AD-A170 608 KNOWLEDGE-BASED PLANNING MODEL FOR COURSES OF ACTION GENERATION(U) ARMY WAR COLL CARLISLE BARRACKS PA D R COLLINS ET AL. 07 APR 86 1/1

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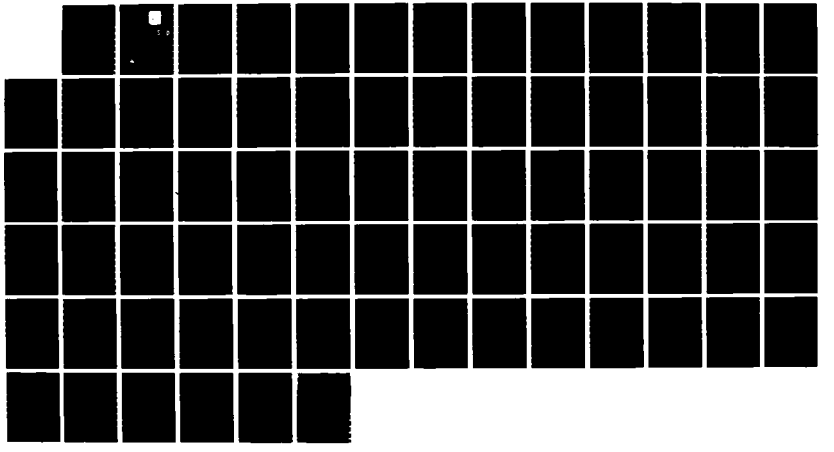

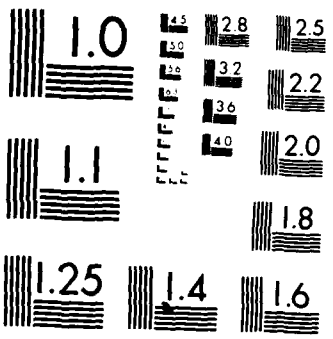

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KNOWLEDGE-BASED PLANNING MODEL
FOR
COURSES OF ACTION GENERATION

BY

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LIEUTENANT COLONEL(P) T. A. BAUCUM

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7 APRIL 1986

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A170608	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Knowledge-based Planning Model for Course of Action Generation		5. TYPE OF REPORT & PERIOD COVERED STUDENT PAPER
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) COL D. R. Collins LTC(P) T. A. Baucum		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army War College Carlisle Barracks, PA 17013-5050		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS SAME		12. REPORT DATE 7 April 1986
		13. NUMBER OF PAGES 70
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

U.S. Army War College (AWC) students of the Class of 1986 were solicited to participate in a Military Studies Program to develop a planning model for "Courses of Action Generation." The model was to be "knowledge-based," i.e., drawn from the collective experience of officers with operations/planning backgrounds. COL D. R. Collins and LTC(P) T. A. Baucum undertook the project. Major Gary Loberg, a computer scientist from the U.S. Army Communications-Electronics Command, joined the two AWC students, providing a research frame-

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work, and acting as a facilitator during the knowledge engineering sessions which ensued.

Initial discussions between the CECOM computer scientist and the AWC students concerned the potential for automation of the process of developing a scheme of maneuver. The opinion of the students was that some aspect of the process would be extremely difficult to include in a computer program: the intent of the commander, for example. While neither student dismissed the potential of artificial intelligence on the battlefield, neither actively sought ways to incorporate it, either. What evolved, therefore, was an exposition by the students of what actually goes on in the minds of commanders and battlefield planners during an active operational environment. The project director did not force the project participants to artificially fit their thoughts into any particular language or matrix to facilitate later inclusion into an automated system. So each session, then, was unconstrained; processes were described in the participants' own words and, in the purest sense, the results were knowledge-based.

Both AWC students concluded that there is great potential for research into the prospects of automated decision-making aids for the battlefield. Automation is going to grow, not shrink, and its growth should be directed by future users. Additionally, a valuable spin-off from the research is understanding the actual process of arriving at a scheme of maneuver (or other key tactical decision) and allowing seasoned officers to share their experiene for the benefit of those with less experience. In summary, the students agreed that the subject matter provides a good subject for continued research, provided that "operators" are not forced into a predetermined model that facilitates automation. They suggested that computer scientists design their models and computer language to accommodate the knowledge and language of operators, not the other way around. USAWC study participants remain concerned that this research could proceed in the absence of experienced operations officers and result in a "cookbook" approach to tactical decisionmaking, so as to facilitate the application of computer technology. It must be recognized that tactical decisionmaking is a skill which falls in the category of an art, not a science. There are few hard-and-fast rules which apply to all situations. The "best" solution is the one which works and it is developed on the basis of the application of sound tactical principles; experience gained over years of trial and error in countless situations; knowledge of soldiers, units, and commanders; and, often, "gut-feel." Computers deal in facts; they cannot factor intangibles, and they cannot produce "gut-feel." Accordingly, it is the opinion of the study participants that the focus of this automation effort should be on the collection, analysis, and timely provision of known facts concerning the battlefield. Inasmuch as virtually all elements of tactical decisionmaking are predicted on interpretation of the factors of METT-T, the magic of the computer can best be devoted to improving the information provided the commander about these factors. In short, the computer can be a valuable decisionmaking aid. It cannot be allowed to become a de facto decisionmaker for those unskilled in the art.

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USAWC MILITARY STUDIES PROGRAM PAPER

KNOWLEDGE-BASED PLANNING MODEL

FOR

COURSES OF ACTION GENERATION

A STUDY CONDUCTED BY

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EXECUTIVE SUMMARY (EXSUM):

1. BACKGROUND: U. S. Army War College (AWC) students of the Class of 1986 were solicited to participate in a Military Studies Program to develop a planning model for "Courses of Action Generation." The model was to be "knowledge-based," i.e., drawn from the collective experience of officers with operational/planning backgrounds. Colonel D. R. Collins and Lieutenant Colonel(P) T. A. Baucum undertook the project. Major Gary Loberg, a computer scientist from the U. S. Army Communications-Electronics Command, joined the two War College students, providing a research framework, and acting as a facilitator during the knowledge engineering sessions which ensued.

2. PURPOSE: The purpose of this EXSUM is to summarize the results of the four knowledge engineering sessions conducted. The detailed results are at enclosures 1-4, each enclosure acting as an agreed-upon record of that engineering session.

3. EVOLUTION OF THE KNOWLEDGE ENGINEERING SESSIONS: Initial discussions between the CECOM computer scientist and the AWC students concerned the potential for automation of the process of developing a scheme of maneuver. It was the opinion of the students that some aspects of the process would be extremely difficult to include in a computer program - the intent of the commander, for example. While neither student dismissed the potential of artificial intelligence on the battlefield, neither actively sought ways to incorporate it, either. What evolved, therefore, was an exposition by the students of what actually goes on in the minds of commanders and battlefield planners during an active operational environment. Wisely, the project director did not force the project participants to artificially fit their thoughts into any particular language or matrix to facilitate later inclusion into an

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automated system. So each session, then, was unconstrained; processes were described in the participants' own words and, in the purest sense, the results were knowledge-based. To facilitate the study, the participants focused on corps level operations in a European environment.

4. THE HUMAN FACTOR: In each session, the importance of personalities emerged as a major factor in the process of arriving at battlefield decisions. The initial session, for example, produced the all-important factor of the intent of the commander (See Encl. 1). This was developed by describing how a G3 or a key member of the G3 planning staff learns how to "read" a commander and anticipate his intentions. The ability of commanders to articulate their intentions, and of G3's to refine, amplify, and operationalize those intentions was posited as a hallmark of effectiveness. The human factor was also pointed out in the task organizing and task assignment process (Encl. 3); certain subordinate commanders have talents and predispositions for certain operations, and seasoned commanders and planners take these factors into account when determining who should do what. It was important to the AWC students that the computer scientist, in whatever direction he may later take with artificial intelligence, remain sensitive to the human factor in actual operations.

5. QUALIFYING FACTORS: The backgrounds of the student officers should be taken into account: one has an armored and one has a mechanized infantry background. Both have extensive experience in Europe. While neither officer believed that an artillery, engineer, or aviation officer would be as qualified to describe the process of determining a scheme of maneuver as a member of a maneuver arm, both agreed that the addition of an artillery officer could have added a different perspective and that he would have acted as a good check on the product.

6. LIMITING ASSUMPTIONS: A number of assumptions were made to limit the scope of the study. The restriction to the corps command level has already been addressed. Other restrictions included: 1) limiting the environment considered to Europe, 2) limiting the staff consideration to the G3 element, with major emphasis on the G3 Plans section, 3) addressing only an active environment, in which planning takes place while operations are being conducted, and 4) considering only the mental processes of the planners as practiced by the AWC participants. This final limitation means that this EXSUM does not reflect a doctrinal description of the planning process, but does reflect the accumulated experience of the AWC participants in performing the planning task in a variety of environments.

7. THE PLANNING ENVIRONMENT. At the corps level, planning is a continuous process involving the full-time efforts of a number of officers of the Corps G3 Plans Section, and the efforts of others (e.g., Commander, Chief of Staff, G3) on an as-needed or desired basis. It is possible to characterize several dimensions of the environment within which planning is performed, including: the planning process, the planning function, and command post responsibilities related to planning (See Encl. 1).

7.1 THE PLANNING PROCESS. For purposes of this study the planning process commences upon receipt of a new mission (to include commander's guidance and intent) from any source, and terminates upon completion of the alternative courses of action (or single course of action). The process also refers only to the actions of planners, and does not refer to the actions of other staff officers concerned with providing information critical to the planning process. This process can be outlined

in several phases, commonly performed in a loose sequence (See Encl. 2).

7.1.1 Mission Analysis. This is the first phase in the planning process. It uses information contained in the higher command's order for the operation (whatever form that may take), and other information provided by the higher command (such as any verbal guidance provided by the higher commander or G3). At the completion of the mission analysis the planners have developed the following information items to be used by the remainder of the planning process: (see Encl. 2)

- Tasks to be accomplished by the corps during the ensuing operation.

