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A First-order Computational Model of Human Operational Planning

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AUGUST 1988

CECOM-TR-01-8
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# A First-Order Computational Model of Human Operational Planning

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Software Engineering Center (SEC)
ATTN: AMC-SE-OP
Fort Monmouth, NJ 07703-5207

## Performing Organization Report Number
CECOM-TR-01-8
(To DTIC: October 2001)

## Report Date
August 1988

## Report Type and Dates Covered
Technical Report

## Funding Numbers

## Supplementary Notes
Approved for public release; distribution is unlimited.

## Abstract
Most computational planning models within AI require complete and accurate knowledge of the starting situation as well as a well-defined goal for their operation. In contrast, human planners often must create plans despite the fact that the goal is often ill-defined and knowledge about the world in which the plan is to be executed is incomplete and possibly inaccurate. Battlefield planning is a paradigmatic example of such a planning context. The development of a model of how planning takes place in this type of domain is therefore a considerable challenge to our current computational understanding of planning. This research is directed at this challenge. Based on observations made of the planning activities of human experts at the Army War College and a review of the pedagogy associated with their training, this paper provides a basic first-order model of the possible control strategy employed by battlefield planning experts. The proposed model is evaluated by comparing its 'predictions' of the types of planning activities that should be observed and the order they should appear against a protocol of the planning activities of human experts. Implications of this first-order model for further knowledge acquisition and development of planning aids are discussed.

## Subject Terms
- Command and control
- Planning
- Human planning
- Operational planning
- Battlefield planning
- Protocol analysis
- Army War College
- Knowledge acquisition
- Cognitive task analysis
- Knowledge-based systems
- Expert systems
- Artificial intelligence
- Expertise
- Control strategy
- Meta level control

## Security Classification of Report
Unclassified

## Security Classification of This Page
Unclassified

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Unclassified

## Limitation of Abstract
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A FIRST-ORDER COMPUTATIONAL MODEL OF HUMAN OPERATIONAL PLANNING

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ABSTRACT

Most computational models of planning developed within AI require complete and accurate knowledge of the starting situation as well as a well-defined goal for their operation. In marked contrast, human planners often must create plans despite the fact that the goal is often ill-defined and knowledge about the world in which the plan is to be executed is incomplete and possibly inaccurate. Battlefield planning is certainly a paradigmatic example of such a planning context. Consequently, the development of a model of how planning takes place within this type of domain represents a considerable challenge to our current computational understanding of planning. The research reported here is directed at this challenge. Based on observations made of the planning activities of human experts at the U.S. Army War College and a review of the pedagogy associated with the training of human experts, the present paper provides a basic first-order model of the possible control strategy employed by experts in battlefield planning. Next, the proposed model is evaluated by comparing its "predictions" concerning the types of planning activities that should be observed and the order in which these activities should appear against a protocol of the planning activities of human experts. Implications of this first-order model for further knowledge acquisition and development of planning aids are discussed.
INTRODUCTION

Most computational models of planning developed within AI require complete and accurate knowledge of the starting situation as well as a well-defined goal for their operation. In marked contrast, human planners often must create plans despite the fact that the goal is often ill-defined and knowledge about the world in which the plan is to be executed is incomplete and possibly inaccurate. Battlefield planning is certainly a paradigmatic example of such a planning context. Consequently, the development of a model of how planning takes place within this type of domain represents a considerable challenge to our current computational understanding of planning.

The research reported here is directed at this challenge. The focus in our present research is primarily descriptive. The goal at this stage is simply to try to identify a plausible high-level description of the basic control cycle that might adequately characterize the observed planning activity of human experts who are given a battlefield planning problem. The research has proceeded by observing the planning activities of human experts, reviewing the pedagogy associated with the training of human experts, and then partially specifying a first-order model of a planning strategy that is suggested by these observations and Army doctrine. Next, the proposed model is evaluated by comparing its "predictions" concerning the types of planning activities that should be observed and the order in which these activities should appear against a protocol of the planning activities of human experts.

Battlefield Planning

Battlefield planning is an activity carried out at a variety of communicating levels of the Army command hierarchy. A higher level communicates to a lower level what can be thought of as a partial specification of a subproblem to be solved, a partial specification of the resources available for use in solving the given subproblem, and often a partial specification of aspects of how the subproblem is to be solved. Further, at each level of the command and control hierarchy, several experts are involved in the planning process. Information and decisions may be completely shared within a level whereas only limited communication is possible between levels. The planning itself may take place over a matter of days and the resulting plan provides the basis for coordinating and controlling the activities of many agents over a protracted period of time. Although planning is distributed over many agents with a relatively low-bandwidth of communication
between levels, common knowledge about doctrine and general principles of battle seems to compensate for this low band-width.

In this research we have focussed on only the planning activity that is carried out at what corresponds to the corps level within the Army's command hierarchy. Clearly, the nature of the planning carried out at any level is influenced by the overall structure of this command hierarchy. However, we will not attempt to characterize the planning process as it moves from one level of the command hierarchy to another.

A Review of Some of the Standard AI Models of Planning

It is useful to briefly characterize the control structure used in some of the models of planning developed within AI. This characterization will enable us to see some of the similarities and differences between these models and the model of control suggested by our investigation of the corps battlefield planning problem.

The method of problem reduction is the underlying search model used in most AI research on planning. In this method a problem is recursively decomposed into a set of subproblems. A subproblem consists of a problem state-pair where the first element, \( I_j \), specifies the starting state or context for the subproblem and the second element, \( G_j \), specifies the goal state for the subproblem. The search is in a space of possible problem decompositions. Rules, referred to as non-terminal rules, are used to map a subproblem into an AND-ed set of presumably "simpler" subproblems. A primitive subproblem is one for which the system can directly produce the solution or can find a solution with only a "trivial" amount of search. These rules serve as the generators of the space of possible decompositions. The recursive decomposition of a problem yields an AND tree that represents one possible decomposition of the given problem in this space of possible decompositions. An alternative decomposition of a problem or subproblem is represented as an OR branch. The resulting AND/OR tree represents the nondeterministic search over alternative candidate solutions to a problem. Rules referred to as terminal rules serve as recognizers of "primitive" subproblems. A partial derivation of a solution to a subproblem refers to an AND-ed subtree in this AND/OR tree. A derivation is complete if each of its terminal elements has been recognized as a primitive subproblem.

A candidate solution is generated through the above described process of decomposition. A candidate solution is tested via a process of composition. Composition is also a recursive process, but in the standard case the
recursion moves from the terminal elements of the **AND** tree representing a
derivation to its root. Composition succeeds if at each level of the **AND**
tree the **AND**ed subproblems imply the parent subproblem. Thus,
decomposition constitutes the generate phase and composition the test
phase in this generate-and-test paradigm.

The simplest adaptation of the reduction method to planning problems is
exemplified by the so-called linear planners. Here search is controlled via a
depth-first search where the decomposition phase is applied recursively
until a primitive subproblem is encountered. The decomposition phase
involves only goal decomposition. Consequently, the subproblems created
during the recursive application of goal decomposition are only partially
formulated; that is, the initial state, \( l_j \), of a subproblem state pair is not
specified. Rather, in this linear planning method the initial state, \( l_0 \), of the
original problem state-pair remains fixed until a primitive subproblem is
encountered. A subproblem is recognized as primitive if it can be "achieved"
by some action whose preconditions are true in the current \( l_j \). The action is
then used to map the current \( l_j \) into a next element which then serves as
the specification of the \( l_{j+1} \) associated with the next subproblem. Thus the
formulation of subproblems is closely coupled with the search for a
solution. If this next element implies the parent subgoal then the test of
this part of the derivation has succeeded. If it fails to imply the parent
subgoal, then backtracking is used to achieve the search through the space
of alternative decompositions. Backtracking allows the reordering of
subgoals that have been created at this state of the recursion or if
reordering fails it allows for the generation of alternative goal
decompositions. Note that because of the possibility of subproblem
dependence this search method must potentially search not simply the space
of decompositions, but rather a space of permutations of the space of
decompositions. Thus, the efficiency of this search heavily depends upon
whether or not subproblem dependence is "frequently" encountered. A
problem solution consists of a linear ordering of a sequence of actions and
it is this linear sequence that is identified as the plan.

So-called non-linear planners alter this control by introducing a test or
composition phase at each level of the decomposition. Again the
decomposition operation associated with this method is goal decomposition
rather than a full problem decomposition. In this method the initial state, \( l_0 \),
of the starting problem serves as the intial state for all of the subgoals
introduced and is never explicitly altered. The test is accomplished via a
process of critiquing. Critics can be thought of as a set of predicates
defined over n-tuples of subproblems where n is greater than or equal to
two. These tests are used to detect subproblem dependence. If some \( k \) subproblems are found to be dependent, then an ordering of these subproblems is sought that accommodates the dependency. This ordering is then imposed on any further derivation of a solution. This constraint on the ordering of subgoals serves to implicitly specify the initial state, \( l_0 \), associated with each subgoal. Through this method of repeated critiquing, this control strategy defers commitment to an ordering of the subproblems until a discovered dependency requires such an ordering. A solution is obtained when only primitive subproblems remain and an ordering has been identified which satisfies the critics. The ordering may be only a partial ordering of the actions.

A final method of planning involves the posting of constraints to annotate the existence of a subproblem dependency. This annotation is used to control the choice of which subproblem to expand. The structure added by this annotation explicitly changes the representation of the derivation from that of a tree to a graph. This complication to the structure of the derivation is handled implicitly in the control structure used in linear and non-linear planning. By making this dependency structure explicit in the derivation, this method can more flexibly control search and enforce a policy of least commitment. However, the constraint propagation mechanism must be invoked after each decomposition in order to update these constraint expressions. This least commitment approach allows the plan to be developed via a process of successive refinement. The policy is to refine first those subgoals that are currently most constrained. As in the non-linear planning method, the full formulation of the \( l_0 \) associated with a subgoal proceeds incrementally as a result of constraint propagation. The test and solution provided by this method is also analogous to that of the non-linear planning method. A complete solution has been derived if each node has been expanded to its terminal level and a consistent set of constraint expressions holds over the derivation. The partial ordering of the solution is imposed by the constraint expressions.

In all of these approaches to planning, it is assumed that the initial problem is well formulated; that is, that both the \( l_0 \) and \( G_0 \) defining the problem is fixed and complete. Each of these planning methods "discovers" implications of this starting information as it carries out the planning process. This discovery occurs primarily during what we have termed the test phase of the planning operation. Whether through action simulation, critiquing or constraint posting and propagation, the new information that is derived is primarily information about subproblem dependence. Note that because of the existence of subproblem dependence it is very difficult to search for and maintain multiple derivations of a solution to a problem or subproblem.
Consequently, all of the planners use some variant of a depth-first, or best-first, search.

A First-order Model for Corps-level Planning

The most striking difference between corps battlefield planning and the situation presumed by AI models of planning is that in the case of battlefield planning the planner is not presented with a completely specified problem. Both the relevant information upon which to base the plan, the problem starting state, and the problem goal state is only partially and indirectly specified.

First, with respect to the starting state of the problem, there is an enormous amount of information that is potentially relevant to the creation of a battlefield plan. This includes information about the terrain, enemy force characteristics and disposition, own force characteristics and disposition, enemy plans and intent, weather information and the like. Some of this information may be directly available, and, other information may be developed only through a complicated process of assumption and inference. The commander's guidance does not specify which of this information must be developed to adequately formulate the problem. The planner is expected to do this. Rather what is provided is general information concerning where and over what period the battle should be fought, which own forces may be committed to the battle, and intelligence guidance on which enemy forces may be committed and where and when they may be committed. There may also be intelligence information concerning the enemy objective.

Similarly, the goal of the plan is typically specified in a fashion that, from the AI planning perspective, is a quite abstract and partial. The planner is given bounds concerning when and where the objective is to be achieved and at what cost, rather than a detailed specification of the goal.

Now in the standard AI planning models, the determination of which of the information about the planning situation is relevant is discovered as part of the planning process. Relevant information is developed and associated with a subproblem in three ways. First, and most typically, information defining the subproblem is inherited from the parent subproblem. This is simply the standard mode of subproblem definition provided by the method of problem reduction. Second, information may become available as a result of simulating the effects of already planned actions which precede the current subproblem. We noted the use of this state simulation mechanism in our discussion of linear planning. Third, a subproblem may be further specified
as a result of constraint propagation that occurs when another subproblem is further refined.

Although any of these mechanisms of subproblem specification may be used in battlefield planning, they do not appear to be sufficient. Rather, battlefield planning appears to involve the necessity of explicitly developing the information required to further the planning process. There is some sense in which the planning process provides a way of recognizing the information required and thus focussing efforts at data retrieval, inference or further data collection. This interplay between planning and data development is probably not atypical of human planning in complex information-rich domains. It is of particular interest in the battlefield domain because the process is not simply one of data retrieval, but also one that can involve complex inference strategies initiated to support the planning effort.

From the point of view of planning, this raises the question of exactly how such processes of retrieval and inference might be incorporated into the basic control structure of a planner. There are two basic ways in which a process that further specifies the information associated with a subproblem might be invoked during the control cycle of a planning model. The first is "triggered" and the second is "predictive".

In the triggered case, a subproblem is chosen and the failure to identify any applicable reduction rule to decompose a given subproblem might provide the basis for recognizing that further information about that subproblem must be acquired. Here a failed rule of decomposition presumably provides the basis for determining what information is currently relevant to the derivation of a particular candidate solution. The interesting side-effect of this method of initiating a process of retrieval and inference is that the planning process itself can strongly bias the development of the information that is deemed relevant to the evolving plan.

In the predictive case, a subproblem is again chosen, but it is evaluated to determine whether or not it is sufficiently formulated to support expansion prior to any attempt to decompose the subproblem. This latter model suggests that the planner possesses explicit meta-knowledge that supports both the recognition of when a subproblem is sufficiently formulated as well as knowledge about how to specify and solve the metaproblem of developing the information required to obtain a well-formulated subproblem. In this case, the planning bias is less likely to be introduced into the retrieval and inference process that has been initiated. This is simply because the problem of further specifying a subproblem is not initiated by a
specific rule of decomposition, but rather by knowledge that is specified independently from the decomposition rules.

The triggered case is very similar to that used by a least commitment planner such as MOLGEN as developed by Stefik (1980; 1980). However, in this case the data searched is fixed, correct and complete. Consequently the issue of bias does not arise. PLANX-10 (Bresina, 1981; Sridharan, Bresina & Schmidt, 1983) was also a planner that possessed powerful abilities to defer commitment and exercise arbitrary control over its order of expansion of subproblems. This planning model also included the ability to draw default inferences when faced with an impasse due to the incompleteness of its knowledge. However, the default inferencing strategy employed was limited and chaining of such inferences was not allowed. This tended to control the degree to which the resulting plan could be biased by the planning process itself as well as to provide the discipline required to simply annotate the ways in which the plan depended upon such default inferences.

In the triggered case the specific metagoal of what information is required to provide a well-formulated subproblem is a result of the specific rule of decomposition that provided the trigger to this metaproblem. In the predictive case, the goal of the metaproblem is not directly dependent upon the chosen rule of decomposition. In problems such as battlefield planning where styles of default reasoning are present, this is an especially important distinction. However, these two cases may be difficult to distinguish empirically in the planning protocol of the experts.

