragmentary orders involves a sequence of activities. The effectiveness of decisions communicated as orders is dependent upon the activities that take place throughout the sequence. A possible corollary of this implication is that training in the production of combat orders should take into account the transitive nature of order-production activities as well as the component activities themselves.

As just suggested, the model also has implications for training in order production. The potential uses of the model are discussed in a later section. It should be emphasized, however, that assuming its validity, the model implies the types of knowledges and skills requisite for effective order production. These could be identified from the model by analyzing the model itself or by using it as a framework for systematically analyzing descriptions (or observations) of order-production performances. A preliminary analysis of the model suggests, for example, that skills such as those listed in Table 1 are involved in the process of Sensing.

In summary, the model implies that effective order production involves sequences of information-processing activities by the individual members of organizations. The validity of the implications of the model is contingent upon the validity of the model itself. After the model has been investigated more thoroughly, it would be possible to develop more explicit recommendations from the model about ways to improve order production.

POTENTIAL USES OF THE MODEL

The model for order production is potentially applicable to a range of combat settings. It could also be used in development of training. In particular, the model could be used in both an identification of training requirements and in the development of training simulations.

Military documents such as FM 101-5[2] list the responsibilities and functions of members of the command group. Such listings do not provide a precise specification of the performances required in the supervision of an ongoing tactical operation, however. As demonstrated earlier, the present model could contribute to a more thorough

[1] H.B. Williams. "Some Functions of Communication in Crisis Behavior," *Human Organization*, vol. 16, 1957.

[2] Department of the Army. *Staff Officers Field Manual, Staff Organization and Procedure*, Field Manual 101-5, Washington, 1972.

Table 1

Sample Skills Involved in the Process of Sensing

- Based on acquired information, identify conditions in the present environment.
- Based on acquired information, anticipate future environmental conditions.
- Based on acquired information, identify differences between present and ideal environmental conditions.
- Based on acquired information, project differences between the likely and ideal environmental conditions in the future.
- Identify trends as they are developing through time.
- Determine the relevance of acquired information for present and/or future environmental conditions.
- Determine the relevance of information for mission accomplishment.
- Seek information by directly observing events, initiating communication with others, or examining recorded data.
- Acquire information by listening to communications initiated by others.
- Identify appropriate recipients of information.
- Communicate information.
- Save acquired information by recording it or through memory.
- Assess the validity of sources of information.
- Evaluate the completeness of information.
- Assess the accuracy of information.

identification of performance requirements in the area of order production. That is, the model delineates performances involved in the production of fragmentary orders. The activities themselves could be viewed as performance requirements for the effective order production. Although the activities are described in terms of "categories of activities" in the model, they are still more specific than the general functions and responsibilities listed in field manuals. The activities could then be used as a framework for the identification of the knowledges and skills necessary to achieve the specified activities.

The model could also contribute to the development of training simulations. Training simulations are often used to prepare individuals and groups in performances required in complex and dynamic settings like combat. Such simulations may vary in the extent to which they represent the job context. The ORTT observed prior to development of the model, for example, is a type of simulation that potentially has a high degree of correspondence with the job context. Such simulations are conducted by selecting samples of the job from the work environment and then practicing the selected performances under conditions that closely approximate combat. Simulations of this scale, however, can be expensive to conduct.

An alternative or adjunct to the preceding simulation approach consists of a "controlled simulation" of the task. The term "controlled simulation" refers to a simulation in which training events are carefully developed in terms of stimuli that will elicit responses previously identified to be critical to successful performance in the actual job setting. In this manner, the training setting would not necessarily have a one-to-one correspondence with the actual job setting. The success of this approach, however,

depends upon the identification and selection of stimuli that will elicit the desired responses. Models such as the one developed for the production of combat orders could be used for this purpose. That is, the model could be a basis for the identification of requirements for the successful production of combat orders. Stimuli having a high probability of eliciting the performance requirements could then be selected. Based on the processes and activity categories in the model, forms could also be developed for evaluation and/or diagnosis of a command group as they perform during the training situations.

This approach allows the development of training simulations in which participants deal with the type of situations which will later occur in combat. However, the costs of training could be reduced due to reduced correspondence between the training and job settings. The approach also allows for the development of training situations that are standardized across participants.

RECOMMENDATIONS

(1) Due to the relatively restricted data base from which the order production model was developed, this model should be thoroughly tested prior to specific application.

(2) The application of a model, such as the one presented in this volume, should be explored as a systematic approach to the development of training materials and programs.

(3) The model can be used as one basis for the development of instruments for the evaluation and/or diagnosis of the performance of the command group.

(4) The analytical approach to order production which is emphasized in the model could be stressed during field exercises and in the course of training programs concerned with situation estimation and order production.

(5) Based on the requirements of the model, attention could be given the identification of more efficient storage and retrieval techniques and/or systems capable of being implemented in a combat situation.

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