- Constraints under which the corps is to operate.

- An "understanding" of the intent of the higher commander in the ensuing operation. From this understanding of the commander's intent, it may should be possible to develop a number of evaluation criteria for use in the following phases of the planning process. The remainder of this paragraph (7.1.1) enumerates possible outputs of the mission analysis phase (potential evaluation criteria) of the planning process which would have an influence on subsequent phases of the process.

7.1.1.1 Time Constraints. Severe time constraints support development of plans which are simple to implement at lower levels (i.e., subordinate commands have a simpler planning problem) and simple to execute.

7.1.1.2 Implied Tasks. This includes both short-term objectives and long-term objectives.

7.1.1.3 Identification of Subsequent Operations.

- Must finish operation in posture to do what is needed next. This will influence how the objective is accomplished.

- Must finish operation in posture to support commander's subsequent operation.

- For example, if the corps mission is to conduct a limited counterattack to secure an objective, the commander's intent in directing the counterattack may be either: 1) to seize and retain the terrain objective, or 2) to capture terrain to facilitate deep counterattack with a subsequent axis through that objective. These options dictate different allowable postures upon completion of the counterattack and different subsequent operations for the corps.

7.1.1.4 "Be Prepared" Constraints.

- Missions. Missions will influence the type of operations that can be conducted.

- Loss of a designated element (name or type) of the force.

-- This will impact corps' use of the force, in that there is a certain level of commitment that cannot be breached.

-- Corps must be prepared to adapt to the loss of the force.

7.1.1.5 Availability of Fire Support Assets from outside Corps.

- EAC operations (e.g., deep interdiction) may imply the EAC assets will not be available for corps.

7.1.1.6 Preservation of Force vs. Accomplishment of Objective. When preservation of the force is given priority, the following is true.

- More likely to impact how tasks will be accomplished than what tasks will be accomplished. Less likely to conduct high-risk operations.

- Normally more important to operations than planning.

-- Counterattack less likely.

-- If conducted, depth of counterattack would be less.

7.1.1.7 Constraints on Reserve Force.

- Size of reserve.

- Position of reserve.

- "String" on commitment of reserve.

-- Commit only with higher command approval.

-- Constraint on time to react to contingency. This could particularly affect maneuver, fire support and aviation elements.

7.1.1.8 Constraints on Covering Force.

- Size of covering force.

-- Attrit enemy well forward implies strong covering force.

-- Develop something early implies strong covering force.

-- Forward divisions need time to deploy implies strong covering force.

- Time of covering force action.

-- Forward divisions need time to deploy implies the duration of the covering force action will extend at least until divisions can deploy.

- Covering force activity.

-- Covering force needed for further operations implies no decisive engagement.

-- Not allowing covering force to fall below certain strength implies limitation of covering force activity.

7.1.2 Course of Action Generation: This is the second phase in the planning process. It is understood that this is in contradiction with the process as described by doctrine (FM 101-5) in that the staff analyses are not required. However, the planners agreed that in the European context, the staff analysis at corps consisted of attempting to identify "aberrations" in the situation, and, in the absence of these aberrations (radical changes in the situation, caused by the loss of continuity of the operation), the planners will deal with staff information in its routine form. One aberration is significant enough to merit special attention, however, and that is when the corps is forced to change its environment (terrain and opposing force) as the result of a new operation. A second significant aberration occurs when there is a change in the operation type to be conducted (e.g., attack is changed to defend). Normally the higher command's mission statement for the corps will contain sufficient information to determine whether or not a detailed staff analysis is required. Course of action generation can be subdivided into five phases which are commonly, but not always, performed in a predictable sequence (See Encl. 2).

7.1.2.1 Scheme of Maneuver (SM) Development. The SM is developed first. All factors of METT-T must be considered in developing the SM. At a minimum, the commander's understanding of the METT-T factors must be verified. From the above it is clear that this does not require a separate staff analysis effort unless an aberration is noted. The scheme of maneuver is discussed in more detail in paragraph 4 below (See Encl. 3).

7.1.2.2 Task Organization (TO) and Task Allocation (TA). After development of the SM, a TO can be developed and tasks allocated.

These phases must be pursued in parallel and decisions made in either will affect decisions to be made in the other (See Encl. 3.).

- TO. Significant factors considered are the number of troops available, type of forces available (NOTE: The distinction between Armored and Mech is for all intents meaningless), and personalities of subordinate force commanders. As the force types become more similar, with a concomitant ability to choose from like forces, the importance of commander personalities increases. Another important point is that the corps has many assets to allocate. It normally is neither necessary nor desirable for the planners to break up maneuver assets into smaller pieces (for example, take a brigade away from a division). Another way to state this is that unit integrity is an important and desirable factor in allocating maneuver elements. It becomes less important in allocating non-maneuver forces.

-- Unit integrity is of most concern when allocating maneuver assets. At the corps level the situation may very well dictate allocating maneuver resources of one division to another division (e.g., "chopping" a brigade), but in these situations the following statements are usually true.

--- The maneuver unit being allocated additional resources possesses insufficient combat power to accomplish the tasks assigned.

--- It is not desirable to allocate corps-level non-maneuver resources to the unit to make up for the combat power shortfall (or, alternatively, the planner would first look for other, non-maneuver resources, to allocate).

--- It is not desirable to allocate tasks in a different manner.

-- Unit integrity is less of a factor when allocating the following types of resources: Engineers, Aviation, Air Defense, Signal, Artillery.

-- TO may sometimes be based on the tasks allocated to the units in the current TO.

- TA. Personalities and types of forces within subordinate elements are critical factors in allocating tasks.

7.1.2.3 Command and Control (C^2) Measures (See Encl. 2). After developing the SM and TO and performing the TA, it is possible to specify the C^2. The C^2 consists of a number of elements, which include:

- Synchronization of Operations (this is the key element).

- Communications measures, to include the allocation of corps' signal assets.

- Command post(s) location(s).

- Reporting mechanisms.

- How to control the battle, once in motion.

- Control Measures. At one point in the discussion, it was agreed that precise unit boundaries were not important in developing courses of action. A general definition is sufficient, and the precise boundaries are best decided by the affected units. The following guidelines apply:

-- Boundaries are important in planning for the function they serve, which is to clearly indicate the responsibility for specific terrain features. At a minimum, the boundaries must clearly indicate into which sector the following terrain features belong:

--- Key Terrain.

--- Avenues of Approach (AA). A basic law - Don't

split an AA between units. Exception - Unless a single force is inadequate to cover an AA. This may result from a number of reasons, which include, but are not limited to, the following: the trace of the AA, terrain does not provide suitable defensive positions for a single unit, other AA's in the unit's sector.

-- Routes (RT). A rule of thumb - Don't split a road between units. Exception - All units need an MSR. If there is no other way to provide for an MSR then a designated road may have to be sahred.

-- As long as this terrain feature assignment function is satisfied, a precise definition of boundaries is not required for planning.

7.1.2.4 Support Priorities (SP). As an alternative to TO changes, support priorities can provide a combat multiplier impact.

7.2 THE PLANNING FUNCTION. The following statements characterize the planning function as practiced at the corps level in the European environment in an active context (See Encl. 2).

7.2.1 G3 Plans Staff. An Army of Excellence TO&E for the corps G3 planning section has yet to be adopted. However, based on the division G3 planning section TO&E, which has numerous officers representing the combat, combat support and combat service support functional areas, it is presumed that plans will be fully integrated. The purpose of this section is to develop the operations plans. The functional area representatives are actively engaged in the planning activity, contributing advice and analysis on the aspects of the plan pertaining to their areas of expertise (e.g., the intelligence officer is concerned with the intelligence aspects of the operations plan, the logistics officer with the logistics aspects of the operations plan). They do not

provide situation information (the current operations staff does this), nor do they develop the functional (e.g., intelligence collection or logistics) plans and annexes (staffs maintain their own plans sections) which implement the operations plan.

7.2.2 G3 Plans Section Planning Problems. (See Encl. 2) Planning problems can be initiated from a number of sources and can result in different types of planning activity. The following decribes the sources of planning problems and the corresponding types of planning activities that may result.

- Higher Headquarters.

-- New Order. This results in a planning activity similar to what has been described in the planning process model.

-- "Be Prepared" Mission. This results in a similar planning activity. It is expected that these missions will be received more often as the situation becomes more fluid.

-- Warning. These are normally received from the higher plans staff and indicate possible future activities. It is important to note that the commander's intent is normally not available for problems of this type. In this case it is necessary to plan in general terms and develop several options which can be used when the specifics are received through one of the other two mechanisms.

- Corps Headquarters. Corps generated planning problems are concerned with the continuation of the operations required to accomplish the last received EAC mission. In this case the EAC commander's intent remains unchanged. However, the corps commander's intent may be modified.

-- Operations generated problem. The operations section is the recognizer. It is important for the plans officer to coordinate

routinely with the operations section to determine future requirements, and what is most likely to be implemented. In this case it is also necessary to plan in general terms.

-- CDR/G3 generated problem. The plans officer should not be surprised if this occurs. Planning activity conducted to satisfy the first type of planning problem should be immediately applicable.

7.2.3 Other Corps Planning Problems. (See Encl. 2)

- Operations section planning. The operations section can generate plans sufficient for short-term follow-ons to current operations. In general, if the frag order can be satisfied with an overlay, then the operations section can perform the planning.

-- Exception: The operations section is too stressed to perform the activity.

-- Exception: The personalities involved (particularly the commander) may negate this general rule - some commanders insist that all plans be done by the plans section.

-- In any exception, the plans section would perform the required planning. Actual performance will depend on decision of G3.

-- A special case exists if need is recognized in Tac CP by CDR and/or G3, inasmuch as no plans section exists in Tac CP. Cdr/G-3, with operations section assistance, would perform planning activity.