Figure 1 provides a graphical depiction of a "simple" control cycle that could support a step that involves the predictive introduction of the metaproblem of deriving a well-formulated subproblem prior to subproblem expansion. Here, the basic cycle is expressed as metaproblems for the planner. It involves first choosing a subproblem, next providing a formulation of this subproblem if this is required, next decomposing the subproblem, this may be followed by critiquing and posting constraints, which may next lead to a process of local repair, and then the cycle begins again with the now expanded tree. Such a control is basically similar to that described for the planning model that implements a method of least commitment except that the meta-level problem of formulating a subproblem has been added.
We will use this basic first-order model of the possible control strategy employed by experts in battlefield planning in two ways. First, we use the list of metaproblems: choosing and formulating a subproblem, decomposing the subproblem, critiquing and evaluating the resulting decomposition, and possible repair of the decomposition, to provide a presumably exhaustive taxonomy of possible tasks that the experts might carry out during the planning episode. Consequently, we will attempt to determine whether the protocol provides evidence of the experts engaging in these tasks. Second, this model predicts a particular ordering in which these tasks should be carried out. Again, we can attempt to determine the degree to which the planning protocol provides evidence consistent with this ordering. Finally, the model represents an overall depth-first search strategy where alternatives should be specified quite locally as part of a backtracking strategy.
METHODS

In the present paper we do not provide a detailed description of the particular type of planning problem this research addresses. That description can be found in Loberg and Powell (1988) which provides a detailed description of the elements of the situation description (enemy and friendly forces, and terrain) and mission description of the corps planning problem. That paper also provides a detailed description of the major plan elements for this planning problem, namely: scheme of maneuver, task organization, task allocation, command and control measures, and support priorities. And that paper presents a description of the doctrinal specification of the military planning process (Figure 2 of the present paper) and discusses what appear to be the key tasks within that process. The emphasis of the present paper is a detailed analysis of the planning activities observed during a planning exercise at the U.S. Army War College (AWC) and how those activities relate to the first-order model of human planning in this domain.

Simulated Planning Exercise

This section describes a simulated planning exercise conducted at the U. S. AWC at Carlisle Barracks, Pennsylvania (1986). This video-taped exercise provided the operational planning data that we analyzed and will discuss in the RESULTS section. The participants in this exercise were two members of the student body, each of colonel rank and with considerable experience in planning. During the course of the exercise the players assumed the roles of corps commander and corps G3 (operations officer). While the exercise was artificial in that the detailed staff action supporting the planning process was not played, it did address key problem-solving elements of the process and mental processes of these planners as they considered these elements. These elements, or tasks, include the mission analysis, terrain analysis, enemy force analysis, and courses-of-action phases of Figure 2, The Military Planning Process. Figure 2, which was adapted from FM 101-5 Staff Organization and Operations, illustrates the major activities of the entire process. The squared rectangles represent staff actions and the rounded rectangles represent commander's decisions. A characteristic of the military planning process clearly reflected by Figure 2 is the significant requirement to develop information both prior to, and interleaved with, course-of-action development.
Figure 2. The Military Planning Process
The following description of the exercise commences with a brief overview of the scenario, or the particular planning problem the corps staff must solve. This description is followed by a presentation of our results which includes an analysis of the verbal protocol obtained during the exercise.

**Exercise Scenario**

The United States' 11th Corps, with principal subordinate elements including the 4th Armored Division, the 90th Infantry Division (Mechanized), the 80th Infantry Division (Mechanized), and the 14th Armored Cavalry Regiment, has been assigned to the NATO Middle Army Group, or MIDAG. Although hostilities have not yet commenced, it is believed that enemy forces will attack NATO forces across the German border. The MIDAG commander and staff have completed and disseminated the MIDAG operations plan for the forthcoming operation. As a MIDAG subordinate element, the US 11th corps has been assigned a mission and given responsibility for a sector of terrain (see Figure 3) as part of that operations plan.

The MIDAG operations plan describes the operation as follows: MIDAG prepares to defend in zone with 2nd (BE) Corps, 4th (GE) Corps and 11th (US) Corps defending in sector. On order 2nd (BE) Corps, 4th (GE) Corps and 11th (US) Corps occupy sector and establish covering force along the international border. Upon commencement of Warsaw Pact attack MIDAG defends in zone. MIDAG attacks to destroy enemy forces and secure NATO territory in zone." *(US Corps Operations-Letort 85)*

As part of this operation, the 11th Corps has been assigned the following missions:

(1) Defend in sector.
(2) Attack to secure NATO territory in zone.
(3) Prepare to continue the attack to destroy Warsaw Pact forces in zone and to secure Magdeburg and a bridgehead over the Elbe river in order to restore access to Berlin." *(US Corps Operations-Letort 85)*

The sector given the 11th Corps (see Figure 3) has a number of prominent terrain features. The Harz Mountains in the southeast are an obstacle to the movement of large, military forces. They can be characterized as rough, forest-covered terrain with limited road networks. The areas around Braunschweig and Hannover are significantly urbanized and present other obstacles to military movement. The areas immediately to the east and west of the Weser River are hilly and provide excellent defensive terrain. Most other terrain in the corps sector provides no significant advantage to either the defender or the attacker.
Figure 3. The Scenario
RESULTS

The results are organized into three major sections. In the first section, we identify three categories into which information characterizing problem states in this type of planning seems to fall. Then we relate this categorization to the model. The categorization is exemplified in the course of presenting a "test" of the descriptive adequacy of the model. This test constitutes the second section and is performed by comparing statements made by the planners, and the ordering of those statements in the protocol, to the types and ordering of operations in the model. In the third section we discuss knowledge classes, the existence of which is implied by the elements of the model.

Categories of Information

The information defining problem states in this type of planning can be characterized in various ways (e.g., in terms of incompleteness and uncertainty). One way in which to characterize this information, which we think is useful, is in terms of whether it is given to planners in a form directly usable for planning purposes or whether the planners must derive the information they need. For this particular characterization we have identified three categories into which information seems to fall and which we call Given, Retrieved and Must-Derive (see Tables 1 & 2). Some of this information is always given to the planners (Given), other of it is available but usually must be sought by the planners (Retrievable), while still other of it must be developed by the planners (Must Derive). This categorization is exemplified at many locations in the protocol. We identify instances where planners retrieve or must derive information by explicitly stating, in the interpretation of the protocol, that these types of operations occurred. For example, all of the protocol in paragraph A, I₀ & G₀ of US 11 Corps (further specified via derivation) of subsection Protocol Analysis represents instances where the planners derived the information they needed. Except where it seems obvious we have included in the interpretation, for each instance of a category, the type of information involved (avenues of approach, implied operational constraint, etc.) as shown in Tables 1 and 2.

The planners' need to derive information will vary depending on such things as the degree to which friendly forces have had the time and intelligence-collection resources to gather and develop it and the degree to which it is specified as part of the operations plan (OPLAN) or order². It should be noted that some information related to the OPLAN may be presented to the corps planners only verbally. In Tables 1 and 2 we have organized the information types (e.g., Maps of region, Enemy force Task Organization) such
that they are associated with descriptions of either the initial state or goal state of subproblems. At present, our understanding is that the initial statement of the problem (i.e., $I_0 - G_0$) will always include the information types shown in category Given, but that the planners' need to retrieve and/or derive information may occur at the time they are given an OPLAN (i.e., $I_0 - G_0$) or at any other point in the planning process. The significant requirement for subproblem formulation in this type of planning is reflected by the types of information in Tables 1 and 2 which typically are not given to the planners, but which must be retrieved or derived by them. Subsection Protocol Analysis further reflects this requirement by identifying those statements in the protocol which appear to represent instances of subproblem formulation.
<table>
<thead>
<tr>
<th><strong>Given</strong></th>
<th><strong>Retrievable</strong></th>
<th><strong>Must Derive</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Maps of region - 1:50,000 - 1:250,000</td>
<td>Terrain factor overlays - roadnets - go/slow-go/no-go ...</td>
<td>Terrain objects - obstacles - avenues of approach - key terrain ...</td>
</tr>
<tr>
<td>Terrain Overview - textual description of own area of influence</td>
<td>Operational overlay providing C2 measures - own sector boundaries - coordinating points (optional) - FEBA^3 (optional) - phase lines (optional)</td>
<td>Operational overlay providing C2 meas. - coordinating pts. - FEBA - phase lines</td>
</tr>
<tr>
<td>Operational overlay</td>
<td>Enemy force</td>
<td>Enemy force capabilities and intentions [based on assessment made by corps]</td>
</tr>
<tr>
<td>- task organization - overlay - capabilities - intentions</td>
<td>Enemy order of battle (OB)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Task Organization for own Army Group - theatre - deploying forces</td>
<td>Friendly OB - status - strength - history ...</td>
</tr>
<tr>
<td></td>
<td>Task Allocation for own Army Group (AG) - each corps in AG</td>
<td>Friendly force capabilities</td>
</tr>
<tr>
<td></td>
<td>Scheme of Maneuver for own Army Group</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Support Priorities for own corps</td>
<td></td>
</tr>
</tbody>
</table>

**Table 1. Categories of Information for Initial State, l_j**
<table>
<thead>
<tr>
<th><strong>Given</strong></th>
<th><strong>Retrievable</strong></th>
<th><strong>Must Derive</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Specified tasks&lt;sup&gt;4&lt;/sup&gt;</td>
<td></td>
<td>Implied tasks</td>
</tr>
<tr>
<td>Specified constraints</td>
<td></td>
<td>Implied constraints</td>
</tr>
<tr>
<td>- temporal</td>
<td>- temporal</td>
<td></td>
</tr>
<tr>
<td>- spatial</td>
<td>- spatial</td>
<td></td>
</tr>
<tr>
<td>- operational</td>
<td>- operational</td>
<td></td>
</tr>
<tr>
<td>Purpose(s) of tasks</td>
<td></td>
<td>Purpose(s) of tasks</td>
</tr>
<tr>
<td>- partially specified</td>
<td>- further specified</td>
<td>- more complete set</td>
</tr>
<tr>
<td>- incomplete set</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ordering of tasks</td>
<td></td>
<td>Ordering of Tasks</td>
</tr>
<tr>
<td>- partially specified</td>
<td>- further specified</td>
<td></td>
</tr>
<tr>
<td>Commander's guidance</td>
<td></td>
<td>Commander's intent</td>
</tr>
<tr>
<td>- two echelons above</td>
<td>- two echelons above</td>
<td></td>
</tr>
<tr>
<td>corps inclusive</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Categories of Information for Goal-State, G_j

Descriptive Adequacy of the Model

In this section we examine the descriptive adequacy of the model by comparing the planners' statements (and their ordering in the protocol) to the types and ordering of operations shown in Figure 4. Figure 4, which is simply a tree version of Figure 1, has three rows of information numbered 1, 2 and 3. These rows represent the flow of planning specified by the model, namely, from left-to-right and from row-1 to row-n. The characters A through L appearing in each cluster of information, in the three rows in Figure 4, index the particular paragraph (e.g., (see A)) the reader should refer to in subsection Protocol Analysis (see below). Each paragraph describes the problem state-pair resulting from the application of a particular operation in the model. For example, the input to the operation Formulate and Choose is shown by the column of information under INPUT in Figure 4. The first cluster of information serving as input to Formulate and Choose cites paragraph A. In general, the paragraph cited on the left-hand side of an operation in Figure 4 describes the problem state-pair serving as input to
1. [Io-Go] partially specified (see A)
   [Io-Go] further specified (see A)

2. decomposition' (see B) (see B)

3. Defensive Subproblem [I1-G1] (see E)
   Defensive Subproblem [I1-G1] (see F)
   Defensive Subproblem [I1-G1] (see J)

   Defensive Subproblem [I1-G1] (see I)
   Defensive Subproblem [I2-G2] (see I)

   Defensive Subproblem [I1-G1] (see J)
   Defensive Subproblem [I2-G2] (see I)

   Southern Battle Subproblem [I31-G31] (see K)
   Middle Battle Subproblem [I41-G41] (see K)
   Northern Battle Subproblem [I51-G51] (see K)

Figure 4. A Test of the Model
the operation and the paragraph cited on the right-hand side of an operation describes the problem state-pair representing the output of the operation. The exception to this scheme of indexing input and output occurs for the operation Local Repair. In the case of Local Repair, the paragraph cited as its output appears directly beneath Local Repair in the figure. Each paragraph also contains statements from the protocol which are presented as evidence for the interpretive statements made about the planning activities observed. The numbers appearing within brackets at the end of each quotation in subsection Protocol Analysis represent the line numbers, within the transcript of the protocol, from which the quotation was taken and thus reflect a temporal ordering of the planners' statements as they were made during the planning exercise. The complete transcript to which the model was applied is reproduced in Appendix A.

In its current state, the model represents an initial approximation of human operational planning. The protocol under consideration represents the first data to which the model has been applied for the purpose of testing its descriptive adequacy. These data were collected prior to construction of the model so the test of the model is retrospective.

An examination of the relationship between the operations of the model and the line numbers associated with the lines of the transcript exemplifying the operations indicate there is a strong correspondence between the ordering of operations specified by the model and the ordering of planning activities in the protocol related to those operations.

Protocol Analysis

This section presents the results of the protocol analysis in the form of descriptions of problem state-pairs (paragraphs A-L) associated with operations in the model. Refer to the first paragraph in Descriptive Adequacy of the Model for a description of the relationship between these state-pair descriptions and Figure 4. Comments between { } are our annotations.

A. Io and Go Given to US 11 Corps (partially specified)

Io: Provided by terrain map, overlays and OPLAN

Terrain, and Command and Control Measures

a. Geographic map of region (1:250,000)
b. Sector of US 11 Corps defined on map via operational overlay
c. IGB on operational overlay

d. FEBA on operational overlay

e. Terrain overview - textual description of US 11 Corps area of interest in West Germany (included with OPLAN from MIDAG)

**Enemy Forces**

a. Enemy force Task Organization

b. Enemy force laydown on overlay (first echelon, division-sized units)

c. Enemy force intent (given in OPLAN from MIDAG)

**Friendly Forces**

a. Task Organization for MIDAG (details only for US 11 Corps, Theatre and Deploying forces; not for adjacent corps)

b. Support Priorities for US 11 Corps

**Go: Provided by MIDAG commander's concept of the operation and guidance**

a. MIDAG will defend in zone with 2d (BE) Corps, 4th (GE) Corps and 11th (US) Corps defending in sector

b. Focus on destruction of Warsaw Pact (PACT) military forces

c. Conduct main defensive effort in northern portion of MIDAG sector

d. Trade real estate for destruction of PACT military forces

e. Deploy a strong covering force

f. Deploy covering force on best defensible terrain nearest the IGB and present PACT with fierce and continuous battle from that border westward

g. Once border (IGB) is violated, adjust assets to fight close-in fight and deep battle in your area of influence

h. The direct destruction of combat power should be focused on the close-in fight

i. Priorities for use of combat power and Intelligence in deep battle are:
   - special weapons' delivery units
   - C2
   - bridges and all other engineering equipment
   - lines of communication and logistics facilities

j. Try to stop PACT east of Weser in north (and Fulda and Werra in the south)

k. Must stop PACT between Weser and Rhine (preserve command while inflicting maximum damage)

l. When MIDAG is able to attack, the intent is for the main attack to be done by the US 11 Corps - plan to cross the Elbe and strike toward Berlin
m. Must survive PACT's use of nuclear and chemical delivery capabilities
n. Offensive air support extremely limited during first few days

**Io and Go of US 11 Corps (further specified via derivation)**

**Io:**

a. Obstacles to enemy force

"This canal here which is as deep as the Mittleland canal. The Weser, the Leine up here (both rivers), right in here is marshy." [2-3]

b. Avenues of approach of enemy force

"The real objective however is a deep objective back here across the Leine. Rapidly. They're going to want to bypass Hannover and all this built-up stuff over here [points to left of upper center of map]. If they go north they can't use the autobahn. If the bridges are dropped on the autobahn they've got three river crossings to make, marshy areas here [upper right quadrant of map is pointed to]. I put them down through here [points to the center right]." [12-18]

c. Location of enemy force main attack

"Yeah and then the main attack will be coming across here [points to right center of map and then across to the left]." [21-22]

d. Location of enemy force feint of main attack

"[points to the upper right section of the map] Some of these here (enemy units), perhaps six, will try to make it through to feint an attack." [19-20]

**Go:**

No further specification was apparent for this problem statement.