7.2.4 Situation Projection Requirements. (See Encl. 2.) The necessity to "look into the future" is motivated by two operational requirements, the corps reserve and the deep battle.

- Commitment of corps reserve.

-- When and where to commit the reserve is the most important decision corps will make.

-- Commitment of the reserve takes time and once placed in motion is difficult to stop. Decision must be made in sufficient time to allow commitment at decisive place at correct time.

--- Time and space movement requirements. Reserves are large formations that take space on roads, and take time to prepare for movement. Additionally, reserves are normally placed away from contact to keep them from being attacked.

--- Planning time requirements.

--- Time required to prepare for operation upon commitment.

- Deep Battle. Special planning cell normally exists to plan for deep battle operations.

- Doctrinal expectation of 72-hour projection is best viewed as a goal. In the experience of the session participants, it is realistic to expect a decent projection of 24-36 hours.

7.3 CORPS COMMAND POSTS RELATIONSHIPS. (See Encl. 2)

7.3.1 Tactical CP.

- Facilitate current forward battle.

- Concerned with activities along the FLOT and forward of the FLOT to the extent they influence the FLOT.

- Synchronizes and integrates resource allocations to forward elements in order to influence forward battle.

- Operations cell, but no plans cell.

7.3.2 Main CP.

- Integrates forward and rear battles.

- Conducts deep battle.

- Obtains resources for all battles.

- Plans section and main operations cell.

7.3.3 Rear CP.

- Conducts rear battle.

- Integrates rear battle into overall operation (maneuver with logistics).

- Liaison with higher headquarters.

8. SCHEME OF MANEUVER. An initial discussion of the SM development process, which was conducted to develop a general characterization, succeeded in producing tentative agreement about something along the lines of the following: (See Encl. 3.)

> Developing a Scheme of Maneuver consists of selecting a number of possible SM parts from a larger collection of known parts; and then constructing (assembling) the scheme from these selected parts.

From this characterization it is apparent that three elements of the SM development process merit further analysis: the collection of known parts, the selection activity, and the construction (assembly) activity.

8.1 SCHEME OF MANEUVER PARTS. In reference to the characterization of the SM development phase given above, the following statements further characterize the term used. PARTS are ways of doing things, and contrast to the sections, or CATEGORIES, of the scheme discussed in FM 100-5. In a complete SM, all of the categories of the SM are "assigned" an appropriate part or parts. Assigning a different part to a category provides a different way of doing what the category says needs to be done. Many parts come from individual experience and are not specified by doctrine. Parts are best described by graphics and/or pieces of text.

8.1.1 Doctrinal Category Listing. A partial (doctrinal) list of categories of the SM includes the following (this list was extracted from FM 100-5):

- An outline of force movements.
- Objectives.
- Areas to be retained.
- Zone, sector or area responsibility.
- Maneuver options which may develop during the operation.
- Defensive counterattack maneuver.
- Airspace control.

8.1.2 Alternative Category Listing. The AWC participants believe that the above categories adequately reflect doctrine as expressed in FM 100-5, but do not reflect the actual categories used when developing an SM. When considering thought processes actually performed in this activity, six categories are addressed. Based on this recognition, the decision was made to redefine the SM categories into the following set. Parts can be easily viewed as alternative manners of answering these questions.

- Who
- What
- When
- Where
- How
- Why

8.1.3 Part Enumeration. The following enumerates the parts identified by the AWC participants. The enumeration is organized by category to which the part may be assigned. It is important to note that

the parts are not mutually exclusive, in that a given situation may result in several parts being used in the same category. However, within a category, there are parts that may not be used together. Where identified as such during the discussion they are also identified as alternatives below. Another important note is that many of the parts are not sensitive to the type of operation, and can be applied to their category independent of the operation type. Again, where identified as such during the discussion they will also be identified below.

8.1.3.1 Who. The Who category identifies the major subordinate elements the corps will have available for the operation. The parts available for this category are different from the other categories in that they are part of the METT-T factors themselves. The Troop List details the complete set of parts the planner has available. The Task Organization under which the corps is currently operating provides the initial decision point for identifying the Who parts the planner will use. The planner's task in addressing the Who category is to determine whether the parts listed in the current Task Organization are sufficient, and, if not, what modifications need be made. When the Who parts have been selected, the planners will have identified the unit or units that the rest of the SM will tell what to do. In performing this task the planners consider the following factors:

- Costs/penalties associated with potential modifications. A principal cost would be the time required to effect the change.

- Components (of elements in task organization).

- Past performance of Task Organization. (The inclination is to keep a good thing going.)

- Availability of forces (numbers).

- Types of forces.

- Relative strengths of forces.

- Current locations of forces.

- Relative proficiency of forces. (This would include experience and strength of the chain of command.)

- Orientation and personality of the force commander.

- Spirit of the force.

- Maintenance status of the force.

- Mobility of the force.

- Logistics status of the force.

8.1.3.2 What. (See Encl. 3.) The What parts describe the major (and some minor) operations the units are to perform. When the Scheme of Manuever is complete there will be at least one What part selected for each Who part selected. If the "Conduct" part is selected, then another What part may also be selected. If more than one What part is selected (neither of which is a "Conduct"), then the Scheme of Maneuver will direct their performance in sequence. The following What parts were identified:

- Attack.

- Defend.

- Delay.

- Move.

- Prepare. Prepare can be contrasted to "Be Prepared," in that Prepare tells a unit that it will perform another What in the future, although the other What part is not identified. It refers to a sustaining type operation in which the unit makes ready for general operations. It is not a contingency. Contingencies are covered by the "Be Prepared" directive. A "Prepare" mission will involve a significant amount of physical activity.

- Conduct (other potential terminology is "Associated Operations"). A "Conduct" What identifies the minor operations associated with the overall Scheme. Specifically, "Conduct" will include activities that involve less than the total force of the controlling unit. It is a grouping of related, specialized activities in support of another What given that force. "Conduct" activities are also selected from a collection of parts, which includes:

-- Raids.

-- Patrolling, to include or exclude ambushes.

-- Reconnaissance.

-- River crossing, if corps mission is related to river.

-- Screening operations.

-- Deception operations, although this part could also be selected for the Why category.

-- Covering Force operations. These operations are identified as a "Conduct" part since the Covering force operation is not a discrete form of maneuver, and is conducted as part of something larger. Normally, however, for the unit conducting the covering force, a "Conduct Covering Force Operations" part will be the only What part assigned.

-- Spoiling attacks.

-- Offensive operations. Included in this would be actions such as a Reconnaissance-in-Force.

-- Move. To contrast this with the What part Move, this movement would be as part of or in preparation for, another activity.

-- Airmobile operations.

-- Airborne operations.

8.1.3.3 When. (See Encl. 3.) The When parts provide alternative means for specifying the times that the selected What parts will be either started, completed, or conducted within (duration). When the Scheme of Maneuver is completed there will be a When part associated with every What part. Each subpart of a Conduct What part will also have a When part associated with it. These latter When parts are normally duration parts. The following When parts were identified:

- ASAP.
- A specified time.
- Daylight.
- Dark.
- H-Hour, or a time to be identified, from which other times will be computed.
- End Evening Nautical Twilight (EENT).
- Begin Morning Nautical Twilight (BMNT).
- Activity dependent, or upon something else happening
- On Order.
- No later than (NLT).
- No earlier than (NET).

- Upon receipt. (This normally applies to a planning activity.)

- From/To (where the from and to are other When parts).

- Between (same comment as From/To).

8.1.3.4 Where. (See Encl. 3.) The Where parts provide alternative means for specifying the locations that the selected What parts will be either started from, completed at, or conducted within. When the Scheme of Maneuver is complete there is a single Where part associated with each What part. The case may be that a single Where part may be associated with more than one What part. The following ...ere parts were identified:

- Terrain objective.

- Geographic designation.

- In Zone (offensive operation).

- In Sector (defensive operation).

- Along Axis.

- Direction of Attack.

- Cardinal Direction. A cardinal direction would include a distance, another location, and a direction. For example, "100 kilometers east of the IGB" would constitute a cardinal direction. (Note that the distance may be zero.)

- Distance From/To, where the from and to are other Where parts.

- Route.

- Enemy Force, where the enemy force designation could include disposition information. An example of this is the Where part "the flank of the first echelon division."

- Friendly Force. A Where part may be specified by a relation to a Where part of another friendly force. An example of this is the "Follow" relationship.

8.1.3.5 How. (See Encl. 3.) The How parts provide alternative means for accomplishing the What parts. Most, if not all, How parts can be associated with a single What part. When the Scheme of Maneuver is completed each What part will have a set of How parts associated with it. There is no necessary restriction on the number and selection of these How parts other than those designated as alternatives and not associated with the same What part at the same time (When part). The following lists the How parts by their association to the corresponding What part:

1) Attack.

- Hasty.
- Deliberate. Alternative with Hasty.
- Supported.
- Unsupported. Alternative with Unsupported.
- Main.
- Supporting. Alternative with Main.
- Illuminated.
- Non-illuminated. Alternative with Illuminated.
- Mounted.
- Dismounted.
- Combination Mounted/Dismounted. Alternative with Mounted and Dismounted.
- Deep.

- Shallow. Alternative with Deep.

- Narrow.

- Broad. Alternative with Narrow. The corresponding Where part also reflects this. Zone, Axis, Direction, Route indicate narrowing of the attack.

- Frontal.

- Flank.

- Reconnaissance-in-Force. This could also be listed as a subpart of the Conduct What part.

- Daylight.

- Night. Alternative with Daylight.

- Pure.

- Task Organized. Also termed Cross-Attached. Alternative with Pure.

- With Preparatory Fires.

- Without Preparatory Fires. Alternative with Preparatory Fires.

- Mode Factors. These are often not explicitly stated, and could also be reflected in Why and Where parts.

-- Speed. More emphasis on speed implies more likely to bypass places of resistance.

-- Tempo, or degree of violence.

2) Defense

- Defend.

- Delay.

- Withdraw.

- Rear Area protection. Separate kind of action.

- Static (positional) Defense. The emphasis is on holding terrain.

- Active Defense. Emphasis is on destroying forces. Alternative with Static. The two can be combined by giving them to What parts that are associated with different Who parts.

- Counterattack. Offensive form of defensive operation.

- Spoiling Attack. Offensive form of defensive operation. This is conducted forward of FLOT. A preemptive attack in the form of ground maneuver, artillery or air, or any combination.

- Point Defense.

- Economy of Force.

- Hasty.

- Prepared.

- Main Battle Area. Alternative with Hasty and Prepared. They reflect differences in degree of preparation and length of time to stay.

3) Operation independent.

- Priority of Fires. This is time-phased, in that at different times this part may be associated with different Who parts, but at any time it prioritizes the Who parts.

8.1.3.6 Why. (See Encl. 3.) The Why parts detail the commander's intent. Although there is no requirement to place a Why category (this is almost always the case in the development of FRAGORDs) into the disseminated SManeuver, the AWC participants believe that all good SM's possess a Why category. Even if the Why parts are not included, it is necessary to decide on them when

developing the SM. When the SM is complete there will be one or more Why parts which relate to the overall SM and one or more Why parts associated with each What part. The following lists the Why parts:

- Destroy Enemy Forces.
- Seize Terrain.
- Retain Terrain.
- Secure Terrain.
- Seize Initiative.
- Retain Initiative.
- Deny (any of above).
- Break Contact.
- Establish Contact.
- Retain Contact.
- Maintain Contact.
- Facilitate Future Operations.
- Facilitate Other (simultaneous) Operations.
- Disrupt.
- Delay.
- Deceive.
- Canalize.
- Continue.
- Reinforce.
- Extract.
- Move or Maneuver.
- Protect.
- Consolidate.

- Reorganize.
- Reorient or Redirect.
- Relieve.
- Exploit.

8.2 PART SELECTION. (See Encl. 4) It is possible to describe the part selection process at different levels. Several statements can be made concerning selection of parts within categories, a general process for selecting parts, relationship of the METT-T factors to part selection, and a general category sequence for part selection.

8.2.1 Category Process Description. It is possible to describe the general part selection process by giving a general description of the process for each category, as follows:

8.2.1.1 Why Parts: The appropriate Why parts for the corps are either given, or obvious. Their selection is driven by the mission and EAC commander's guidance. This is not necessarily true for the Why parts for the corps subordinates.

8.2.1.2 What Parts: The appropriate What parts are driven, if not given, by the mission.

8.2.1.3 How Parts: The selection of appropriate How parts is heavily reliant on the situation as expressed in the METT-T factors. There are two summary measures of METT-T which are particularly useful in selecting the How parts: Relative Strength and Relative Mobility.

8.2.1.4 Who Parts: The selection of Who parts is also influenced heavily by the METT-T factors. It is common to consider METT-T factors not previously considered when selecting Who parts.

8.2.1.5 Where Parts: The selection of Where parts is also influenced heavily by the METT-T factors. It is common to consider METT-T factors not previously considered when selecting Where parts.

8.2.1.6 When Parts: The selection of When parts is also influenced heavily by the METT-T factors. It is common to consider METT-T factors not previously considered when selecting When parts.

8.2.2 General Process Characterization. A general characterization exists for those categories which are strongly dependent on the analysis of the METT-T factors. This characterization can be stated as follows:

In selecting those parts that will be assembled into a Scheme of Maneuver consider all known factors of METT-T. As this is done certain parts will be eliminated as being not applicable to the situation. This leaves a set of parts which are potentially useful. This set of parts is further analyzed in the context of the METT-T factors to select those which are best for the situation.

The following comments relate to this description of the selection process.

- Best. The term "best" needs to be further defined. It is clear that the concept of an "optimal" solution may not apply. "Best" in terms of "suitable" is more appropriate.

-- If the corps is operating in a staff planning mode, then there will be many "best" solutions, each defining an alternative course-of-action.

-- Suitability is often in the eye of the beholder.

- Assembly. Whatever is selected must also be put together correctly. The term "correctly" also needs to be further defined. At a minimum there seems to be two levels of correctness:

-- The assembly is correct at the first level if it does not violate operational principles. If an assembled SM does not meet these criteria then it is a bad SM.

-- The assembly is correct at the second level if it is acceptable to the commander. This is strongly dependent on the personality of the commander. A good SM is correct at the first and second level.

8.2.3 METT-T Factor Relationship. Any planning situation is uniquely described by a discrete set of METT-T factors. The number of potential combinations of factors which may exist is, for all practical purposes, infinite. Each of these combinations produces a corresponding discrete set of METT-T factors. Further complicating this is the fact that planners often have incomplete knowledge of the actual set of factors relevant to their particular problem, and the nature of this incompleteness is often unknown as well. Due to this incompleteness, a planning situation may be described by one of a number of discrete sets of METT-T factors, each of which captures different incompleteness.

8.2.3.1 Higher Level Situation Descriptors. Planners find it useful to capture higher level situation descriptors from the information in the discrete set of METT-T factors describing the planning situation. These higher level descriptors are then used in the part selection process.

- Relative strength is one such situation descriptor. Relative strength is a comparison of enemy and friendly strengths and weaknesses, and their ability to employ those strengths and attack those weaknesses. All factors of METT-T contribute to the assessment of relative strength.

-- Relative strengths can be described by place and time. In this case the METT-T factors would describe a number of different relative strength descriptions, each differing in place and time.

-- Strength computations involve all that is known about the following METT-T factors:

--- Enemy forces available.

--- Friendly forces available.

--- Terrain over which the forces are to deploy.

--- Terrain over which the forces are to move.

--- Time available in which to move.

-- The Mission factor may affect which other METT-T factors are actually considered in the determination of relative strength. This is particularly true in considering the enemy forces.

- Center of Gravity is another potential descriptor. Center of Gravity refers to the enemy force. It is the object that, if seized or destroyed (potentially other Why parts may fit here as well) by friendly forces, will cause the enemy the most damage and allow the corps to accomplish its mission.

-- Center of Gravity may be a piece of terrain.

-- Center of Gravity may be an enemy force.

-- Center of Gravity may be an installation.

- Relative mobility is another high level situation descriptor. Relative mobility was not further discussed.

- Key Terrain is another high level situation descriptor. Key Terrain is any terrain, the possession of which gives the owner a specific advantage.

-- At corps, the following terrain features often contribute to key terrain: natural terrain obstacles, road networks, air avenues of approach, bridges (given conditions: river cannot be forded; river cannot be bridged with tactical bridging; and no other class 60 bridges exist across river, for example).

-- Force composition is an important factor in determining key terrain.

-- Terrain characteristics to evaluate include: on- and off- road trafficability, visibility.

- Avenues of Approach (AA). The AA is another high level situation descriptor.

-- At corps level divisional AA's are major AA's and regimental AA's are minor AA's.

-- If terrain is characterized by many minor AA's and few, if any, major AA's, then it may be desirable to aggregate minor AA's into fewer major AA's. It must make tactical sense to do this, however.

-- Two-phase AA determination. First, look for terrain-supported approaches. Second, match to enemy disposition to prioritize likely use of AA's.

-- Air AA's are also important. Three types of air AA's are of interest: Airmobile force approaches, high-performance aircraft approaches, and helicopter gunship approaches.

8.2.3.2 Specific METT-T Relationships to Part Selection. A number of comments were made regarding the relationships between the METT-T factors and part selection and assembly.

- It is usually the case that if the enemy is strong relative to friendly forces, then options which fall into the BOLD category should be rejected.

-- Bold options usually involve an offensive form with a degree of risk.

-- It is not possible to classify parts as possessing or lacking boldness.

-- In this case, "bold" refers to assembly, and the options are different assemblages, not different selections.

-- Exception: It may be that the enemy is so strong that only a bold option will be successful.

- Why parts.

-- Consideration of mission may dictate a series of Why parts.

-- Why parts associated with Who parts may be different than Why part for corps, but they must facilitate the corps Why part.

-- As the relative strength favors friendly forces, the destroy enemy force Why part is more feasible.

- What parts. No comments.

- How parts. Relative strength is major determinant of How parts. Of particular importance is the manner in which the different How parts change relative strengths.

-- How parts must gain the relative strength required at all points. In other words, they must implement the principles of Mass and Economy of Force.

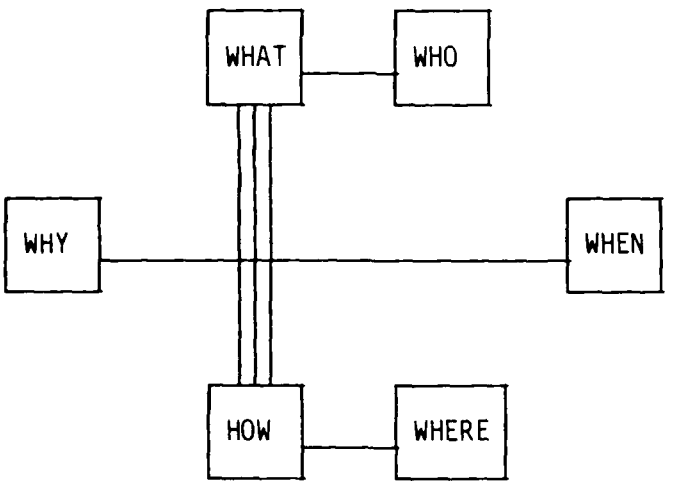
-- Relative strength allows elimination of a number of How parts.

- Who parts. No comments.

- Where parts. No comments.

- When parts. No comments.