**B. Defense-to-the-Rhine [I1-G1] and Counter-attack [I2-G2] Subproblems**

The decomposition chosen here is strongly constrained by, and consistent with, the OPLAN given to the planners (i.e., a defense and intent to attack to the east (counter-attack) are stated as requirements in the MIDAG
commander's guidance). However, it is not obvious that this is the only decomposition they might have chosen. For example, it seems plausible that the decomposition may have consisted of, in addition to the counter-attack subproblem, two defensive subproblems in the form of defending from the IGB to the Weser River and defending from the Weser River to the Rhine River.

I1:
a. 10 is inherited by, and provides the definition of, I1 except for the geographic region.

b. The geographic region is from the IGB to the Rhine River. The planners use element k. in Go to infer the geographic extent of the defensive plan. See the last two sentences in the quotation given under section G1: b. below. [167-174]

G1:

a. Go (except for element l) is inherited by G1.

b. The PACT force must be stopped (i.e., defensive battle) before the Rhine River. This is an example of a specified task.

"The boss would like us to hold east of the Weser. He would really like that. He says "I believe we can stop the attacker east of the Weser River, and north of the Fulda River. If we do, it will make it easier for the Middle Army Group to assume the defensive. If we cannot, and here again this is pretty consistent with telling us not to die in place, if we cannot stop the attack then I will need your corps and subordinate commands as healthy as possible in order to stop him between the Weser and the Rhine." So I'm going to have to plan, you know, for a defense from here [points to left upper quadrant of the map] and all the way back to the Rhine which is off the map." [163-174]

I2:

a. Using elements j, k and l from Go, the planners infer that their counter-attack plan will have a geographic extent from the Rhine River to Berlin with the extent possibly limited to the geography between the Weser River and Berlin.

b. The planners strike a phase line at the Weser River; this is a command and control measure which they inferred from the mission statement and it relates to element j. in the partial specification of Go (it reflects a
recognition by the corps planners of at least a first and second phase of the battle).

"What that's done is dictated the first phase line that you put on the map. Near the Weser because you know that there's a phase, at least one phase that's going to happen before that. And at least one phase that's going to happen behind that. And it's a geographically distinctive feature. Therefore you would strike some sort of phase line there." [175-182]

G2:

a. The planners identify element I from Go as the definition of G2. They state that they understand the MIDAG commander's intent to be to counter-attack. This is an example of understanding the intent of the commander who is at echelon-above-corps.

"And in the back of my mind I know, see, this is where we said if we understand the commander's intent we can plan a lot smarter because his intent is ultimately for us to counter-attack. Knowing that, it all makes sense. You can't counter-attack with nothing." [204-208]

b. The planners state that they recognize the necessity to be prepared to counter-attack, and that this necessity imposes a constraint on how they can defend. This is an example of an implied operational constraint.

"To a degree it imposes a restriction on how you defend. The restriction being, you've got to keep in the back of your mind a continuous readiness to attack. You cannot attack with forces in contact." [209-212]

c. The planners infer that in order to conduct a counter-attack they will need a force in reserve; a Division-sized force, armored if the terrain is appropriate.

"Which tells you that you gotta keep a reserve. A reserve that has the capability to kick butt. In gross terms what it told me is keep a division in reserve and if the terrain dictates keep an armored division in reserve." [214-217]

d. The planners also stated that an inability to attrit sufficiently with two divisions could result in the armored division not being used as the reserve, i.e., it may need to be committed to the defensive battle.
"Now we may get up here and look at this thing. We've got three divisions. We may not be able to attrit sufficiently with two. Which poses a limit. It could mean we'd take a brigade. It could mean we'd take a brigade plus the cavalry regiment which is the screening force. But it's got implications. Most guys like to keep something in their hip pocket anyhow." [221-227]

C. Local Repair

A local repair was not required because the planners appeared to find decomposition' (i.e., [I1-G1] and [I2-G2]) satisfactory. They made no comments that would indicate decomposition' required modification.

D. INPUT

Decomposition', which is the same decomposition mentioned in paragraph C. Local Repair above, provides the input to Formulate and Choose.

E. Defensive Subproblem

The planners chose to work on Defensive Subproblem [I1-G1]. However, additional formulation of this subproblem was not performed. The choice of this subproblem is represented as the output of Formulate and Choose.

F. Covering-Force Subproblem and Main-Battle Subproblem

The planners appeared to decompose Defensive Subproblem into a Covering-Force Subproblem [I11-G11] and a Main-Battle Subproblem [I21-G21].

I11:

Information defining state I1 is inherited by I11. That information plus element f. from Go is used by the planners to infer that the geographic extent of the Covering-Force Subproblem should be from the IGB to the FEBA.

"He even told us where to establish it {the covering force}. Along here [points to the area along the IGB]." [232-233]

The next quotation actually followed the planners' assignment of a particular force to the covering-force area (see G11 b.). It appears here because it indicates how the planners decided the geographic extent of the covering-force area.
"What you've got to do is subdivide the battlefield into covering-force area and main-battle area {we believe this statement reflects the planners' choice of decomposition of the defensive problem}. You determine the main-battle area based upon the first defensible terrain where you can have a continuous defense established. That becomes, by definition, the FEBA or the main-battle area. By definition, everything to the bad guys' side of that is covering-force area. So, while it might have appeared that we were concentrating on the covering force, the fact is we were drawing the line between the main-battle area and the covering-force area. That's what we just did." [287-296]

G11:

a. Information defining state G1 is inherited by G11. *Elements e. and f. of G1* are constraints which specify: the use of a covering force and the location where the covering force should be deployed. These are examples of a specified operational constraint and a specified spatial constraint respectively.

"Well, in fact we were told to {establish a covering force}. It's as cut and dried as that. He even told us where to establish it." [230-232]

b. The planners assign the 14th Armored Cavalry Regiment (14 ACR) to fight the covering-force battle.

"We are trying to envision the way the covering-force battle would go. A cavalry regiment, it's a pretty sizeable outfit. It's got good communications. It covers a lot of ground very quickly not without some punch and it does have an air cavalry squadron. " [264-268]

[I21-G21]:

The second quotation under I11 refers to the main-battle subproblem of the defensive-subproblem decomposition. It also refers to the planners' identification of the forward geographic boundary of this subproblem. At this stage the planners did not discuss this subproblem further.

G. Critique/Evaluate

Following the decomposition of Defensive Subproblem into a Covering-Force Subproblem and a Main-Battle Subproblem, and the assignment of the 14 ACR to the Covering-Force Subproblem, the planners state that the 14 ACR will need more depth in the southern aspect of the covering-force area to
adequately develop a defense and that more continuity between the US 11 Corps and NORTAG in the initial defense will be needed in the northern aspect of the covering-force area. So, these two regions of the covering-force area are marked in decomposition" as problems that need to be addressed by *Local Repair*.

"We would like to give them {14 ACR} a little continuity. And in order to do that, we set what we felt was our first really defensible line. We adjusted your FEBA a little bit. That was to give better continuity in the initial defense and to provide a little bit of depth for the cav to develop. Not a lot, but a little bit. Plus if you look at the area to our north where those guys {NORTHAG} would probably establish. See this continuity. A highway's there. The IGB goes back. So those guys up north would probably be defending along here [points to a region within the NORTAG sector]. So that adjustment, we'd work it out. It's {the degree of adjustment} about the same as the south {adjustment}." [268-279]

**H. Local Repair**

*Local Repair* receives decomposition" as input. Both problem areas marked in decomposition" are repaired by adjusting the FEBA to give more depth in the covering-force area in the south and more continuity with NORTAG in the initial defense in the north. The quotation in *G. Critique/Evaluate* above refers to the nature of these repairs. [268-279]

**I. Alternative Decomposition for Defensive Subproblem**

At this point the planners choose an alternative decomposition for the Defensive Subproblem. We represent this state under INPUT in Figure 4 as a return to the original conjunction of [I1-G1] and [I2-G2]. The planners recognized that this alternative decomposition violated the commander's guidance given in the OPLAN and that this decomposition was chosen only for the purpose of showing what these planners would have done if guidance had not constrained planning in the way that it did.

a. It appears that the planners took issue with the MIDAG commander's guidance to establish a covering force when MIDAG was not going to control that force. Although the planners began development of the first scheme of maneuver in accordance with this guidance, their dissatisfaction with this guidance appeared early in the planning session during their reading of the OPLAN.
"I personally, as a corps commander, would be resentful of that to start with." [234-235]

"If he is going to give me {i.e., the superior commander was not retaining control of the covering force} a sector going all the way to the border, then it's none of his business really whether or not I use a cover force." [241-243]

b. The planners' recognize that the alternative decomposition they would give was a violation of guidance.

"What I personally might have opted to do, and he's cut my options (my commander), I might have considered because this is ..." [299-301]

J. Defensive Subproblem

The planners choose Defensive Subproblem [I1-G1] to be expanded next. We give this interpretation because the planners began working on this subproblem rather than the counter-attack subproblem.

K. Southern-, Middle- and Northern-Battle Subproblems

The planners appeared to decompose Defensive Subproblem [I1-G1] into three subproblems (Southern-Battle, Middle-Battle, and Northern-Battle) each consisting of a geographic region of the US 11 Corps sector originating at the IGB and terminating at the Rhine River.

Initially, the choice for this alternative decomposition seemed to be based on two factors, namely: terrain in the southern aspect of the corps' sector is well-suited for the use of the cavalry regiment; and keeping the battle under the control of a single commander across the entire battlefield.

"... I might have considered because this is pretty damned tough terrain in the southern part of the sector. And because you want to keep the battle under the control of a single commander who can understand what's going on all the way across the battlefield. Particularly when you are waiting for the bad guys to attack you know what they are doing." [301-306]

In a discussion following the planners' presentation of this decomposition of the Defensive Subproblem, they provided additional information regarding its choice.
"Another major factor in that decision process and one that, remember I told you a while ago, that by exploring the whys {i.e., seize initiative to counterattack} within the original guidance dictates to some degree what your scheme up here is [points to map]. It tells you you want to maintain flexibility. One of the ways you gain flexibility is defending on a narrower sector. A sector narrower in fact than your force can defend {i.e., your force can more easily defend on a narrower sector than a wider sector). So you take a combination of the terrain in the south, the width of the sector north of that terrain and you cut that in half then what you've given the division commanders is flexibility for them to maintain their own reserve."

[458-467]

I31:

a. It is inherited by, and partially defines, I31. The planners partitioned the geographic region of the corps sector first by drawing a line from the IGB to the Rhine River in the southern aspect of their sector. This line provides the northern boundary for this subregion of the sector.

"I might have wanted to draw a boundary that went something like this [draws a line on the acetate]." [308-309]

G31:

The planners assign the 14 ACR to the subregion defined in I31. They indicate the ACR will fight both the covering-force battle and main battle in that subregion.

"Giving the cav regiment an economy-of-force mission in the south, and putting two divisions on line from here north [points to the north of the boundary line he had drawn for the 14 ACR] with each division providing its own cover force." [363-367]

I41:

I1 is inherited by, and partially defines, I41. The planners decompose the remainder of the corps sector by drawing another line which begins at the IGB and ends at the Rhine River. This line approximately splits this remaining geographic subregion of the corps sector.

"... and we gave that to the regiment and we put another boundary between divisions up here someplace." [386-387]
G41:

a. The planners assigned one mechanized division (the 90th) to fight both the covering-force battle and main battle in this subregion; they gave the division control of its covering force (see quotation under G31 [364-367]).

This assignment of a single division to fight both these battles seems based on the planners belief that there will be one continuous battle from the IGB to the Weser River (main defense of corps begins at the Weser, i.e., up to this terrain feature the defensive battle will be under the command and control of the corps' subordinate forces; the Weser is the location of the first phase line struck by the planners).

"We're back with the continuity of the battle flow from the border back. Not a strict transition of the battle along here." [389-391]

b. The planners believe a continuous battle should be under the control of one commander.

See second and third sentences in the quotation directly under K. Southern-, Middle-, and Northern-Battle Subproblems. [302-306]

c. In Counter-attack Subproblem [I2-G2] the planners inferred that a division-sized force (armored if terrain is appropriate) would be required to conduct the counter-attack. However, they also stated at that time that if they could not develop a sufficient defense with their other forces, then the armored division, or at least part of it, would not be kept as the reserve force (see G2: d.). Although it was implicit from the time they stated that a division (armored if necessary) would be required to conduct the counter-attack, it was not until the planners were asked about the reserve force that we were certain that they had assigned that task to the 4th Armored Division (4AD).

"In fact we have our task organization. ... What we're seeing right now is a mech to the north and a mech to the south and armored in reserve." [636-644]

d. The planners assigned the 4 AD to the rear of the corps sector immediately behind the subregion of the 90 Mech Div. The planners placement of the reserve force seemed to be based on their beliefs that: the enemy main attack was expected to occur through that subregion; if a major attack came from the south, the reserve would be in a good location to help
defend against that attack and; if the defense meets the objectives of the OPLAN given to the corps, the reserve will be in a good location to conduct the counter-attack.

"You always look for a place you can put it [the reserve]; a place you can fit. You've got to look at what are all the possibilities of your utilization of it. And then you examine the terrain, the situation, your deployment and the feasibility standpoint of doing all those things and it kind of falls out at you." [652-656]

"We're trying to think like the other guy. We've got fewer obstacles along in here. You've got canals, you've got the crossings, the autobahn crosses it. So we think, we probably will make our run this way [points to an area of the map]." [663-667]

"What if the major attack does come along this way [points to an avenue of approach entering the corps sector on its southern flank]? See, we've got pivot points. We're not stuck. We've got plenty of options. And a good operator does that." [679-680]

"Now, what if everything goes according to plan and we don't get these divisions chopped up and they both can get back here and occupy a coherent defense along the Weser? Then that would leave us again poised to do the third thing we were told to do. To be prepared to go attack Magdeburg." [696-702]

e. The planners were asked which factors were considered in deciding which units (types as opposed to size) would comprise the reserve.

"We chose the reserve based on its punch. There's not much difference between a mechanized infantry division and an armored division except that an armored division has six tank battalions. Whereas a mechanized division has only got five. The mech division is five tank, five mech. The armored division has six tanks and four mech. Which means that you've got more armor punch to go into a deep attack with the armored division. The additional consideration is in the main battle area. There are lots of good places there because of all these marshes and bogs and all that kind of stuff, to put dismounted infantry in those built-up areas and places like that to conduct a good defense. Built-up areas aren't where you want tanks. So you've got more infantrymen up there in those two mech divisions than you have in the armored division." [727-740]
"There is one intangible. And this goes right back to something else we told you. We like to keep armor in reserve because of the different mentality within the armored division's tactical operation center. If these three divisions knew what the corps order was, before we ever even came and saw them they would probably already have themselves in place. Because armored divisions are used to being employed in a decisive manner and a reserve is the decisive factor." [741-748]

I51:

I1 is inherited by, and partially defines, I51. The remaining subregion in the corps sector becomes the geographic area for Northern-Battle.