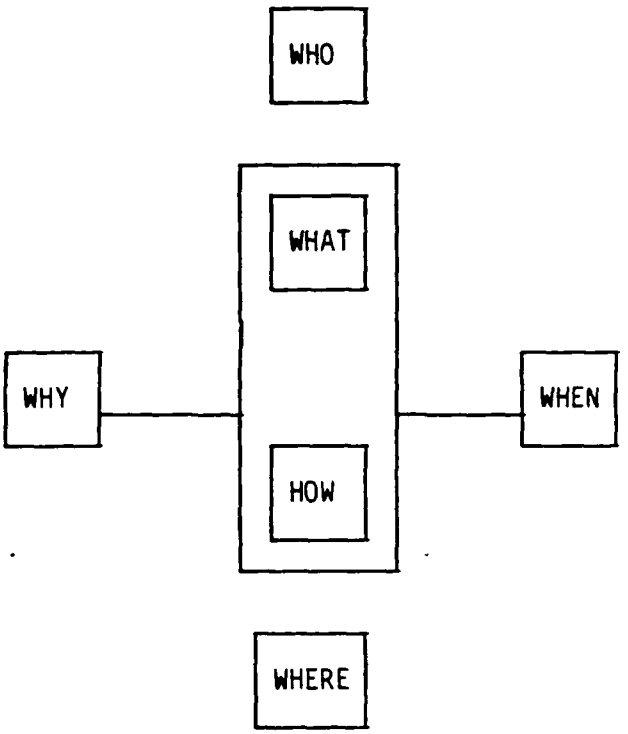
8.2.4 Category Sequence. (See Encl. 3) A loose sequence exists which relates the part selection process. Almost always the Why parts are selected first. Selection of these parts will establish a framework to assist in the selection of other parts. Additionally, the selection of the Why parts may influence the sequence for selecting the remaining parts. It is common (but not always true) for the What parts and How parts to be selected next. Normally these are selected together. Again, it is common, but not always true, for the Who parts and the Where parts to be selected next. It is almost always true that the When parts are selected last. The following diagrams attempt to capture this sequence:



ORDER

POTENTIAL INTERACTION

STRONG INTERACTION



ORDER

9. FUTURE RESEARCH: Both AWC students believe that there is great potential for research into the prospects of automated decision-making aids for the battlefield. Automation is going to grow, not shrink, and its growth should be directed by future users. Additionally, a valuable spin-off from the research is understanding the actual process of arriving at a scheme of maneuver (or other key tactical decision) and allowing seasoned officers to share their experience for the benefit of those with less experience. In summary, the subject matter provides a good subject for continued research, provided that "operators" are not forced into a predetermined model that facilitates automation. It is suggested that computer scientists design their models and computer language to accommodate the knowledge and language of operators, not

the other way around. USAWC study participants remain concerned that this research could proceed in the absence of experienced operations officers and result in a "cookbook" approach to tactical decision-making, so as to facilitate the application of computer technology. It must be recognized that tactical decision-making is a skill which falls in the category of an art, not a science. There are few hard-and-fast rules which apply to all situations. The "best" solution is the one which works and it is developed on the basis of the application of sound tactical principles; experience gained over years of trial and error in countless situations; knowledge of soldiers, units, and commanders; and, often, "gut-feel." Computers deal in facts; they cannot factor intangibles, and they cannot produce "gut-feel." Accordingly, it is the opinion of the study participants that the focus of this automation effort should be on the collection, analysis, and timely provision of known facts concerning the battlefield. Inasmuch as virtually all elements of tactical decision-making are predicated on interpretation of the factors of METT-T, the magic of the computer can best be devoted to improving the information provided the commander about these factors. In short, the computer can be a valuable decision-making aid. It cannot be allowed to become a de facto decision-maker for those unskilled in the art.

SUMMARY: AWC/CECOM Knowledge Engineering Session, 12 February 86

1. BACKGROUND. The initial knowledge engineering session was conducted at AWC on 12 February 1986, from 1330 until 1600 hours. The session served to familiarize the CECOM participant with the final model developed by the AWC students and to initiate discussion on the Scheme of Maneuver (SM) development process of the model.

2. PURPOSE. This MFR summarizes the major points of discussion of the session. It does not recreate the flow of the discussion, or summarize the discussions that led to the development of the ideas presented. The points discussed in this MFR were generally accepted by all participants in the session.

3. PLANNING PROCESS. The following reflects the AWC participants' understanding of the manner in which planning is practiced at corps level, in the European Theater of Operations, and in an active context. It is not meant to reflect a doctrinal description of the planning process, but does reflect the accumulated experience of the students in performing the planning task in a variety of environments.

- The Planning Process Scope: For purposes of this study project the planning process commences upon receipt of a new mission (to include commander's guidance and intent) from the higher command, and terminates upon completion of the alternative courses of action. The process also refers only to the actions of planners, and does not refer to the actions of other staff officers concerned with providing information critical to the planning process.

Encl 1

- The Mission Analysis: This is the first phase in the planning process. It uses information contained in the higher command's order for the operation (whatever form that may take), and other information provided by the higher command (such as any verbal guidance provided by the higher commander or G3). At the completion of the mission analysis the planners have developed the following information items to be used by the remainder of the planning process:

- Tasks to be accomplished by the corps during the ensuing operation.

- Constraints under which the corps is to operate.

- An "understanding" of the intent of the higher commander in the ensuing operation. From this understanding of the commander's intent, it may (should?) be possible to develop a number of evaluation priorities for use in the following phases of the planning process.

- Course of Action Generation: This is the second phase in the planning process. It is understood that this is in contradiction with the process as described by doctrine (FM 101-5) in that the staff analyses are not required. However, the planners agreed that in the European context, the staff analysis at corps consisted of attempting to identify "aberrations" in the situation, and, in the absence of these aberrations (radical changes in the situation, caused by the loss of continuity of the operation), the planners will deal with staff information in its routine form. One aberration is significant enough to merit special attention, however, and that is when the corps is forced to change its environment (terrain and opposing force) as a result of the new operation. In that case, the planners must wait for the production of the detailed staff information. Course of action generation can be subdivided into five phases which can (should?) be performed in a predictable sequence.

- Scheme of Manuever (SM) Development. The SM is developed first. All factors of METT-T must be considered in developing the SM. At a minimum, the commander's understanding of the METT-T factors must be verified. From the above it is clear that this does not require a separate staff analysis effort unless an aberration is noted.

- Task Organization (TO) and Task Allocation (TA). After development of the SM, a TO can be developed and tasks allocated. These phases must be pursued in parallel and decisions made in either will effect decisions to be made in the other.

- TO. Significant factors considered are the number of troops available, type of forces available (NOTE: The distinction between Armored and Mech is for all intents meaningless), and personalities of subordinate force commanders. As the force types become more similar, the importance of commander personalities increases. Another important point is that the corps has many assets to allocate. It normally is not necessary or desirable for the planners to break up maneuver assets into smaller pieces (for example, take a brigade away from a division). Another way to state this is that unit integrity is an important and desirable factor in allocating maneuver elements. It becomes less important in allocating non-maneuver forces.

- TA. Personalities and types of forces within subordinate elements are critical factors in allocating tasks.

- Command and Control (C^2) Measures. After developing the SM and TO and performing the TA, it is possible to specify the C^2. The C^2 consists of a number of elements, which include:

- Synchronization of Operations (this is the key element).

- Communications measures, to include the allocation of corps' signal assets.

- Command post(s) location(s).

- Reporting mechanisms.

- How to control the battle.

- Control Measures. At one point in the discussion, it was agreed that precise unit boundaries were not important in developing courses of action. A general definition is sufficient, and the precise boundaries are best decided by the neighboring units.

4. SCHEME OF MANEUVER. An initial discussion of the SM development process, which was conducted to develop a general characterization, succeeded in producing tentative agreement about something along the lines of the following:

> Developing a Scheme of Maneuver consists of selecting a number of possible SM parts from a larger collection of <u>known</u> parts; and then constructing (assembling) the Scheme from these selected parts.

From this characterization it is apparent that three elements of the SM development process merit further analysis: the collection of known parts, the selection activity, and the construction (assembly) activity.

5. PROPOSED ACTIVITY. The next session should concentrate on the following items:

- Evaluation Priorities: To develop an understanding of how the Evaluation Priorities developed by the mission analysis effect the subsequent SM development, it is necessary to first identify the possible

evaluation priorities. This should be limited to corps defensive operations in the European environment. It is not necessary to determine how these priorities are developed - just what they may be.

- SM Parts: In a similar manner, it is necessary to identify the collection of parts that may be applicable in a corps defensive operation in the European environment. Where possible, the relationship of the parts to parts of the SM should also be identified.

- Selection of Parts: Thought should also be directed to how the SM parts are selected. Consideration should be given to the evaluation priorities and the METT-T factors relationship to part selection.

SUMMARY: AWC/CECOM Knowledge Engineering Session, 28 February, 1986

1. BACKGROUND. The second knowledge engineering session was conducted at AWC on 28 February 1986, from 1330 until 1600 hours. The session served to verify the MFR prepared to record the activities of the first knowledge engineering session, enumerate possible outcomes of the mission analysis process, and to clarify the role of the planning function at a corps headquarters in the European environment in an active context.

2. PURPOSE. This MFR summarizes the major points of discussion of the session. It does not recreate the flow of the discussion, or summarize the discussions that led to the development of the ideas presented. The points discussed in this MFR were generally accepted by all participants in the session.

3. THE PLANNING PROCESS. Several clarifications and corrections of the original MFR were agreed to during the session, and have been entered into a revised MFR dated 3 March 1986. Additionally, a number of additional points were made during the discussion which provided further clarification of the planning process model. These points are organized below by the model component they address.

a. Mission Analysis. The following points pertain to the mission analysis (MA) phase of the process.

1) Determination of requirement for detailed staff analysis.

- Normally the higher command's mission statement for the corps contains sufficient information to determine whether or not detailed staff analyses will be required.

Encl. 2

- Another form of "aberration" possibly requiring staff analyses would be a change in operation type to be conducted (e.g., the current operation is defensive and the operation required by the new mission is offensive).

b. Scheme of Maneuver. The following points pertain to the scheme of maneuver development (SM) phase of the process.