G51:

The planners assigned one division (the 80th Mechanized Division in this case) to fight both the covering-force battle and main battle in this subregion; they gave the 80th Mech Division control of its covering force.

See G41 (a. and b.) for the interpretations and quotations related to this problem statement.

L. Critique/Evaluate

No mention was made of needing to adjust the FEBA or anything else in this decomposition. The assignments of forces (each having its own particular role assigned by the planners) to geographic subregions in this decomposition is believed to represent the core of the solution to the planning problem for the scenario given to the planners.

The planners did mention other factors that they would address in creating a scheme of maneuver if the planning context provided the necessary information and called for such consideration. These factors were the following:

(a) personalities of the supporting commanders

"... the personalities of the supporting commanders. You've got to know that. And there could be overriding considerations that would cause us to designate another guy as the reserve guy."

(b) special forces
"They {the ranger battalion} can be used very, very decisively. ... They could support a counter-attack. They could .... . That's not a major force that we would be playing with as a corps commander."

(c) engineer resources

"Now again if we had a different map based on a very key terrain analysis, we might see this guy up here {Division placed in northern subregion} for whatever reason he might need more engineer resources of a kind. So he could end up with more engineer assets, okay."

(d) support priorities

"This guy {90th Mech Div., i.e., the Division opposing what is believed to be the enemy main attack} would definitely have priority in fires."

**Other key comments**

The planners also mentioned that if a 1:50,000 scale map was available, they might make some minor changes to the terrain regions allocated to the subordinate forces.

"Now, what a 1:50,000 scale map would do for you at this point, now that you've got this basic scheme, is you'd be able to be a little more finite in terms of where those lines go. It may be that when you look at this on a 1 to 50 it may be that the ACR sector might run up here somewhere something like that. You'd just have to look at it where you could see the terrain better. And then you could get even more finite when those guys got on the ground."

The planners also mentioned that the corps planning staff would have important decisions to make regarding the locations of various corps assets.

"Now the other thing that we never got a chance to get into. We touched on it once. Now I, the commander, I feel pretty good about this {scheme of maneuver}. And I'll leave my G3 to fight the battle with the G4 and the COSCOM (Combat Service Support Command) commander and the corps artillery commander. Because everybody and his dog wants real-estate back in here. And the very key thing that the G3 does, and this is the allocation of rearward real estate. If you don't do that right you're going to fix the corps, so that, one, it can't extricate itself ... You really have to balance. ... but it is all driven by the scheme."
When questioned, the planners commented on the apparent quickness with which they assessed the battlefield situation and generated the schemes of maneuver.

"See, we don't know when the attack is coming. And, if it comes tomorrow, based on what we've done in a period of over an hour or whatever, you could call the division commanders in right now. And while they were coming in you could have some ops [operations] guy draw just that [i.e., what was on

the acetate at the end of their problem-solving] on an overlay. And you stand there and just talk the division commanders through it. The way we just did. And they can run away and start doing division plans for it. Now, that's not the end of the process. Now, if the attack isn't coming for another three months, and this continuously gets refined, and it may be, based on the G2's templating and where he puts ... and all that stuff, you might do some adjustments to the FEBA and stuff like that to get stuff outside of artillery range and things like that. It's going to be a continuous refinement. Plus those division commanders now will go out and they will get their brigade commanders in, they'll get their battalion commanders, they'll get their company commanders in and they'll all ... and they'll find things that we didn't find based on our rough map recon. So it's a continuous refinement process."

**Implied Knowledge Classes**

The elements (operations) of the control structure in Figure 4 imply the existence of certain classes of knowledge. In this section we present our current set of those knowledge classes organized by control-structure element. We describe the function served by each knowledge class and give one or more examples to illustrate each function.

**Choose Subproblem**

**Class.** Knowledge must exist regarding the desired order for expanding the plan tree.

**Function.** This knowledge will serve to identify subproblems whose solutions are critical to the success of the overall plan and/or subproblems which should be planned for in more detail before other subproblems.

**Example.** The planners seemed to reserve the armored division for the counter-attack subproblem prior to planning for the defensive subproblem; otherwise, little planning was done for the counter-attack subproblem. A possible explanation for this result is based on our belief that when planning
for a mission of defend and then counter-attack to occur in a world which is
strongly characterized by uncertainty and incompleteness, more planning
should be done for earlier than later activities because the initial and goal
states of later activities typically will be more uncertain than those of
earlier activities.

**Formulate Subproblem**

**Class.** Knowledge is required to recognize an ill-formulated subproblem.
**Function.** This knowledge will allow the planner to know that either the
subproblem needs to be further formulated via retrieval or derivation of
additional information, or it may be more appropriate to choose another
subproblem to expand next.

**Example.** The planners required a more detailed analysis of the terrain
before they began generating a scheme of maneuver.

**Class.** Knowledge is required to convert an ill-formulated subproblem into a
well-formulated subproblem.
**Function.** The knowledge serves to increase a planners confidence in his
choice for a decomposition of a problem by allowing him to reduce the
uncertainty and/or incompleteness of the problem statement before a choice
of decomposition is made.

**Example 1.** Because the information was not given to them, the planners
identified terrain obstacles to the enemy force and the avenues of approach
they believed the enemy would use. Identification of these terrain objects
was performed prior to generating a scheme of maneuver. This example
explicates formulating of an initial state, I_j.

**Example 2.** In analyzing the mission statement and commander's guidance
they receive from their superior command, the planners must have the
knowledge to understand the commanders' intent. They must understand the
relationships between the activities/tasks given (explicitly and implicitly)
to the corps and the superiors' concept of the operation. The planners were
directed to "trade real estate for destruction of PACT forces (preserve
command while inflicting maximum damage)." They understood this
statement, within the context of the entire OPLAN, to mean they should
conduct a dynamic (rather than static) defense and try to maintain unit
integrity in preparation for their counter-attack which would be part of the
MIDAG counter-attack. This example explicates formulation of a goal state,
G_j.
Example 3. This example is similar to Example 2 in that it illustrates the requirement for knowledge that allows the planners to understand the relationship between the activities of the corps and the superiors' concept of the operation. Example 2 illustrates how the concept of the operation can restrict how the corps can fight (e.g., dynamic defense). We believe the present example illustrates the requirement for knowledge that can relate the superiors' concept of the operation to the tactical requirements on what forces the corps can use to execute different portions of the scheme of maneuver. The planners recognize the necessity to be-prepared to counter-attack, and that this necessity imposes a restriction on how they are to defend. The planners said an attack cannot occur with forces in contact so they must create a reserve (an implied operational constraint). The knowledge the planners seemed to apply in this case was as follows: (a) If the intent is to counter-attack after a defense, then prior to constructing a plan for the defensive battle retain an adequate size reserve for the counter-attack. This operation indicates the planners are further formulating the goal state for the counter-attack subproblem by constraining the choice of force to a certain size and (b) Select the reserve type based on counter-attack requirements (e.g., deep-strike capability) and terrain types in defensive and offensive battle areas.

Decompose Subproblem

Class. Knowledge is required to recognize distinct general tactical courses of action, distinct phases of the battle, and geographic locations reflecting points at which critical decisions will be required.
Function. This knowledge is necessary to identify and clarify the types of plans required (e.g., defensive and counter-attack), their spatial extent, and temporal relationships to each other.
Example. The planners decomposed the problem into a defensive subproblem and a counter-attack subproblem. Geographically, they decomposed the defensive subproblem into two areas, namely, that area between the IGB and the Weser River (which they said was one phase of the battle) and that area between the Weser and Rhine rivers (which they said was another phase of the battle). They also identified an area to the east of the Weser River which they said they would use as a point to assess the flow of the defensive battle and to make a critical decision regarding how to adjust the forces.

Class. Tactical knowledge of the relationships between roles, force types, configurations and terrain types is required.
Function. This knowledge is used to assign roles to forces, and to assign those forces in appropriate configurations to geographic areas to solve a subproblem.

Example. Having understood the commanders' intent, the planners had to decide which forces should be placed on which geographic areas in order to provide a dynamic defense which would solve the defense subproblem. The second scheme of maneuver along with the assignments of particular forces to particular geographic areas represents the application of such knowledge.

Critique/Evaluate

Class. Knowledge is required to do critiquing and evaluation of the plan tree.

Function. This knowledge serves to detect and describe conflicts in a decomposition and opportunities for improving adequate decompositions.

Example. The planners detected that the covering-force area in the southern aspect of the corps' sector was too shallow to adequately develop a covering-force defense in depth in that area.

Local Repair

Class. Knowledge is required to resolve detected conflicts, or make improvements to adequate decompositions, in a plan subtree.

Function. In addition to resolving detected conflicts and improving adequate solutions, this knowledge should alert the meta-planner when detected conflicts cannot be resolved. This knowledge should make it possible to express the basis of the failed repair.

Example. The planners resolved the problem of an inadequate covering-force area in the southern aspect of the corps' sector by moving the FEBA farther west in that area.

CONCLUSIONS

The most striking aspect of the protocol for this corps planning problem is the interleaving of the task of subproblem formulation with the tasks of subproblem decomposition, plan critiquing and plan repair. Further, the evidence from the protocol is quite consistent with the ordering of these tasks as predicted from our first-order model. Also of note is the fact that the experts developed, at most, two alternative plans.

The second plan generated by the planners was a revision of the first. The second plan was the result of backtracking to a location in the plan tree where all of the planning results (including problem formulation) to that
point in the first plan were retained in the second plan. For the second plan, the planners retained the first plan through the point where they had decomposed the problem into the defensive and counter-attack subproblems. The plan tree was expanded from that location to complete the second plan. Thus, the planning observed supports an overall depth-first search strategy (and associated local plan repair). It should be noted that the first plan they began to construct was constrained by guidance, in the OPLAN they were given, in such a way that they generated a partial plan which was different from what they would have produced if guidance had not constrained them in the way that it did (the second plan they generated was recognized by the planners as a violation of guidance, but produced for purposes of the exercise).

Another characteristic of the planning process was that it was done in a temporally forward direction with respect to the ordering of battle types faced by the corps. The planners appeared to impose one constraint on the counter-attack subproblem very early in planning, but otherwise they planned for the defensive subproblem first. It may be that an offensive mission would show more backward reasoning related to less uncertainty about the initial and goal states.

Knowledge Acquisition and Planning Aids

The interleaving of subproblem formulation with planning tasks is of considerable significance for projected work in knowledge acquisition and the development of planning aids in this domain. First, with respect to knowledge acquisition, this suggests that attention must be given to identifying the knowledge and expertise required to recognize ill-formulated subproblems and the knowledge required to develop the information needed to transform an ill-formulated subproblem into a well-formulated one.

Large institutionally created and supported databases are crucially involved in this task of subproblem formulation. In some cases, the information required by the planners is directly available in the database and support could be realized through provision of a fairly standard query language. However, in other cases the information required to support planning must be derived through inference. Further, in some cases, the inference process may involve the use of default assumptions. Here the ability to provide computational aids in carrying out the inference, as well as in annotating the structure of the inference process, might be of considerable importance.

One type of computational aid that may be of importance in this type of planning is external memory. The vast quantity of information to consider in
this type of planning and the apparent complexity of the structure of this type of plan suggests that the inferencing necessary to generate plans and the subsequent evaluation, maintenance, and revision of plans are hindered by human memory limitations. External memory to facilitate the storage and retrieval of necessary information, related to situations and plans, should allow planners to have a style of planning less hampered by human memory limitations. For example, an external memory facilitating the recording and retrieval of assumptions and decisions made as part of the planning process should increase the planners' capability to simultaneously consider multiple plans.

Also, we think it is appropriate to view this type of planning as cooperative problem-solving. There appears to be much knowledge that needs to be shared and understood by multiple problem-solvers to support the development of coherent plans. For example, we observed that the planners' communications largely were with respect to information provided by, or that they recorded on, the map and acetate. Here again we see a potentially important role for external memories in this type of planning.
Notes

1. The value of the subscript indicates a particular decomposition.

2. An operations order is an order issued by a commander specifying missions and tasks to be accomplished by his subordinate units. The order normally specifies a time at which the operation is to commence, and, unless superseded by a later order, subordinates are to take all necessary action to begin execution at that time. An operations plan is prepared to be executed at some future time, normally unspecified. Operations plans are normally prepared in advanced for certain contingencies, and are executed upon order of the commander.

3. The FEBA is the Forward Edge of the Battle Area, a control measure that identifies where the beginning of the main battle area for the operation will be. Forces within the main battle area defend, attempting to deny success to the enemy forces. Forces forward of the main battle area, the covering force in a defense, attempt to delay the enemy as it approaches the FEBA, disrupting and confusing his approach.

4. In mission analysis (FM 101-5 Staff Organization and Operations) the planners must identify specified and implied tasks. By task we mean subgoal rather than subproblem because it appears that specified tasks are more like statements of objectives than statements of problems.

5. Another area where there may be implications for knowledge acquisition and development of planning aids involves understanding the extent practice differs from pedagogy in this type of planning. Some of the questions for which answers should be sought are as follows: Do planners use their own procedures or those taught in the schools? In what way are principles of war and key concepts of operational design used by planners (e.g., in plan generation, plan evaluation, or solution explanation)? How explicit is the use of such principles and concepts?
References


HQ, Department of the Army, FM 101-5, Staff Organization and Operations, 1984.


Appendix A

*A and *B = planners
*C and *D = interviewers

001 *A NOT MAJOR THINGS, BUT A WHOLE LOT OF GARBAGE... [POINTS TO
002 THE LEFT OF THE CHART] THIS CANAL HERE WHICH IS AS DEEP AS THE
003 MITTELAND CANAL, THE WESER WHICH IS... THE LEINE UP HERE AND
004 THE OPEN... RIGHT IN HERE IS MARSHY [*A POINTING TO THE CENTER
005 OF THE THREE PATHS] ... [SPEAKING IN LOW VOICES,
006 INDISTINGUISHABLE]

007 *B THE IMMEDIATE FORCES FACING US ARE ALL ARMoured?

008 *A YEAH

009 *B HEAVY TANKS?
010 [MORE INDISTINGUISHABLE MURMERING *A POINTING TO TOP RIGHT
011 QUADRANT OF THE MAP USING MARKER TO SHOW FLOW OF BLUE AREA]

012 *B THE REAL OBJECTIVE HOWEVER IS A DEEP OBJECTIVE BACK HERE
013 ACROSS THE LEINE. RAPIDLY, THEY'RE GONNA WANT TO BYPASS HANNOVER
014 AND ALL THIS BUILT UP STUFF OVER HERE. [POINTS TO THE LEFT OF
015 THE UPPER CENTER]. ...IF THEY GO NORTH THEY CAN'T USE THE
016 AUTOBAHN. IF THE BRIDGES ARE DROPPED ON THE AUTOBAHN THEY'VE GOT
017 THREE RIVER CROSSINGS TO MAKE... MARSHY AREAS HERE [UPPER RIGHT
018 QUADRANT]... I PUT EM DOWN THROUGH HERE [POINTS TO CENTER RIGHT],

019 *A [POINTS TO UPPER RIGHT] SOME OF THESE HERE, PERHAPS SIX, WILL
020 TRY TO MAKE IT THROUGH TO FEINT AN ATTACK.

021 *B YEAH AND THEN THE MAIN ATTACK WILL BE COMING ACROSS HERE
022 [POINTS TO RIGHT CENTER AND THEN ACROSS TO LEFT]

023 *A WANT ME TO DRAW SOME ARROWS?

024 *B YEAH

025 *B THE FIRST CONSTRAINT IS WORKING WITH THIS SCALE MAP.

026 *B NEVER PLAN ON A 1 TO 250,000 SCALE.

027 *A [TURNS AROUND AND FACES CAMERA] THE OLD STORY; LITTLE THINGS MEAN
028 A LOT.

029 *B THE IDEAL IN MY VIEW IS 1 TO 100. IT GIVES YOU A LEVEL OF
030 RESOLUTION THAT IS MUCH BETTER THAN THIS. [*A AND *B LOOK AT MAP]

031 *C WOULD YOU NORMALLY HAVE A SERIES OF TERRAIN OVERLAYS AVAILABLE
032 THAT YOU WOULD USE IN DOING THIS.

033 *B YEAH, G2 WOULD NORMALLY WORK ONE, BUT AT THE POINT WE'RE AT
034 RIGHT NOW IN THE PLANNING HAVING JUST RECEIVED THIS ORDER THEY
MAY OR MAY NOT HAVE. IF THIS IS 11TH CORPS' LONG TRADITIONAL GDP
SECTOR; YEAH YOU WOULD HAVE ALL OF THAT. BUT AS I HAVE READ THE
SITUATION THAT HAS BEEN PRESENTED HERE, THAT'S NOT THE CASE.

*A THAT'S RIGHT SIR. [A LOOKING AT *B. THEN *A LOOKING AT
CAMERA] IN TERMS OF WHAT WE'LL PROBABLY DO, THIS BEING THE TOP,
WE'LL PROBABLY AMBLE OVER TO THE MAP, AND MAYBE TAKE A LOOK AT
WHERE
THAT WESER IS, GET A LOOK AT THE MAJOR LANDMARKS, GET YOURSELF
ORIENTED, YOU KNOW, ON THE MAP. YOU KNOW, WHAT HAVE I GOT TO
OPERATE WITH. THAT'S ALL WE ARE DOING HERE. WHAT DOES IT LOOK
LIKE.

*B WHAT I GENERALLY DO WHEN YOU GET ONE LIKE THAT IS SIT
THERE AND LOOK AT THE MAP, WHAT YOU ARE TRYING TO DO IS GET A
FEEL FOR HOW THE TERRAIN LAYS AND HOW IT ALL FITS TOGETHER, AND
THINGS JUST KIND OF START POPPING OUT AS YOU LOOK AT THE MAP.
BUT YOU CAN'T DO IT AT THIS SCALE. YOU CAN'T. IT TAKES A LOT
LONGER AND YOU DON'T GET THE LEVEL OF RESOLUTION THAT YOU NEED.
I'D PROBABLY BE SATISFIED WITH THAT MAP ONLY SO LONG AS IT TOOK
MY STAFF TO ASSEMBLE A 1 TO 50,000.

*C SO THE ENTITY THAT HAS POPPED OUT IN THIS SITUATION IS THE
EXTENSIVE WATERWAYS?

*B [POINTING TO RIGHT EDGE OF MAP] YOU START OFF AND YOU LOOK
OUT HERE AND WHAT YOU SEE ARE TANK FORCES. OKAY? WHAT DO TANK
FORCES NEED TO ATTACK? THEY NEED GOOD TERRAIN [POINTING TO THE
LEFT] WATER IS A MAJOR OBSTACLE. ONE THING THAT JUST JUMPS OUT
AT YOU AS YOU LOOK AT THAT AREA IS THE AMOUNT OF BLUE. ALL THE
RIVERS AND CANALS AND MARSHY AREAS AND ALL THAT STUFF. SO WHEN
YOU TAKE THOSE TWO FACTS AND PUT THEM TOGETHER YOU LOOK FOR
AVENUES THAT DON'T HAVE THOSE THINGS. *A PLUS HAVE ROADS THAT
NATURALLY FLOW. *B TRY TO PROJECT YOURSELF INTO THE HEAD OF THE
BAD GUY, COMMANDER. IF I WAS HIM, WHAT WOULD I DO? THAT'S THE
PROCESS WE WENT THROUGH TO COME UP WITH THOSE THREE MAJOR ACCESES.
WE'RE WORKING GROSS ESTIMATES AT THIS POINT, IF YOU WILL, MACRO-
ESTIMATES. WE AINT WORRIED ABOUT REGIMENTAL LEVEL AVENUES OF
APPROACH AND THAT KIND OF STUFF.

BUT JUST A QUICK LOOK AT THAT

TERRAIN. WHAT IT TELLS ME IS DESPITE THE FACT THAT THE MIDDLE
ARMY COMMANDER SAID THAT THE MAIN ATTACK WAS COMING FROM THE
NORTH, I REJECT THAT. I MEAN THE MAIN ATTACK FROM THE NORTHERN
PART OF THE 11TH CORPS SECTOR, AND THE REASON I REJECT THAT IS I
GOT MYSELF IN THE HEAD OF THE OPPOSING ARMOUR HEAVY FORCE
COMMANDER. HE LOOKS AT THIS TERRAIN [POINTS TO THE RIGHT CORNER
OF THE MAP] THE HIGH SPEED AVENUE THAT COULD GET YOU IN THERE
QUICKEST IS THE AUTOBAHN. BUT, YOU SAY TO YOURSELF, YEAH BUT HE'S
GOING TO DROP ALL THE BRIDGES ON THE AUTOBAHN SO YOU'VE GOT TO
WORST CASE IT AND GOTTA ASSUME YOU AIN'T GONNA BE ABLE TO USE IT.
THIS DOESN'T MEAN YOU'RE NOT GOING TO PUT FORCES ON IT AND TRY TO USE IT
JUST IN CASE HE SCREWS UP. BUT THE SMART OPPOSING COMMANDER IS
GOING TO DROP ALL THE BRIDGES AND YOU WONT BE ABLE TO USE IT.
WHAT WOULD THAT LEAVE YOU WITH THE NORTH. IT WOULD LEAVE YOU GOING
THROUGH LOTS OF BLUE. YOU VE GOT TO
MAKE THREE RIVER CROSSINGS IN THE NORTH, ONE OF WHICH IS A MAJOR
CANAL, WHICH IS DIFFICULT AND REQUIRES ASSETS TO THESE
DIVISIONS TO DO THAT WITH. HERE, IF YOU RE SUCCESSFUL IN GETTING
ACROSS THESE THREE MAJOR WATER OBSTACLES [POINTS TO THE TOP
CENTER OF THE MAP] THIS WILL DUMP YOU INTO THE MIDDLE OF DOWNTOWN
HANOVER. IF YOUR OBJECTIVE IS TO MAKE A DEEP ATTACK AND SEIZE
CROSSINGS OVER THE RHINE [POINTS TO THE LEFT OF THE MAP] YOU
DONT WANT TO SCREW AROUND FIGHTING THROUGH THE BUILT UP AREA
AROUND HANOVER AND EVEN IF HE GETS THROUGH HANOVER, WHAT HAS HE
GOT? HE S GOT A BUNCH OF BLUE AGAIN. ONE OF WHICH RUNS RIGHT
DOWN THE CENTER OF THE SECTOR AND KIND OF PINCHES HIM OUT HERE
[POINTS TO TOP LEFT QUADRANT] SO HE S GOT MORE RIVER CROSSINGS.
MORE BUILT UP AREAS, WUSDORF AND OUT HERE AT MINDEN HE S Gotta
GO THROUGH. THAT S WHY I PERSONALLY REJECT THE IDEA OF HIS
MAKING HIS MAIN EFFORT FROM THE NORTH. THEN YOU LOOK FOR
ANYTHING ELSE THAT CAN INFLUENCE YOUR AREA AND THIS IS A NATURAL
RIGHT HERE [POINTS TO LOWER RIGHT QUADRANT OF MAP, CURVES TOWARDS
THE CENTER]. A NATURAL HIGH SPEED, DIVISION PLUS, AVENUE OF
APPROACH. IT COMES UP OUT OF THE 2ND BELGIAN CORP SECTOR AND IF YOU
FOLLOW THE NATURAL FLOW OF THAT AVENUE OF APPROACH IT DOESN T GO
DOWN THROUGH THE BELGIAN SECTOR BECAUSE OF THE TERRAIN. YOU VE
GOT A MAJOR RIDGE LINE THAT COMES THROUGH HERE [POINTS TO CENTER
OF LOWER LEFT QUADRANT], YOU VE GOT RIVER CROSSINGS THAT YOU VE
Gotta MAKE, YOU VE GOT A BIG ESCARPMENT DOWN HERE [POINTS TO
LOWER LEFT QUADRANT]. THE NATURAL FLOW OF THAT USING THE NORMAL
ROUTES THAT ARE THERE [POINTS TO CENTER OF LOWER RIGHT QUADRANT,
CURVING UPWARD WITH TWO FINGERS] IS RIGHT UP IN TO HERE [POINTS
TO CENTER OF MAP], INTO OUR CORPS. WELL, THAT S A MAJOR
CONSIDERATION HERE. THAT TELLS ME THAT THE MAJOR ATTACK, BY THE
BAD GUY, OUGHT TO BE THROUGH HERE [POINTS TO CENTER RIGHT OF MAP]
BECAUSE THE TERRAIN IS MORE TRACTABLE; IT S MORE CONducIVE TO
MOVEMENT BY TANK FORCES. YOU STILL HAVE SOME RIVER CROSSINGS
YOU Ve GOT TO MAKE BUT YOU STILL HAVE MORE OPTIONS BY PUTTING
YOUR MAIN EFFORT DOWN HERE [POINTS TO CENTER RIGHT OF MAP] THAN
YOU HAVE IF YOU PUT IT UP HERE [POINTS TO RIGHT UPPER QUADRANT].
NOW TO FACILITATE MY USING THIS AS MY MAIN ACCESS IF I M THE BAD
GUy, I MAY TRY TO MAKE THE BLUE GUY THINK THAT MY MAIN ATTACK IS
IN THE NORTH AND GET HIM TO TRY TO DEFEND HEAVILY UP HERE. SO HE
MAY CONSIDER ATTACKING THAT. NOW WHAT DOES THAT TELL YOU FROM
THE BLUE GUYS SIDE, IN TERMS OF YOUR THINKING? THAT IF YOU SEE
SOMETHING UP HERE DON T AUTOMATICALLY ASSUME THAT IT S THE MAIN
ATTACK. THAT S WHAT YOU LL TELL ME.

* A OK. NOW THE OTHER THINGS THAT WE WOULD, NOW THIS IS ALL GOING
ON CONCURRENTLY, OK? WE VE LOOKED AT THIS. WE KNOW ESSENTIALLY
THAT HE S SAYING IS, AND IT S IMPORTANT THAT WE KNOW THE
LEVEL ABOVE US, THAT SINCE THIS IS A MAJOR THREAT, UH, LETS SEE NOW,
LET ME BACK UP HERE SO I CAN BE SURE... [READING FROM DOCUMENT]
SO THE CONCEPT CALLS FOR HALTING AND DESTROYING PACT FORCES
ATTACKING NORTH AND MIDDLE ARMY GROUP WHILE ...[STARTS
TALKING VERY FAST, NOT INTELLIGIBLE, STOPS READING FROM DOCUMENT
AND POINTS TO LEFT UPPER QUADRANT OF MAP]... ANYHOW WE VE
CONDUCTED DEFENSE IN DEPTH UP HERE. OH, AND, WHAT CINCENT WANTS
TO DO IN THE SOUTH IS CONDUCT HIS MAJOR ATTACK. SO WE KNOW THE
BOSS, HE'S TOLD US, OK NOW TO FACILITATE THAT, GUYS, I WANT YOU
TO DEFEND IN ZONES FORWARD OF A CERTAIN LINE, BUT, AND HE
UNDERLINES, AND HE TELLS ME TWO THINGS. A LITTLE BIT
CONTRADICTORY. HE SAID, "ORIENT ON THE DESTRUCTION OF HIS
FORCES, BUT, AND HE UNDERLINES THAT, AND IN ANY CASE YOU MUST
PRESERVE YOUR COMMAND WHILE INFLICTING MAXIMUM DAMAGE ON THE
ATTACKER, AND WHAT HE WANTS TO DO OBVIOUSLY IS HAVE ENOUGH LEFT
AFTER OUR DEFENSE TO COUNTER-ATTACK. TO SEIZE MAGDEBURG WHICH IS
UP HERE [POINTS TO TOP RIGHT QUADRANT OF MAP]. IN TERMS OF WHAT
HE DID THAT'S PRETTY GOOD. I MEAN I'M CLEAR. HIS CONCEPT IS
CLEAR. HIS INTENT IS CLEAR. THIS COULD START TELLING ME A FEW
THINGS IN TERMS OF HOW TO ORGANIZE A DEFENSE. I MEAN I'M NOT
GOING TO DIE IN PLACE. HE DOESN'T WANT ME TO DO THAT. MAX
CASUALTIES, BUT DON'T LOSE YOUR COMMAND WHILE DOING IT; MAINTAIN
ENOUGH. AND THEN ONE THING HE DIRECTS; HE DIRECTS THAT WE
ESTABLISH A COVER FORCE.

"NOW I DON'T UNDERSTAND THAT. THAT WOULD NOT NORMALLY BE A
THING TO COME OUT OF THAT LEVEL OF COMMAND. HE GIVES YOU A PIECE
OF DIRT AND LETS YOU DECIDE HOW TO DO THAT. I DON'T KNOW WHO'S
GOT THIS COVER FORCE IDEA.
[DELETED]
"C MAYBE WE'VE MADE TOO MANY TRIPS TO THE WAR COLLEGE. MAYBE
WE'RE CONTAMINATED.

"YEAH. IT MAY BE THAT I'LL WANT TO ESTABLISH A COVER FORCE,
AT THAT LEVEL OF COMMAND YOU WOULD NOT NORMALLY DIRECT A
COVER FORCE.

"A THE BOSS WOULD LIKE US TO HOLD EAST OF WESER [RIVER JUST
WEST OF HANOVER]. HE WOULD REALLY LIKE THAT. HE SAYS "I BELIEVE
WE CAN STOP THE ATTACKER EAST OF THE WESER RIVER, AND NORTH OF
THE FULDA RIVER. IF WE DO, IT WILL MAKE IT EASIER FOR THE MIDDLE
ARMY GROUP TO ASSUME THE DEFENSIVE. IF WE CANNOT, AND HERE AGAIN
THIS IS PRETTY CONSISTENT WITH TELLING US NOT TO DIE IN PLACE, IF
WE CANNOT STOP THE ATTACK THEN I WILL NEED YOUR CORPS AND SUBORDINATE
COMMANDS AS QUICKLY AS POSSIBLE IN ORDER TO STOP HIM BETWEEN
THE WESER AND THE RHEINE. SO, I'M GOING TO HAVE TO PLAN, YOU
KNOW, FOR A DEFENSE FROM HERE [POINTS TO LEFT UPPER QUADRANT OF
MAP WEST OF HANOVER] AND ALL THE WAY BACK TO THE RHEINE WHICH IS
OFF THE MAP. IT'S ABOUT A HUNDRED CLICKS.

"WHAT THAT'S DONE IS DICTATED THE FIRST PHASE LINE THAT YOU
PUT ON THE MAP.

"NEAR THE WESER RIVER?

"YES. BECAUSE YOU KNOW THAT THERE'S A PHASE, AT LEAST ONE
PHASE, THAT'S GOING TO HAPPEN BEFORE THAT. AND AT LEAST ONE
PHASE THAT'S GOING TO HAPPEN BEHIND THAT. AND IT'S A
GEOGRAPHICAL DISTINCTIVE FEATURE. THEREFORE YOU WOULD STRIKE
SOME SORT OF PHASE LINE THERE.
"A SO, WHAT HE AND I ARE GOING TO PRETTY WELL HAVE TO FIGURE
OUT NOW IS WE'RE GOING TO START LOOKING AT WHAT... AND WHO WE...
(DELETED).