1) Parts/Categories. In reference to the characterization of the SM development phase given in the first MFR, the following statements further characterize the term used.

- PARTS are ways of doing things, and contrast to the sections, or CATEGORIES, of the Scheme discussed in FM 100-5. In a complete SM, all (or some?) of the categories of the SM are "assigned" an appropriate part or parts. Assigning a different part to a category provides a different way of doing what the category says needs to be done.

- Many parts come from individual experience and are not specified by doctrine.

- Parts are best described by graphics and/or pieces of text.

- A partial list of categories of the SM includes the following:
  - -- An outline of force movements.
  - -- Objectives.
  - -- Areas to be retained.
  - -- Zone, sector or area responsibility.
  - -- Maneuver options which may develop during the operation.
  - -- Defensive counterattack maneuver.
  - -- Airspace control.

2) Terrain Factors. The terrain component of the METT-T factors was discussed. At the corps level there are two primary terrain factors which are important in developing the SM.

- Key Terrain.

-- Key Terrain is any terrain, the possession of which gives the owner a specific advantage.

-- At corps, the following terrain features often contribute to Key Terrain: natural terrain obstacles, road networks, air avenues of approach, bridges (given conditions: river cannot be forded, and, river cannot be bridged with tactical bridging, and, no other class 60 bridges exist across river).

-- Force composition is an important factor in determining key terrain.

-- Terrain characteristics to evaluate include: on- and off-road trafficability, visibility.

- Avenues of Approach (AA).

-- At corps level divisional AA's are major AA's and regimental AA's are minor AA's.

-- If terrain is characterized by many minor AA's and few, if any, major AA's, then it may be desirable to gather minor AA's into fewer major AA's. It must make tactical sense to do this, however.

-- Two-phase AA determination. First, look for terrain-supported approaches. Second, match to enemy disposition to prioritize likely use of AA's.

-- Air AA's are also important. Three types of air AA's are of interest: Airmobile force approaches, high-performance aircraft approaches, and helicopter gunship approaches.

c. Task Organization/Task Allocation. The following points pertain to the task organization/task allocation (TA/TO) phase of the process.

1) Unit integrity. Unit integrity is a matter of concern when developing the task organization.

- Unit integrity is of most concern when allocating maneuver assets. At the corps level the situation may very well dictate allocating maneuver resources of one division to another division (e.g., chopping a brigade), but in these situations the following statements are usually true.

-- The maneuver unit being allocated additional resources possesses insufficient combat power to accomplish the tasks assigned.

-- It is not desirable to allocate corps-level non-maneuver resources to the unit to make up for the combat power shortfall (or, alternatively, the planner would first look for other, non-maneuver resources, to allocate).

-- It is not desirable to allocate tasks in a different manner.

- Unit integrity is less of a factor when allocating the following types of resources: Engineers, Aviation, Air Defense, Signal, Artillery.

2) TO may some times be based on the tasks allocated to the units in the TO.

d. Command and Control Measures. The following points pertain to the command and control measures (C^2) phase of the process.

1) Unit Boundaries.

- Boundaries are important in planning for the function they serve, which is to clearly indicate into which sector the following terrain features belong:

-- Key Terrain.

-- Avenues of Approach (AA). A basic law - Don't split an AA between units. Exception - Unless a single force is inadequate to cover an AA. This may result from a number of reasons, which include, but are not limited to, the following: the course of the AA, terrain does not provide suitable defensive positions for a single unit, other AA's in the unit's sector.

-- Routes (RT). A rule of thumb - Don't split a road between units. Exception - All units need an MSR. If there is no other way to provide for an MSR then you have to split a road.

- As long as this terrain feature assignment function is satisfied, a precise definition of boundaries is not required for planning.

e. Support Priorities. The following points pertain to the support priorities (SP) phase of the process.

1) As an alternative to TO changes, support priorities can provide a combat multiplier impact.

4. MISSION ANALYSIS INFORMATION. This paragraph enumerates possible outputs of the mission analysis phase of the planning process which would have an influence on subsequent phases of the process. These outputs are the result of understanding the corps mission as stated in the higher command's order and the intent of the higher commander.

a. Time constraints. Severe time constraints support development of plans which are simple to implement at lower levels (i.e., subordinate commands have a simpler planning problem) and simple to execute.

b. Implied tasks. This includes both short-term objectives and long-term objectives.

c. Identification of subsequent operations.

- Must finish operation in posture to do what is needed next. This will impact how you approach accomplishing objective.

- Must finish operation in posture to support commander's subsequent operation.

For example, if the corps mission is to conduct a limited counterattack to secure an objective, the commander's intent in directing the counterattack may be either of 1) seize and retain terrain objective, or 2) capture terrain to facilitate deep counterattack with Axis through objective. These options dictate different allowable postures upon completion of the counterattack and different subsequent operations for the corps.

d. Be Prepared constraints.

- Missions. These can influence the type of operations you can conduct.

- Lose a designated element (name or type) of your force.

-- These will impact corps' use of the force, in that they have a certain level of commitment they cannot breach.

-- Corps must be prepared to adapt to the loss of the force.

e. Availability of fire support assets from outside corps.

- EAC operations (e.g., deep interdiction) may imply the EAC assets will not be available for corps.

f. Preservation of force vs. Accomplishment of objective. When preservation of the force is given priority, the following is true.

- More likely to impact how tasks will be accomplished than what tasks will be accomplished. Less likely to conduct high-risk operations.

- Normally more important to operations than planning.

-- Counterattack less likely.

-- If conducted, depth of counterattack would be less.

g. Constraints on reserve force.

- Size of reserve.

- Position of reserve.

- String on commitment of reserve.

-- Commit only with higher command approval.

-- Constraint on time to react to contingency. This could particularly effect maneuver, fire support and aviation elements.

h. Constraints on covering force.

- Size of covering force.

-- Attrit enemy well forward implies strong covering force.

-- Develop something early implies strong covering force.

-- Forward divisions need time to deploy implies strong covering force.

- Time of covering force action.

-- Forward divisions need time to deploy implies the duration of the covering force action will extend at least until divisions can deploy.

- Covering force activity.

-- Covering force needed for further operations implies no decisive engagement.

-- Don't let covering force fall below certain strength implies limitation of covering force activity.

5. THE PLANNING FUNCTION. The following statements characterize the planning function as practiced at the corps level in the European environment in an active context.

a. G3 Plans Staff. An Army of Excellence TO&E for the corps G3 planning section has yet to be adopted. However, based on the division G3 planning section TO&E, which has 13 majors representing the combat, combat support and combat service support functional areas, it is presumed that the section will contain officers of the combat, combat support and combat service support functional areas. The purpose of this section is to develop the operations plans. The functional area representatives are actively engaged in the planning activity, contributing advice and analysis on the aspects of the plan effecting their area of expertise (e.g., the intelligence officer is concerned with the intelligence aspects of the operations

plan, the logistics officer with the logistics aspects of the operations plan). They do not provide situation information (the staff does this), nor do they develop the functional (e.g., intelligence collection or logistics) plans and annexes (staffs maintain their own plans sections) which implement the operations plan.

b. G3 Plans Section Planning Problems. Planning problems can be initiated from a number of sources and can result in different types of planning activity. The following describes the sources of planning problems and the corresponding types of planning activities that may result.

- Higher Headquarters.

-- New Order. This results in a planning activity similar to what has been described in the planning process model.

-- Be Prepared Mission. This results in a similar planning activity. It is expected that these missions will be received more often as the situation becomes more fluid.

-- Warning. These are normally received from the higher plans staff and indicate possible future activities. It is important to note that the commander's intent is normally not available for problems of this type. In this case it is necessary to plan in general terms and develop several options which can be used when the specifics are received through one of the other two mechanisms.

- Corps Headquarters. Corps generated planning problems are concerned with the continuation of the operations required to accomplish the last received EAC mission. In this case it seems that the EAC commander's intent remains unchanged. However, the corps commander's intent may be modified.

-- Operations generated problem. The operations section is the recognizer. It is important for the plans officer to coordinate routinely with the operations section to determine future requirements, and what is most likely to be implemented. In this case it is also necessary to plan in general terms.

-- CDR/G3 generated problem. The plans officer should not be surprised if this occurs. Planning activity conducted to satisfy the first type of planning problem should be immediately applicable.

c. Other Corps Planning Problems.

- Operations section planning. The operations section can generate plans sufficient for short-term follow-ons to current operations. In general, if the frag order can be satisfied with an overlay, then the operations section can perform the planning.

-- Exception: The operations section is too stressed to perform the activity.

-- Exception: The personalities involved (particularly the commander) may effect this general rule.

-- In any exception, the plans section would perform the required planning. Actual performance will depend on decision of G3.

-- A special case exists if need is recognized in Tac CP by CDR and/or G3. Since no plans section exists in Tac CP, CDR/G3 with operations section assistance would perform planning activity.

d. Corps Command Posts' Relationships.

- Tactical CP.

-- Facilitate current forward battle.

-- Concerned with activities along the FLOT and forward of the FLOT to the extent they influence the FLOT.

-- Synchronizes and integrates resource allocations to forward elements in order to influence forward battle.

-- Operations cell but no plans cell.

- Main CP.

-- Integrates forward and rear battles.

-- Conducts deep battle.

-- Obtains resources for all battles.

-- Plans section and main operations cell.

- Rear CP.

-- Conducts rear battle.

-- Integrates rear battle into overall operation (maneuver with logistics).

-- Liaison with higher headquarters.

e. Situation Projection Requirements. The necessity to "look into the future" is motivated by two operational requirements, the corps reserve and the deep battle.

- Commitment of corps reserve.

-- When and where to commit reserve is most important decision corps will make.

-- Commitment of reserve takes time and cannot be stopped. Decision must be made in sufficient time to allow commitment at decisive place at correct time.

-- Time and space movement requirements. Reserves are large formations that take space on roads, and take time to prepare for movement. Additionally, reserves are normally placed away from contact to keep them from being attacked.

--- Planning time requirements.