*B WHERE YOU'RE GOING TO MAKE YOUR FIRST LINE OF EFFORT AT.

*A SO NOW WE'RE GOING TO START DOING THAT [*A AND *B TURN TOWARD
MAP].

*C OK SIR, LET ME ASK A COUPLE OF QUESTIONS. DID YOU DETERMINE TO
YOUR SATISFACTION WHAT YOUR HIGHER COMMANDER'S INTENT IS AT THIS?

*A YES. WE BELIEVE HE DID A PRETTY GOOD JOB IN TELLING US WHAT
HE INTENDED TO DO. IT'S VERY CLEAR TO US.

*C YES SIR. AND WHAT WERE THE IMMEDIATE, JUST A REHASH OF, THE
IMMEDIATE IMPLICATIONS THAT CAME ACROSS YOUR MIND IN DETERMINING
THE COMMANDER'S INTENT?

*A THE IMMEDIATE TWO THINGS. ONE IS THE ENEMY IN
SECTOR.

*B YOU'VE GOT NO REQUIREMENT TO CONDUCT A STATIC DEFENSE, NUMBER 1.

*A AND DON'T LOSE OUR FORCES WHILE DOING THAT. THOSE ARE THE
TWO BIGGIES IN MY MIND.

*B FOCUS ON DESTROYING ENEMY FORCES AND AT THE SAME TIME ON
PRESERVING YOUR OWN FORCES.

*A AND IN THE BACK OF MY MIND I KNOW, SEE, THIS IS WHERE WE SAID
IF WE UNDERSTAND THE COMMANDER'S INTENT WE CAN PLAN A LOT SMARTER
BECAUSE HIS INTENT IS ULTIMATELY FOR US TO COUNTERATTACK.
KNOWING THAT, IT ALL MAKES SENSE. YOU CAN'T COUNTERATTACK WITH
NOTHING.

*B TO A DEGREE IT IMPOSES A RESTRICTION ON HOW YOU DEFEND. THE
RESTRICTION BEING, YOU'VE GOT TO KEEP IN THE BACK OF YOUR MIND A
CONTINUOUS READINESS TO ATTACK. YOU CANNOT ATTACK WITH FORCES IN
CONTACT.

*C SO THAT MEANS...?

*B WHICH TELLS YOU THAT YOU GOTTA KEEP A RESERVE. A RESERVE,
THAT HAS THE CAPABILITY TO KICK BUTT. IN GROSS TERMS WHAT IT TOLD
ME IS KEEP A DIVISION IN RESERVE AND IF THE TERRAIN DICTATES
KEEP AN ARMoured DIVISION IN RESERVE. THAT'S WHAT IS TOLD ME.

*C WOULD YOU AGREE WITH THAT SIR? [*A]

*A YES. BECAUSE YOU SEE....

*B [INTERRUPTS] UNLESS THE TERRAIN DICTATES DIFFERENTLY.
A NOW WE MAY GET UP HERE AND LOOK AT THIS THING. WE'VE GOT THREE DIVISIONS. WE MAY NOT BE ABLE TO ATTRIT SUFFICIENTLY WITH TWO. WHICH POSES A LIMIT. IT COULD MEAN WE'LL TAKE A BRIGADE. IT COULD MEAN WE'D TAKE A BRIGADE PLUS THE CAV. REGIMENT WHICH WILL BE THE SCREENING FORCE. IT COULD MEAN... BUT IT'S GOT IMPLICATIONS. MOST GUYS LIKE TO KEEP SOMETHING IN THEIR HIP POCKET ANYHOW.

*C YOU ALSO EXTRACTED THE NECESSITY TO ESTABLISH A COVERING FORCE AS WELL?

*B WELL, IN FACT WE WERE TOLD TO. IT'S AS CUT AND DRIED AS THAT.

*A HE EVEN TOLD US WHERE TO ESTABLISH IT. ALONG HERE [POINTS TO RIGHT UPPER QUADRANT OF MAP] ALONG THE IGB.

*B I PERSONALLY AS A COMMANDER WOULD BE RESENTFUL OF THAT TO START WITH.

*C IS THAT AS A CORPS COMMANDER, SIR?

*B YES.

*C AT A DIVISION YOU WOULD EXPECT THE CORPS TO TELL YOU HOW TO COVER FORCE IF THERE WAS GOING TO BE ONE FOR THE CORPS...

*B [INTERRUPTS] ONLY IF THE CORPS COMMANDER WAS GOING TO RETAIN CONTROL OF THE COVER FORCE. IF HE WAS GOING TO GIVE ME A SECTOR GOING ALL THE WAY TO THE BORDER THEN IT'S NONE OF HIS BUSINESS REALLY WHETHER OR NOT I USE A COVER FORCE.

*C OK SIR.

*A GOT ANY MORE QUESTIONS?

*C IF WE JUMP BACK TO OUR TERMINOLOGY THAT WE'VE BEEN USING UP TO NOW, THE WHY PART THEN FOR THE CORPS IS TO DESTROY ENEMY FORCES?

*B NO. IT'S TO DESTROY THE ENEMY FORCES FOR THE PURPOSE OF GAINING THE INITIATIVE TO ATTACK. THAT'S THE REAL WHY.

*C OK.

*A REMEMBER THAT WE SAID THAT TO BE PREPARED IS ALWAYS A CONSTRAINT ON WHAT YOU HAVE. AND SURE ENOUGH WE'VE GOT THAT. WE HAVE TO BE PREPARED TO DO THAT.

{DELETED}

{DELETED}

{DELETED}

{DELETED}
[A turns back to the camera, "B has left the camera range. A
wide vertical line has been drawn on the map in the upper right
quadrant near the center]

* A OK GUYS. DO YOU KNOW WHAT WE HAVE DONE SO FAR?

* C NO SIR.

* A OK LET ME... WE ARE TRYING TO ENVISION THE WAY THE COVERING
FORCE BATTLE WOULD GO. A CAVALRY REGIMENT, IT'S A PRETTY
SIZEABLE OUTFIT. IT'S GOT GOOD COMMUNICATIONS. IT COVERS A LOT
OF GROUND VERY QUICKLY NOT WITHOUT SOME PUNCH AND IT DOES HAVE AN
AIR CAVALRY SQUADRON. WE WOULD LIKE TO GIVE THEM A LITTLE BIT OF
CONTINUITY. AND IN ORDER TO DO THAT WE SET, WHAT WE FELT WAS OUR
FIRST REALLY DEFENSIBLE LINE. WE ADJUSTED YOUR FEBA A LITTLE
BIT. THAT WAS TO GIVE BETTER CONTINUITY IN THE INITIAL DEFENSE
AND TO PROVIDE A LITTLE BIT OF DEPTH FOR THE CAV TO
DEVELOP. NOT A LOT. BUT A LITTLE BIT. PLUS, IF YOU LOOK AT THE
AREA TO OUR NORTH, WHERE THOSE GUYS WOULD PROBABLY ESTABLISH...
SEE THIS CONTINUITY. A HIGHWAY'S THERE. THE IGB GOES BACK...
SO THOSE GUYS UP NORTH WOULD PROBABLY BE DEFENDING ALONG HERE
[POINTS TO UPPER RIGHT QUADRANT NEAR THE CENTER DIRECTLY ABOVE
THE WIDE VERTICAL LINE]. SO THAT ADJUSTMENT; WE'D WORK IT OUT.
IT'S ABOUT THE SAME AS THE SOUTH. IT'S JUST A MATTER OF
ADJUSTMENT IN TERMS OF HOW TO ALLOCATE THE STUFF.

* C IS THERE ANY REASON WHY YOU CHOSE TO WORK ON THE COVERING FORCE
FIRST?

* B THE FACT THAT WE'VE BEEN DICTATED TO HAVE A COVER FORCE.

* C SIR, WHY DID YOU CHOOSE TO WORK ON THAT FIRST BEFORE YOU
LOOKED AT THE MAIN BATTLE AREA?

* A THAT'S THE FIRST THING THAT WILL FIGHT.

* B WHAT YOU'VE GOT TO DO IS SUBDIVIDE THE BATTLEFIELD INTO
COVERING FORCE AREA AND THE MAIN BATTLE AREA. YOU DETERMINE THE
MAIN BATTLE AREA BASED UPON WHERE THE FIRST DEFENSIBLE TERRAIN
WHERE YOU CAN HAVE A CONTINUOUS DEFENSE ESTABLISHED. THAT
BECOMES BY DEFINITION THE FLOT OR OF THE FEBA OR THE MAIN BATTLE
AREA. BY DEFINITION EVERYTHING TO THE BAD GUYS SIDE OF THAT IS
COVERING FORCE AREA. SO, WHILE IT MIGHT HAVE APPEARED THAT WE
WERE
CONCENTRATING ON THE COVERING FORCE, THE FACT IS WE WERE DRAWING
THE LINE BETWEEN THE MAIN BATTLE AREA AND THE COVERING FORCE
AREA. THAT'S WHAT WE JUST DID. NOW THINGS THAT IMPACT ON THAT
IS YOU LOOK TO THE EAST OF THAT LINE AND SEE WHAT
GIVES US A PROBLEM TERRAIN-WISE IS WHERE THE IGB PULLS BACK RIGHT
HERE [POINTS TO BASE OF LINE]. WHAT I PERSONALLY MIGHT HAVE OPTED TO
DO, AND HE'S CUT MY OPTIONS (MY COMMANDER), I MIGHT HAVE
CONSIDERED, BECAUSE THIS IS PRETTY DARNED TOUGH TERRAIN HERE IN
THE SOUTHERN PART OF THE SECTOR. AND BECAUSE YOU WANT TO KEEP
THE BATTLE UNDER THE CONTROL OF A SINGLE COMMANDER WHO CAN
UNDERSTAND WHAT'S GOING ON ALL THE WAY ACROSS THE BATTLEFIELD.
PARTICULARLY WHEN YOU'RE WAITING FOR THE BAD GUYS TO ATTACK,
YOU KNOW WHAT THEY ARE DOING. I MIGHT HAVE CHOSEN TO PUT THE
CAVALRY DOWN HERE IN AN ECONOMY OF FORCE SECTOR [POINTS TO
THE RIGHT OF THE BOTTOM OF THE VERTICAL LINE]. I MIGHT HAVE
WANTED TO DRAW A BOUNDARY THAT WENT SOMETHING LIKE THIS [DRAWS A
HORIZONTAL LINE NEAR THE BOTTOM OF THE VERTICAL LINE]. IT COMES
IN HERE AND GIVE THAT TO THE CAV. REGIMENT, AN ECONOMY OF FORCE,
AND PUT MY TWO DIVISIONS UP HERE [POINTS TO THE TOP RIGHT OF THE
VERTICAL LINE]. ALL THE WAY FROM THE EIGB, FIGHT THIS BATTLE ALL
THE WAY BACK BECAUSE THERE'S NOT A NATURAL BREAK TO THE BATTLE
FLOW AS IT COMES DOWN THROUGH HERE. BUT THE FIRST DEFENSIBLE
TERRAIN AS YOU COME THROUGH HERE COMES ALONG THE RIVER HERE. THE
RIVER LINE COMES UP THROUGH BRAUNSCHWEIG AND THEN CONTINUES ON
UP THROUGH THE NORTH HERE. THIS IS NOT REAL GOOD DEFENSIBLE
TERRAIN UP HERE [POINTS TO THE TOP OF THE VERTICAL LINE AND DRAWS
A MEDIUM SIZE CIRCLE WITH HIS FINGER AROUND THE TOP OF THE LINE],
THERE'S A LITTLE BIT, BUT, THE COMMANDER WHO OWNS THAT PIECE OF
DIRT IS GOING TO CONCENTRATE ON MAKING HIM FIGHT HIS WAY THROUGH THESE
TOWNS AND BUILT UP AREAS AND BOGS AND SWAMPS AND ALL THAT WATER.
BUT THERE'S NOT GOING TO BE A REAL STRONG CONTINUOUS DEFENSE
ALONG THAT LINE. WHERE WE ARE NOW, BECAUSE HE HAS DICTA**ED A
COVERING FORCE, THIS OPTION ISN'T OPEN TO ME ANY MORE [POINTS TO
LEFT OF BOTTOM OF LINE]. SO THE PROBLEM YOU RUN INTO NOW IS THE
DEFENSIBLE TERRAIN IS HERE [POINTS TO UPPER RIGHT QUADRANT
THE GOOD DEFENSIBLE TERRAIN IN THE
SOUTH YOU CAN TIE THAT IN TO BRAUNSCHWEIG UP TO ABOUT HERE
[POINTS TO CENTER RIGHT OF VERTICAL LINE]. GOOD DEFENSIBLE
TERRAIN HERE [POINTS TO LOWER PART OF LINE, A LITTLE BIT ABOVE
THE BOTTOM]. GOOD COVERING FORCE OUT HERE [POINTS TO RIGHT OF
LOWER PART OF LINE]. BUT, WHAT HAPPENS DOWN HERE [POINTS TO LOWER
RIGHT OF BOTTOM OF LINE]. YOU KNOW AFTER THE FIRST FIGHT, THE
BATTLE HAS TO BE IMMEDIATELY SHIFTED TO THE MBA FORCE, IF
THERE WAS A MAJOR ATTACK THAT CAME IN HERE THAT UNHINGED THE
GUY THAT WAS FIGHTING THE COVERING FORCE DOWN HERE [POINTS TO RIGHT
SIDE OF BOTTOM OF LINE].

* OF COURSE THE TERRAIN SUPPORT MOST OF IT'S COMING IN HERE
[POINTS TO AREA TO THE RIGHT OF THE TOP OF THE LINE]. THIS AIN'T
TOO BAD. THIS ISN'T REAL SHABBY [POINTS TO THE RIGHT OF THE
BOTTOM OF THE LINE]. SOMETHINGS GOING TO BE COMING ALONG HERE.
THERE'S PROBABLY GOING TO BE SOME FIGHTING DOWN HERE. THE MBA,
THE MAIN BATTLE AREA IS GOING TO PICK UP SOME OF THAT, PROBABLY,
WHILE THE COVERING FORCE BATTLE IS STILL GOING ON. THAT'S A LITTLE
MESSY.

* WHAT WILL PROBABLY HAPPEN IF YOU PROJECT THIS THING ON AHEAD
IS THE REGIMENTAL COMMANDER WHO OWNS THE COVERING FORCE AREA,
WHOEVER HE'S GOT DOWN HERE [POINTS TO LOWER RIGHT SIDE OF LINE],
AT THE FIRST FIGHT THIS FORCE IS GOING TO BE CHOPPED TO THIS GUY,
THIS MBA FORCE COMMANDER RIGHT HERE [POINTS TO LOWER LEFT SIDE OF
LINE]. HE AND THE REGIMENTAL COMMANDER ARE GOING TO CONCENTRATE
ON THIS [POINTS TO UPPER RIGHT SIDE OF LINE] FIGHT UP HERE HAVING
ALREADY CHOPPED A BOUNDARY THAT RUNS IN HERE SOMEPLACE [POINTS TO BOTTOM OF LINE AND THEN TO THE LEFT OF THE LINE]. AND THESE GUYS GET TURNED OVER TO THE MBA COMMANDER.

*C SIR. HAVE YOU ALREADY MADE A DECISION THAT THE CAV REGIMENT WILL BE THE COVERING FORCE?

*B IT'S THE FORCE MOST SUITED TO DO THAT.

*C ARE THEY STRONG ENOUGH TO COVER THAT WIDE A FRONT?

*B YEAH. PARTICULARLY AS IT'S PITCHED OUT THERE. NOW ANOTHER SOLUTION TO THE PROBLEM IS: STILL GIVING THE CAV. REGIMENT AN ECONOMY FORCE MISSION IN THE SOUTH, AND PUTTING TWO DIVISIONS ON LINE FROM HERE [POINTS TO MIDDLE OF LINE ON THE LEFT SIDE], NORTH [BRUSHES HAND UP MAP TO THE TOP OF THE LINE STILL ON THE LEFT SIDE] WITH EACH DIVISION PROVIDING ITS OWN COVER FORCE [POINTS TO RIGHT UPPER QUADRANT TO THE RIGHT OF THE LINE]. THAT'S ANOTHER OPTION.

*C WOULD YOU SERIOUSLY CONSIDER THAT SIR? OR IS THERE SOMETHING IN THERE THAT TELLS YOU THAT'S NOT....?

*B I PERSONALLY HAVE NOT REJECTED ANY OPTION AT THIS POINT.

*C YES SIR. SO AT THIS POINT YOU'VE DETERMINED WHERE THE FLOT IS? AND YOU'RE DEVELOPING CERTAIN OPTIONS FOR OTHER PARTS OF THE DEFENSE, BUT NO DECISIONS YET?

*B YES.

*C SO ACTUALLY WE DETERMINED THE WHERE PART FIRST?

*B THAT'S NOT A BAD OPTION DAVE [*B LOOKS AT *A]. WHAT HE JUST SAID.


*A OUR CONTROL?

*B NO. UNDER DIVISION CONTROL.
*A. We would lose the continuity and our ability to know what the hell is developing.

*B. Not really. The regimental commander down here would be reporting to the corps, and the two division commanders would be reporting to the corps, or you can come with a lash-up that had the division including his Cav. squadron plus two battalions or so. If you made these sectors narrow enough (points to left lower part of line) for the two division commanders I guess is what I'm trying to say. Put it in there some place (points to vertical line near the top and to the right) that's narrow enough that he can have a two-up and one-back configuration as well. Whereas if he covers the whole sector and we come up with still trying to do the two and one and still try to keep a corps reserve and also postured so we can make a significant counter attack. Then you're talking about a 35km wide sector for each division. It's almost going to keep him from being two up and one back. Particularly in terrain like this.

*A. Okay let's look at how that would play by the time it got to the Weser, by that time back to the Weser it evens up as I see it pretty nicely into a two division front. So we would see something like this (points right hand on center of vertical line, runs hand to the left a ways), the continuity of this (runs hand across map to the left, from top left of vertical line), this guy would have to break off (points to center of vertical line) this guy in this sector again (points to center of vertical line). Okay the ground flows that way. Pretty much.

*B. You have to make a decision right there (points roughly to the center of the map). He's either got to decide to go that way [draws a line northwest from the center of the map] or he's got to cut through this bad terrain here (points to left center of map near a lot of blue area) and make his crossing right there. Otherwise he's coming up here (points at an angle from the above position going slightly northwest above the blue) and we've got a good strong defensive line across there. [Indistinguishable]...ground's rough in there. So he's gotta come down here [runs pen southwest from above first position].

*A. Would you see pinching him out... [pauses]? I like that. We could pinch him out at the line. Really. Something like this (cannot see what *A is pointing at; he is standing directly in front of where he is drawing). It would look about like this pointing to mountainous area in center of map, drawing a line slightly northeast and then east towards the vertical line. This gives him a natural flow back to here (runs hand from center of vertical line across past the blue area in the center of the map). The other guy here (points to the left upper quadrant of the map). Hopefully we can still keep the armour.

Let's go. [*A and *B turn and face the audience.]

*B. I like that. We've met the bosses guidance by establishing a cover force. We've maximized our flexibility.
"A IT'S VERY HARD TO DO THIS WITH GREAT PRECISION ON THIS SCALE
OF MAP. AND REALLY AT THIS POINT LITTLE THINGS DO MEAN A LOT;
LIKE BOUNDARIES. AND WHAT WE'RE DOING IS DRAWING IN DIVISION AND
REGIMENTAL BOUNDARIES. I'LL GO AHEAD AND DRAW THESE IN AND HE
CAN EXPLAIN WHAT WE'VE DONE.

"B ARE YOU FOLLOWING THE DECISION FRONTIERS THERE [IN FACING
INTERVIEWERS]."

"C SIR. I HAVE SOME QUESTIONS ABOUT IT. YOU LET ME SEE IF I
CAN RECONSTRUCT IT, IT SEEMS THAT YOU ARE CONCERNED ABOUT THE
NARROWNESS OF, THE LACK OF DEPTH IN THE COVER FORCE AREA IN THE
SOUTH. AND ALSO THAT THE TERRAIN IN THE SOUTH PAST THE COVERING
FORCE AREA WAS ACTUALLY GOOD DEFENSIBLE TERRAIN. AND BECAUSE OF
THAT I GUESS THOSE WERE THE TWO PRINCIPLE REASONS THAT YOU FELT
THAT AN ECONOMY OF FORCE MISSION WAS FEASIBLE DOWN THERE WITH THE
CAV REGIMENT.

"B ANOTHER MAJOR FACTOR IN THAT DECISION PROCESS AND ONE THAT,
REMEMBER I TOLD YOU A WHILE AGO, THAT BY EXPLORING THE WAYS WITHIN
THE ORIGINAL GUIDANCE DICTATES TO SOME DEGREE WHAT YOUR SCHEME UP
HERE IS [POINTS TO MAP]. IT TELLS YOU YOU WANT TO MAINTAIN
FLEXIBILITY. ONE OF THE WAYS YOU GAIN FLEXIBILITY IS DEFENDING
ON A NARROWER SECTOR. A SECTOR NARROWER IN FACT THAN YOUR
FORCE IN FACT CAN DEFEND. SO YOU TAKE A COMBINATION OF THE
TERRAIN IN THE SOUTH, THE WIDTH OF THE SECTOR NORTH OF THAT
TERRAIN AND YOU CUT THAT IN HALF THEN WHAT YOU'VE GIVEN THE
DIVISION COMMANDERS IS FLEXIBILITY FOR THEM TO MAINTAIN THEIR OWN RESERVE.

"C YES SIR.

"B NOW THE CONTINUITY OF THE BATTLE, THE FLOW OF THE BATTLE
FROM TH IGB BACK TO HERE [POINTS TO TOP OF VERTICAL LINE AND
RUNS HAND TO THE LEFT TOWARD THE LEFT UPPER QUADRANT] IS ALL
UNDER THE ONE GUYS CONTROL. IF YOU'VE GOT A COVERING FORCE OUT
THERE, SAY A CORPS CONTROL COVERING FORCE, AND THE CAV REGIMENT
THERE'S A DEFINITE BREAK IN THE BATTLE RIGHT HERE [PUTS HAND
ALONG THE TOP OF THE VERTICAL LINE]. AS YOU SWITCH CONTROL OF THE
BATTLE FROM A REGIMENTAL OR SQUADRON COMMANDER TO THE DIVISION
COMMANDER OR THE BRIGADE COMMANDER. WHEREAS IN THIS CASE,
HOWEVER, I WOULD NOT TELL THE DIVISION COMMANDER, I WOULD TELL HIM
TO ESTABLISH A COVER FORCE OR CONDUCT COVERING FORCE OPERATIONS
FROM THE IGB TO THE FEBA AND MAKE HIS MAIN DEFENSE BEGIN ON
THE FEBA. IT'S UNDER HIS CONTROL. SAME THING FOR THIS GUY
[POINTS TO RIGHT OF CENTER OF VERTICAL LINE]. IN HERE.
FROM HERE, WHEN HE CROSSES THE IGB HE'S IN THE MBA, SO THERE'S NO
WAY YOU CAN HAVE A TRANSITION OF BATTLE AT THE SAME TIME YOU HAVE
A MAJOR ATTACK. THAT'S IN FACT DISASTER. THAT'S WHY WE
DECIDED TO MAKE THIS A CONTINUOUS BATTLE THROUGH HERE [POINTS
TOWARDS THE CENTER OF THE MAP]. THE CAV REGIMENT BECAUSE IT'S
VERY MOBILE, HAS ITS OWN FIRE SUPPORT. HAS A GOOD ABILITY TO
FIGHT SMALL BATALES WITH UNIT INTEGRITY. THERE IS GOING TO BE A
LOT OF SMALL BATALES THAT HAPPEN RIGHT IN HERE BECAUSE OF THE
NATURE OF THE TERRAIN. THERE ARE A LOT OF HILL MASSES IN HERE.
HE IN FACT CAN FIGHT A HELL OF A BATTLE RIGHT THROUGH HERE
[POINTS TO LEFT OF BOTTOM OF VERTICAL LINE]. THE REGIMENT CAN.
A SQUADRON CANT. FROM THE REGIMENTAL PERSPECTIVE, HE MAY CHOOSE
TO PUT, PROBABLY INITIALLY, TWO SQUADRONS UP, WITH A SQUADRON IN
RESERVE AND HE WILL FIGHT THOSE TWO SQUADRONS AGAINST EACH
OTHER. IF THE MAIN ATTACK COMES HERE [POINTS TO BOTTOM OF
VERTICAL LINE] HE'LL HAVE A SQUADRON HOLDING DOWN HERE [POINTS TO
THE BOTTOM OF THE VERTICAL LINE] AND A SQUADRON HOLDING DOWN HERE
[POINTS TO A FEW INCHES ABOVE THE BOTTOM OF THE VERTICAL LINE].
AND THIS GUY [POINTS TO BOTTOM OF VERTICAL LINE], IF HE'S FREE
PART OF HIM MAY ATTACK INTO THE FLANK RIGHT HERE. AND HE'S STILL
HOLDING A SQUADRON IN RESERVE BACK HERE [POINTS TO ABOUT SIX
INCHES TO THE LEFT OF THE BOTTOM OF THE VERTICAL LINE]. SO THE
REGIMENTAL COMMANDER CAN FIGHT A GOOD FIGHT ALL THE WAY BACK
THROUGH HERE [POINTS TO LEFT OF BOTTOM OF VERTICAL LINE].

*A [NOT AUDIBLE] AND PROBABLY JUST FOR CONTROL. THE CORPS
USUALLY EARNS IN SOME CONTROL MEASURES. BUT, OUR MAIN DEFENSE IS
GOING TO BE ALONG LINE ZULU. BUT THIS RIVER LINE HERE... AGAIN,
DIVISIONS ARE GOING TO JOIN OTHERS. IT WILL BE NO GREAT THING.
WE'LL PROBABLY CALL THIS LINE XRAY [DRAWING LINE TO LEFT OF
BOTTOM OF VERTICAL LINE ABOUT 12 INCHES FROM LINE]. THIS IS
WHERE OLD TOM AND I WILL START MAKING DECISIONS. ONCE THINGS
GOT BACK ALONG THIS WAY WE'D REALLY START LOOKING AT THIS LITTLE
PINCH OUT THING, SEEING IF THESE GUYS WERE HAVING ANY TROUBLE
GETTING WHERE WE WANT THEM TO GO ALONG THE WESER. FOLLOWS THAT
RIVER LINE [POINTS TO A NORTH TO SOUTH RUNNING RIVER IN THE UPPER
LEFT QUADRANT]. CAUSE YOU MENTALLY DRAW IN DECISION POINTS,
CRITICAL PARTS OF THE BATTLE, WE'LL BE HAVING COFFEE TILL AROUND
HERE [POINTS TO AREA ABOUT 8 INCHES TO LEFT OF BOTTOM OF THE
VERTICAL LINE]. WE'LL TAKE A LOOK AT THIS FOR A LITTLE BIT
[POINTS TO LEFT OF UPPER PART OF VERTICAL LINE]. WE'LL GO
OUTSIDE THE TOC AND TAKE A LOOK AROUND.

*B THE FIRST CORPS BATTLE IS BACK HERE AT FEBA [POINTS TO LEFT OF TOP OF
LINE] THE MBA FORCES WILL BE DEPLOYING ALONG HERE [FEBA] THE DIVISION
CONTROL COVERING FORCE IS HERE [POINTS TWO FINGERS COVERING AN AREA
ABOUT 3 INCHES LONG TO RIGHT OF TOP OF LINE AND DOWN] AND HERE
[POINTS TO FINGERS COVERING AN AREA ABOUT 3 INCHES LONG TO RIGHT
OF CENTER OF LINE AND DOWN]. THE REGIMENT'S GOT HERE [POINTS TO
BOTTOM LEFT OF THE VERTICAL LINE]. THE DIVISION COMMANDERS WILL
FIGHT THIS RIGHT BACK TO ALONG HERE [POINTS TO AREA ABOUT 8 INCHES
TO LEFT OF THE TOP OF THE VERTICAL LINE]. THERE'S
MAYBE... PROBABLY TO LINE X-RAY [POINTS IN GENERAL AREA OF
THE WESER RIVER]. IS THE FIRST PLACE CORPS COMMANDER IS GOING TO MAKE
CRITICAL DECISIONS.

*A AND THIS, TO US, WOULD BE, AND THIS IS NO DEFINITION, CALL
THIS A PIVOT POINT [POINTS TO LEFT UPPER QUADRANT]. THAT'S WHEN
I WOULD SAY, "WELL LET'S SEE TOM, WHERE ARE THE GUYS IN THE
NORTH? WHERE ARE THE GUYS IN THE SOUTH? ARE THESE GUYS WAY UP
HERE WHILE THESE GUYS ARE WAY BACK HERE? ARE WE GOING TO BE
ABLE TO... YOU KNOW?

*B WHAT ARE YOU GOING TO HAVE TO DO AT LINE XRAY TO BE PROPERLY POSTURED AT LINE ZULU TO MAKE A MAIN DEFENSE? WHICH IS WHAT YOU'VE BEEN TOLD TO DO.

*A WE CAN STILL MAKE SOME CHANGES HERE IF WE HAVE TO [POINTS TO CENTER OF MAP A LITTLE BIT TO THE NORTH]. ONCE IT GETS BACK HERE WE WOULD BE MESSING THINGS UP AT THAT POINT BY CHANCE. BECAUSE WE'VE STILL GOT QUITE A WAYS. REALLY. THAT'S A PIVOT POINT. WE SEE THAT. THAT'S WHERE A BUNCH OF DECISIONS ARE GOING TO BE MADE. THAT'S NOT IN THE ORDERS. THAT'S NOT WRITTEN DOWN ANYWHERE. IN FACT I DON'T THINK WE'VE DISCUSSED THAT BEFORE.

HAVE WE? BUT AS YOU LOOK AT THE BATTLEFIELD, A VERY INTENSE LOOK, AS PEOPLE START COMING ALONG LINE XRAY [POINTS TO RIVER LINE RUNNING NORTH TO SOUTH IN UPPER LEFT QUADRANT]. BECAUSE THIS IS WHAT WILL FACILITATE... [PAUSES]

*C SO WHAT IS IT ABOUT, IS IT THE TERRAIN AROUND LINE XRAY THAT YOU'VE SPOKEN OF? YOU SAID IT JUMPS RIGHT OUT AT YOU.