--- Time required to prepare for operation upon commitment.

- Deep Battle. Special planning cell exists to plan for deep battle operations.

- Doctrinal expectation of 72-hour projection is best viewed as a goal. In the experience of the session participants, it is realistic to expect a decent projection for 24 hours.

6. FUTURE MEETINGS. We propose that the following issues be addressed in sequence over the course of the next several meetings.

a. Identification and description of the collection of known SM parts.

b. Description of the process of selecting relevant parts from the set of known parts.

c. Description of the process of assembling the selected parts into the final SM.

SUMMARY:

SUBJECT: AWC/CECOM Knowledge Engineering Session, 6 March 1986

1. BACKGROUND: The third knowledge engineering session was conducted at AWC on 6 March 1986, from 1230 until 1600 hours. The session served to review the draft MFR prepared to summarize the previous session and to enumerate Scheme of Maneuver parts from which experienced planners select when developing a Scheme of Maneuver.

2. PURPOSE. This MFR summarizes the major points of discussion of the session. It does not recreate the flow of the discussion, or summarize the discussions that led to the development of the ideas presented. The points discussed in this MFR were generally accepted by all participants in the session.

3. REVIEW OF PREVIOUS SESSION. With one exception, the modifications of the draft MFR describing the previous session served to clarify what was written, and have been incorporated into a revised version dated 10 March 1986. These modifications are not further described in this MFR, and the contents of the revised version are assumed true for purposes of this MFR.

The one significant exception concerned the Scheme of maneuver (SM) categories listed in the MFR. The AWC participants expressed the opinion that these categories adequately reflected doctrine as expressed in FM 100-5, but did not reflect the actual categories they used when developing an SM. When considering their thought processes as they performed this activity, they were able to identify six categories that were consciously

addressed. Based on this recognition, the decision was made to redefine the SM categories into the following set:

- Who
- What
- When
- Where
- How
- Why

Parts, then, could be easily viewed as alternative matters of answering these questions.

4. SCHEME OF MANEUVER PARTS. It was quickly determined that parts could usefully be listed by category. The following describes each category by associating with it the various parts which could satisfy that category.

It is important to note that the parts are not mutually exclusive, in that a given situation may result in several parts being used in the same category. However, within a category, there are parts that may not be used together. Where identified as such during the discussion they are also identified as alternatives below.

Another important note is that many of the parts are not sensitive to the type of operation, and can be applied to their category independent of the operation type. Again, where identified as such during the discussion they will also be identified below.

a. Who. The Who category identifies the major subordinate elements the corps will have available for the operation. The parts available for

this category are different from the other categories in that they are part of the METT-T factors themselves. The Troop List details the complete set of parts the planner has available. The Task Organization under which the corps is currently operating provides the initial decision point for identifying the Who parts the planner will use. The planner's task in addressing the Who category is to determine whether the parts listed in the current Task Organization are sufficient, and, if not, what modifications need be made. In performing this task the planners consider the following factors:

- Costs/penalties associated with potential modifications. A principal cost would be the time required to effect the change.
- Components (of elements in task organization).
- Past performance of Task Organization. The inclination is to keep a good thing going.
- Availability of forces (numbers).
- Types of forces.
- Relative strengths of forces.
- Current locations of forces.
- Relative proficiency of forces. This would include experience.
- Orientation and personality of the force commander.
- Spirit of the force.
- Maintenance status of the force.
- Mobility of the force.
- Logistics status of the force. This is most often less important than the other factors since the cost to change this is often less than the cost to modify the existing task organization.

When the Who parts have been selected, the planners will have identified the unit or units that the rest of the Scheme will tell what to do.

b. What. The What parts describe the major (and some minor) operations the units are to perform. The following What parts were identified:

- Attack.
- Defend.
- Delay.
- Move.
- Prepare. Prepare can be contrasted to Be Prepared, in that Prepare tells a unit that it will perform another What in the future, although the other What part is not identified. It refers to a sustaining type operation in which the unit makes ready for general operations. It is not a contingency. Contingencies are covered by the Be Prepared directive. It was decided not to further discuss the Be Prepared directive. A Prepare mission will involve a significant amount of physical activity.
- Conduct (other potential terminology is "Associated Operations"). A Conduct What identifies the minor operations associated with the overall Scheme. Specifically, Conduct will include activites that involve less than the total force of the controlling unit. It is a grouping of related, specialized activities in support of another What given that force. Conduct activities are also selected from a collection of parts, which includes:

-- Raids.

-- Patrolling, to include or exclude ambushes.

-- Reconnaissance.

-- River crossing, if corps mission is related to river.

-- Screening operations.

-- Deception operations, although this part could also be selected for the Why category.

-- Covering Force operations. These operations are identified as a Conduct part since the Covering force operation is not a discrete form of maneuver, and is conducted as part of something larger. Normally, however, for the unit conducting the covering force, a Conduct Covering Force operations part will be the only What part assigned.

-- Spoiling attacks.

-- Offensive operations, included in this would be actions such as a Reconnaissance-in-Force.

-- Move. To contrast this with the What part Move, this movement would be as part of or in preparation for, another activity.

-- Airmobile operations.

-- Airborne operations.

When the Scheme of Maneuver is complete there will be at least one What part selected for each Who part selected. If the Conduct part is selected, then another What part may also be selected. If more than one What part is selected (neither of which is a Conduct), then the Scheme of Maneuver will direct their performance in sequence.

c. When. The When parts provide alternative means for specifying the times that the selected What parts will be either started, completed, or conducted within (duration). The following When parts were identified.

- ASAP.
- A specified time.
- Daylight.
- Dark.
- H-Hour, or a time to be identified, from which other times will be computed.
- End Evening Nautical Twilight (EENT).
- Begin Morning Nautical Twilight (BMNT).
- Activity dependent, or upon something else happening.
- On Order.
- No later than (NLT).
- No earlier than (NET).
- Upon receipt. This normally applies to a planning activity.
- From/To, where the from and to are other When parts.
- Between (same comment as From/To).

When the Scheme of maneuver is completed there will be a When part associated with every What part. Each subpart of a Conduct What part will also have a When part associated with it. These latter When parts are normally duration parts.

d. Where. The Where parts provide alternative means for specifying the locations that the selected What parts will be either started from, completed at, or conducted within. The following Where parts were identified:

- Terrain objective.

- Geographic designation.

- In Zone (offensive operation).

- In Sector (defensive operation).

- Along Axis.

- Direction of Attack.

- Cardinal Direction. A cardinal direction would include a distance, another location, and a direction. For example, "100 kilometers east of the IGB" would constitute a cardinal direction. Note that the distance may be zero.

- Distance From/To, where the from and to are other Where parts.

- Route.

- Enemy Force, where the enemy force designation could include disposition information. An example of this is the Where part "the flank of the first echelon division."

- Friendly Force. A Where part may be specified by a relation to a Where part of another friendly force. An example of this is the Follow relation.

When the Scheme of Maneuver is complete there is a single Where part associated with each What part. The case may be that a single Where part may be associated with more than one What part.

e. How. The How parts provide alternative means for accomplishing the What parts. Most, if not all, How parts can be associated with a single What part. The following lists the How parts by their association to the corresponding What part:

1) Attack.

- Hasty.
- Deliberate. Alternative with Hasty.
- Supported.
- Unsupported. Alternative with Supported.
- Main.
- Supporting. Alternative with Main.
- Illuminated.
- Non-illuminated. Alternative with Illuminated.
- Mounted.
- Dismounted.
- Combination Mounted/Dismounted. Alternative with Mounted and Dismounted.
- Deep.
- Shallow. Alternative with Deep.
- Narrow.
- Broad. Alternative with Narrow. The corresponding Where part also reflects this. Zone, Axis, Direction, Route indicate narrowing of the attack.
- Frontal.
- Flank.
- Reconnaissance-in-Force. This could also be listed as a subpart of the Conduct What part.
- Daylight.
- Night. Alternative with Daylight.
- Pure.
- Task Organized. Also termed Cross-Attached. Alternative with Pure.

- With Preparatory Fires.

- Without Preparatory Fires. Alternative with Preparatory Fires.

- Mode factors. These are often not explicitly stated, and could also be reflected in Why and Where parts.

-- Speed. More emphasis on speed implies more likely to bypass places of resistance.

-- Tempo, or degree of violence.

2) Defense.

- Defend.

- Delay.

- Withdraw.

- Rear Area Protection. Separate kind of Action.

- Static (positional) Defense. The emphasis is on holding terrain.

- Active Defense. Emphasis is on destroying forces. Alternative with Static. The two can be combined by giving them to What parts that are associated with different Who parts.

- Counterattack. Offensive form of defensive operation.

- Spoiling Attack. Offensive form of defensive operation. This is conducted forward of FLOT. A preemptive attack in the form of ground maneuver, artillery or air, or any combination.

- Point Defense.

- Economy of Force.

- Hasty.

- Prepared.

- Main Battle Area. Alternative with Hasty and Prepared. They reflect differences in degree of preparation and length of time to stay.

3) Operation independent.

- Priority of Fires. This is time-phased, in that at different times this part may be associated with different Who parts, but at any time it prioritizes the Who parts.