*B YEAH. THERE'S ONE BATTLE, THE BATTLE... THIS IS ALL ONE BATTLE UP TO HERE [PUTS HAND IN RIGHT UPPER QUADRANT ABOUT SIX INCHES TO THE RIGHT OF THE VERTICAL LINE, RUNS HAND ACROSS LINE TO ABOUT 6 INCHES TO THE LEFT OF THE TOP OF THE LINE]. THE BATTLE CHANGES COMPLEXION RIGHT HERE.

*C IS THAT BECAUSE YOU'RE ENCOUNTERING BUILT UP AREAS AND...

*B BUILT UP AREAS AND A COMBINATION OF THESE RIDGE LINES THAT STICK OUT THROUGH HERE [POINTS TO CENTER OF MAP IN A MOUNTAINOUS AREA] GOOD DEFENSIBLE TERRAIN UP TO HERE [RUNS FINGER NORTHWEST ABOVE MOUNTAINOUS REGION]. THEN IT'S MARSHY UP THERE WHICH IS SOMETHING OF AN OBSTACLE. THAT'S THE MAIN OBSTACLE THE CITY OF HANNOVER. BUT THE BATTLE CHANGES COMPLEXION RIGHT HERE [PUTS HAND ON AREA NEAR CITY OF HANNOVER IN THE LEFT UPPER QUADRANT].

*A AND ROAD NETWORK. SO, THE REASON WE'VE GOT THE ECONOMY OF FORCE RIGHT HERE IS BECAUSE NOTHING IN HERE GOES INTO ANYTHING [POINTS TO AREA TO LEFT OF THE BOTTOM OF THE VERTICAL LINE]. SO A REGIMENT WILL DO THAT.

*B ANOTHER THING A REGIMENT DOES FOR YOU HERE...

*A [INTERRUPTS] THIS SUPPORTS A LOT OF STUFF. THESE ROADS CLEARLY... [PAUSES]

*B REMEMBER THIS FLANK THREAT? THE REGIMENT IS PERFECTLY POSTURED TO TAKE CARE OF THAT. IF THIS GUY ATTACKS DOWN HERE [POINTS TO LOWER RIGHT QUADRANT OF MAP WAY BELOW DEFENSIVE LINE], THE MAIN ATTACK. THEN WE'VE GUESSED WRONG. THE MAIN ATTACK IS COMING RIGHT UP THROUGH HERE [ANGLES UP AND COMES UP BEHIND VERTICAL LINE] WE'VE GOT A MAJOR FORCE UNDER THE CONTROL OF ONE COMMANDER THAT YOU CAN CHOP TO THAT WHILE YOU'RE REACTING. YOU
COULD VERY EASILY IF NECESSARY; IF THIS THREAT BECAME TOO BIG
YOU COULD THEN CHOP THIS SECTOR [POINTS TO LEFT OF BOTTOM OF VERTICAL LINE].
YOU'D ELIMINATE THIS BOUNDARY. YOU CAN GIVE CONTROL OF THIS
[POINTS TO LEFT OF THE BOTTOM OF THE VERTICAL LINE] TO THIS
DIVISION COMMANDER [POINTS TO CENTER OF VERTICAL LINE] AND HE'D
PROBABLY RUN HIS RESERVE BRIGADE DOWN THERE [POINTS TO RIGHT
LOWER QUADRANT OF MAP]. PUT YOUR CAV REGIMENT COMMANDER ON THIS
THING [POINTS TO LEFT OF CENTER OF MAP] COMING INTO THE FLANK
HERE.

*A NOW WHAT HAVE WE NOT DONE? WHAT HAVE WE TRIED TO AVOID?
WE'VE TRIED TO AVOID THE USE OF OUR RESERVE FORCE. WE'VE NARROWED
THOSE SECTORS BY SQUEEZING THESE THINGS... BY USING HIM IN AN
ECONOMY OF FORCE WE'VE NARROWED THESE SECTORS GIVING HIM MORE
PUNCH. NOW THE MORE YOU CAN SQUEEZE IT THE MORE PUNCH YOU'VE
GOT. PEOPLE CALL IT TWO BRIGADES UP AND ONE BRIGADE BACK. BUT,
IT KEEPS US... UNDERSTAND THAT THE BOSS BASICALLY WANTS US TO
COUNTERATTACK. WE'VE STILL GOT A DIVISION NOT COMMITTED AND IT
PROBABLY WON'T HAVE TO BE COMMITTED. YET, IF HE DOES HAVE TO BE
COMMITTED WE WOULD PROBABLY SEE THE MORE DECISIVE COMMITMENT
HERE ALONG THE WESER. SO WE'VE DONE TWO THINGS: WE'VE PRESERVED
OUR FORCE, WE'VE TRIED TO ATTRIT FORWARD; AND WE'RE PREPARING FOR
A CONTINGENCY TO COUNTERATTACK.

*B WE'VE GOT ENOUGH FORCE UP THERE TO DEVELOP THE BATTLE. WE
SHOULD BE ABLE TO IDENTIFY WHERE THE MAIN ATTACK IS COMING
FROM.

*A WE KIND OF LOSE THE FEEL FOR THE MAGNITUDE OF THIS BECAUSE OF
THE RELATIVELY SMALL SCALE MAP. FROM HERE TO HERE ARE 70KM
[POINTS TO LEFT UPPER QUADRANT OF MAP ABOUT 12 INCHES TO
THE LEFT OF THE TOP OF THE VERTICAL LINE AND THEN POINTS THE SAME
DISTANCE FROM THE BOTTOM OF THE LINE]. DISTANCE BETWEEN BOUNDARIES.

*C YES SIR. LET ME ASK THIS QUESTION. APPARENTLY FROM WHAT I
UNDERSTAND, ONE OF THE CRITICAL THINGS YOU'RE TRYING TO DO IS TO
KEEP A RESERVE UNCOMMITTED. IT APPARENTLY SEEMS TO BE ONE OF THE...

*B EVEN IF WE DID NOT HAVE THE CONTINGENCY TO BE PREPARED TO
ATTACK I WOULD STILL ATTEMPT TO MAINTAIN ONE THIRD OF MY FORCE
UNCOMMITTED. TO GIVE ME THE FLEXIBILITY TO DESTROY THE ENEMY
FORCES IN SECTOR. WHICH IS THE FIRST MISSION THAT MY BOSS GAVE
ME.

*A NOW THIS IS AN OLD, TRADITIONAL, CONVENTIONAL WAY OF SEEING
THINGS AND TOMMY AND I AGREE ON IT. WE WENT THROUGH A PERIOD
WHERE EVERYTHING WAS FORWARD AND YOU DIDN'T HAVE A RESERVE. THE
RESERVE CAME OUT OF SOMEBODY NOT COMMITTED. WE WERE NEVER
COMFORTABLE WITH THAT. THERE'S A SWING. THINGS HAVE SWUNG BACK
THE OTHER WAY. TO TRY TO KEEP SOMETHING THAT YOU CAN BE DECISIVE
WITH. WHATSOEVER. I FEEL PRETTY GOOD ABOUT THAT. I FEEL THAT EVEN
IF HE... A MAJOR RUPTURE... WHICH HE COULD TRY TO DO WITH ALL
THINGS AND NUKES AND ALL. I'VE GOT A DIVISION TO PLUG IT. AN
ARMOURED DIVISION.
"B. We're talking six tank battalions.

A. We haven't given you our task organization yet, but, we've got one pretty well under way. In fact we have our task organization. Remember we said it sort of takes place concurrently as you start looking at how you want to go about this stuff? See you can't do this and then say, "Now we will do our task organization." What we will do now is tidy up our task organization. I mean we might want to fuss a little bit about, well, we'll give this to that one and give this to the other one. What we're seeing right now is a mech to the north and a mech to the south and armoured in reserve.

[A and "B, turn back to the map, talking fast and quickly drawing lines on the map]

C. So this is very fast. Compared to the exercises we've seen on tape before, which are the same situation. In positioning your reserve you're really considering two things. One is your ability to use the reserve in the defense and the second one is the ability to launch a counterattack from where they are.

B. You always look for a place you can put it; a place you can fit. You've got to look at what are all the possibilities of your utilization of it. And then you examine the terrain, the situation, your deployment and the feasibility standpoint of doing all those things and it kind of falls out at you.

A. Let's take a look again. Now you have to come up here to the map to see it. Ok, now, this is a major high speed avenue of approach [points to autobahn going from east to west across the map]. Not going anywhere. It goes right into hannover which is a mess. I mean, it's a major city. But, you know, there's still a lot of these routes [points to routes north of the autobahn]. These are significant. We're not indifferent to this. We're trying to think like the other guy. We've got fewer obstacless along in here. You've got canals, you've got the crossings, the autobahn crosses it. So we think, we probably will make our run this way [points to an area of the map]. But, he's going to put major forces in here. So a division up here.

[points to map a little left of the top of the vertical line]. Now this division has a narrower sector that helps beef it up and behind this division sits a reserve [points to armoured division symbol to the left of the center of the map]. Now even though the reserve is away from him, it still beefs him up. Now, we're going to pinch this guy out [points to left of bottom of vertical line]. This guy comes back and defends along the river [points to left of center of vertical line]. What if he doesn't make it?

What if the major attack does come along this way [points to right lower quadrant and runs hand up in a northwesterly direction]? See, we've got pivot points. We're not stuck. We've got plenty of options. And a good operator does that. We've got options here. He's an option [points to left of center of
VERTICAL LINE. HE'S AN OPTION [POINTS TO TANK BATTALION IN
RESERVE]. HELL, SOMETHING UP HERE COULD BE AN OPTION [POINTS TO
ABOUT 6 INCHES TO THE LEFT OF THE TOP OF THE VERTICAL LINE].
MAYBE HE'S NOT DOING ANYTHING. SO WE CAN SAY SEND 2 BRIGADES OR
A BRIGADE. SO WE KEEP FLEXIBILITY THROUGHOUT, AND YOU DO
THAT A LOT BY, YOUR BOUNDARIES HELP OF COURSE, BUT YOUR POSITION
IS A BIGGER. THESE GUYS, NOW IF THE MAIN ATTACK COMES HERE
[POINTS TO RIGHT LOWER QUADRANT AND UP NORTHWESTERLY]. THESE
GUYS COULD GO IN THERE AND BLOCK IT. WE COULD CHOP THESE GUYS TO
THEM [POINTING NEAR THE CENTER OF THE MAP].
WHAT IF THIS IS A CORPS ATTACK, OR AN ARMY GROUP ATTACK
I DON'T THINK IT WOULD BE BUT IT'S A SIGNIFICANT ... SOMETHING
BIGGER COULD DEVELOP LIKE THIS [POINTS TO RIGHT LOWER QUADRANT
AND SHOWS A WIDER FRONT COMING UP]. SO, THIS GIVES US
FLEXIBILITY WITH THESE GUYS. NOW, WHAT IF EVERYTHING GOES
ACCORDING TO PLAN AND WE DON'T GET THESE DIVISION CHOPPED UP THEY
BOTH CAN BACK HERE [POINTS TO UPPER LEFT QUADRANT] AND OCCUPY A
COHERENT DEFENSE ALONG THE WESER. WE'RE HOPING THEY CAN. WE THINK
THEM. THEN THAT WOULD LEAVE US AGAIN POISED TO DO THE SECOND,
THE THIRD, THING WE WERE TOLD TO DO. TO BE PREPARED TO GO ATTACK
MAGDEBURG.

*B AND I WOULD POINT OUT AT THAT POINT YOU WOULD STILL HAVE A
RESERVE. EVEN IF YOU COMMITTED THE 4TH ARMOUR DIVISION BECAUSE
THE CAV REGIMENT HAS BEEN PINCHED OUT.

*A THEN I AM POISED WELL TO CONDUCT THAT COUNTERATTACK IF I HAVE
TO. IF ONE OF THESE GUYS IS TAKING HEAVY DAMAGE. THEN I'M POISED WELL TO GO AND
REINFORCE HIM. I'LL KNOW THAT BY THE TIME THEY GET BACK TO LINE X-RAY. THAT'S
WHY I SAID HE AND I WOULD START EASING UP TOWARDS THE MAP WHEN
PEOPLE GET JUST OUTSIDE OF LINE XRAY.. BECAUSE THAT'LL BE THE
DECISION TIME. BIG TIME DECISION. WE MAY, WE MIGHT HAVE TO MOVE
THE RESERVE FORWARD. DON'T WANT TO. BUT, THAT WE THINK, UH...

*B THERE'S EVEN THE POSSIBILITY OF MOVING THE 4TH ARMOUR
DIVISION FURTHER TO THE WEST. IF THE DEFENSE IS GOING WELL FOR
BOTH THE 80TH AND THE 90TH. THEN YOU JUST LET THEM FIGHT THEIR
WAY ON BACK THERE. IF YOU WANT TO KEEP THE 4TH ARMOUR DIVISION
ABSOLUTELY UNSCATHED THEN LET THEM CONTINUE THAT FIGHT BACK

*D YOU'VE ALREADY SPOKEN ABOUT HOW YOU DECIDE WHAT SIZE YOUR
RESERVE SHOULD BE, ROUGHLY ONE THIRD OF YOUR TOTAL FORCES...

*B THAT'S A GENERAL RULE.

*D AND YOU'VE SPOKEN ABOUT, AT LEAST IN THIS CASE, WHERE YOU
WOULD POSITION THEM AND WHY. WHAT FACT IN GENERAL, WHAT FACTORS
ARE TAKEN INTO CONSIDERATION IN DECIDING WHICH UNITS WOULD
COMPRISE THE RESERVE? AND THEN, WHAT WERE THEY IN THIS
PARTICULAR...?

*B WE CHOSE THE RESERVE BASED ON ITS PUNCH. THERE'S NOT MUCH
DIFFERENCE BETWEEN A MECHANIZED INFANTRY DIVISION AND AN ARMOURED
DIVISION EXCEPT THAT AN ARMoured DIVISION HAS SIX TANK
BATTALLIONS. WHEREAS A MECH DIVISION HAS ONLY GOTT FIVE. THE
MECH DIVISION IS FIVE TANK, FIVE MECH. THE ARMoured DIVISION HAS
SIX TANKS AND FOUR MECH. WHICH MEANS THAT YOuVE GOTT MORE ARMOUR
PUNCH TO GO INTO A DEEP ATTACK WITH THE ARMoured DIVISION. THE
ADDITIONAL CONSIDERATION IS IN THE MBA. THERE ARE LOTS OF GOOD
PLACES THERE BECAUSE OF ALL THESE MARSHES AND BOGS AND ALL. THAT
KIND OF STUFF, TO PUT DISMOUNTED INFANTRY IN THOSE BUILT-UP
AREAS AND PLACES LIKE THAT TO CONDUCT A GOOD DEFENSE. BUILT-UP
AREAS Arent WHERE YOu WANT TANKS. SO YOuVE GOTT MORE INFANTRYMEN
UP THERE IN THOSE TWO MECH DIVISIONS THAN YOu HAVE IN THE
ARMoured DIVISION.

*A THERE IS ONE INTANGIBLE. AND THIS GOES RIGHT BACK TO
SOMETHING ELSE WE TOLD YOU. WE LIKE TO KEEP ARMOUR IN RESERVE
BECAUSE OF THE DIFFERENT MENTALITY WITHIN THE ARMoured DIVISION'S
TOC. IF THESE THREE DIVISION KNEW WHAT THE CORP ORDER WAS,
BEFORE WE EVER EVEN CAME AND SAW THEM THEY WOULD PROBABLY ALREADY
HAVE THEMSELVES IN PLACE. BECAUSE, ARMoured DIVISIONS ARE USED TO
BEING EMPLOYED IN A DECISIVE MANNER AND A RESERVE IS THE DECISIVE
FACTOR.