When the Scheme of Maneuver is completed each What part will have a set of How parts associated with it. There is no necessary restriction on the number and selection of these How parts other than those designated as alternatives are not associated with the same What part at the same time (When part).

g. Why. The Why parts detail the commander's intent. Although there is no requirement to place a Why category (this is almost always the case in the development of FRAGORDs) into the disseminated Scheme of Maneuver, the AWC participants felt that all good Schemes did possess a Why category. Even if the Why parts are not included, it is necessary to decide on them when developing the Scheme. The following lists the Why parts:

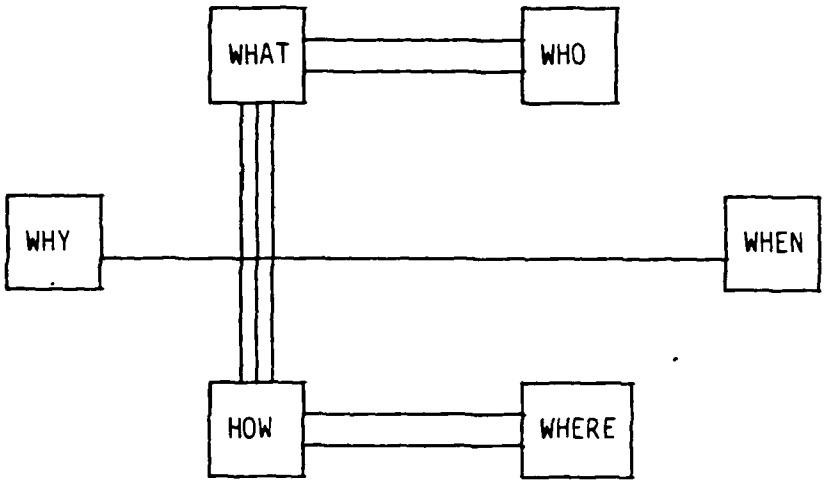
- Destroy Enemy Forces.
- Seize Terrain.
- Retain Terrain.
- Secure Terrain.
- Seize Initiative.
- Retain Initiative.
- Deny (any of above).
- Break Contact.
- Establish Contact.
- Retain Contact.
- Maintain Contact.

- Facilitate Future Operations.
- Facilitate Other (simultaneous) Operations.
- Disrupt.
- Delay.
- Deceive.
- Canalize.
- Continue.
- Reinforce.
- Extract.
- Move or Maneuver.
- Protect.
- Consolidate.
- Reorganize.
- Reorient or Redirect.
- Relieve.
- Exploit.

When the Scheme of Maneuver is complete there will be one or more Why parts which relate to the overall Scheme and one or more Why parts associated with each What part.

5. THE SCHEME OF MANEUVER PROCESS. A loose sequence exists which relates the part selection process. Almost always the Why parts are selected first. Selection of these parts will establish a framework to assist in the selection of other parts. Additionally, the selection of the Why parts may influence the sequence for selecting the remaining parts. It is common (but not always true) for the What parts and How parts to be selected next. Normally these are selected together. Again, it is common, but not always

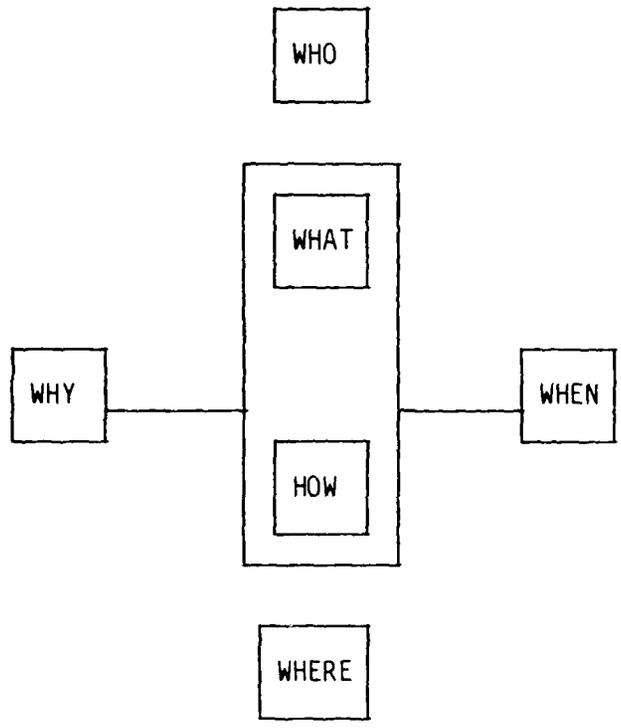
true, for the Who parts and the Where parts to be selected next. It is almost always true that the When parts are selected last. The following diagrams capture this sequence:



ORDER

POTENTIAL INTERACTION

STRONG INTERACTION



ORDER

6. PROPOSAL FOR NEXT SESSION. The next session should begin the work on defining how the parts are selected for the Scheme of Maneuver. The order should be as given in the diagram above: Why, What and How together, Who and Where together, and then When.

SUMMARY: AWC/CECOM Knowledge Engineering Session, 12 March 1986

1. BACKGROUND: The fourth knowledge engineering session was conducted at AWC on 12 March 1986, from 1330 until 1600 hours. The session served to review the draft MFR prepared to summarize the previous session and to begin discussion of the relationship between the METT-T factors and the Scheme of Maneuver parts. The MFR was accepted with minor modifications and will not be further discussed in this document. A revised version of the MFR will be prepared.

2. PURPOSE. This MFR summarizes the major points of discussion of the session. It does not recreate the flow of the discussion, or summarize the discussions that led to the development of the ideas presented. The points discussed in this MFR were generally accepted by all participants in the session.

3. SELECTION OF PARTS.

a. General Process. It is possible to describe the general part selection process by giving a general description of the process for each category, as follows:

- Why Parts: The appropriate Why parts for the corps are either given, or obvious. Their selection is driven by the mission and EAC commander's guidance. This is not necessarily true for the Why parts for the corps subordinates.

- What Parts: The appropriate What parts are driven, if not given, by the mission.

- How Parts: The selection of appropriate How parts is heavily reliant on the situation as expressed in the METT-T factors. There are two summary measures of METT-T which are particularly useful in selecting the How parts: Relative Strength and Relative Mobility.

- Who Parts: The selection of Who parts is also influenced heavily by the METT-T factors. It is common to consider METT-T factors not previously considered when selecting Who parts.

- Where Parts: The selection of Where parts is also influenced heavily by the METT-T factors. It is common to consider METT-T factors not previously considered when selecting Where parts.

- When Parts: The selection of When parts is also influenced heavily by the METT-T factors. It is common to consider METT-T factors not previously considered when selecting When parts.

b. Process Characterization. A general characterization exists for those categories which are strongly dependent on the analysis of the METT-T factors. This characterization can be stated as follows:

> In selecting those parts that will be assembled into a Scheme of ..aneuver you must consider all you know about all the factors of METT-T. As you do this certain parts will be eliminated as being not applicable to the situation. This leaves a set of parts which are potentially useful for this problem. This set of parts is further analyzed in the context of the METT-T factors to select those which are best for the situation.

The following comments relate to this description of the selection process

- Best. The term "best" needs to be further defined. It is clear that the concept of an "optimal" solution does not apply. Best in terms of suitable is more appropriate.

-- If the corps was operating in a staff planning mode then there would be many best solutions, each defining an alternative course-of-action.

-- Suitability is often in the eye of the beholder.

- Assembly. Whatever is selected must also be put together correctly. The term "correctly" also needs to be further defined. At a minimum there seems to be two levels of correctness.

-- The assembly is correct at the first level if it does not violate operational principles. If an assembled scheme of Maneuver does not meet this criteria then it is a bad scheme.

-- The assembly is correct at the second level if it is acceptable to the commander. A good scheme is correct at the first and second level.

4. METT-T CHARACTERIZATION. Any planning situation is uniquely described by a discrete set of METT-T factors. The number of potential combinations of factors which may exist is, for all practical purposes, infinite. Each of these combinations produces a corresponding discrete set of METT-T factors. Further complicating this is the fact that planners often have incomplete knowledge of the actual set of factors relevant to their particular problem, and the nature of this incompleteness is often unknown as well.

a. Due to this incompleteness, a planning situation may be described by one of a number of discrete sets of METT-T factors, each of which captures different incompleteness.

*** IMPORTANT QUESTION: Choose (1) or (2) or (3) or another:

(1) Planners explicitly deal with incompleteness in the known METT-T factors by attempting to make them complete.

(2) Planners select and assemble based on the METT-T factors they have available.

(3) Incompleteness in some, but not all, METT-T factors will be recognized by planners and force them to develop the METT-T information.

b. Planners find it useful to capture higher level situation descriptors from the information in the discrete set of METT-T factors describing the planning situation. These higher level descriptors are then used in the part selection process.

- Relative Strength is one such situation descriptor. Relative strength is a comparison of enemy and friendly strengths and weaknesses, and their ability to employ those strengths and attack those weaknesses. All factors of METT-T contribute to the assessment of relative strength.

-- Relative strengths can be described by place and time. In this case the METT-T factors would describe a number of different relative strength descriptions, each differing in place and time.

-- Strength computations involve <u>all</u> that is <u>known</u> about the following METT-T factors:

-- Enemy forces available.

-- Friendly forces available.

-- Terrain over which the forces are to deploy.

-- Terrain over which the forces are to move.

-- Time available in which to move.

-- The Mission factor may affect which other METT-T factors are actually considered in the determination of relative strength. This is particularly true in considering the enemy forces.

- Center of Gravity is another potential descriptor. Center of Gravity refers to the enemy force. It is the object that, if seized or destroyed (potentially other Why parts may fit here as well) by friendly forces, will cause the enemy the most damage and allow the corps to accomplish its mission.

-- Center of Gravity may be a piece of terrain.

-- Center of Gravity may be an enemy force.

-- Center of Gravity may be an installation.

- Relative mobility is another high level situation descriptor. Relative mobility was not further discussed.

5. RELATIONSHIP OF METT-T FACTORS TO PART SELECTION. A number of comments were made regarding the relationships between the METT-T factors and part selection and assembly.

a. General statements.

- It is usually the case that if the enemy is strong relative to friendly forces, then options which fall into the BOLD category should be rejected.

-- Bold options usually involve an offensive form with a degree of risk.

-- It is not possible to classify parts as possessing or lacking boldness.

-- In this case, bold refers to assembly, and the options are different assemblages, not different selections.

-- Exception: It may be that the enemy is so strong that only a bold option will be successful.

b. Category statements.

- Why parts.

-- Consideration of mission may dictate a series of Why parts.

-- Why parts associated with Who parts may be different than Why part for corps, but they must facilitate the corps Why part.

-- As the relative strength favors friendly forces, the destroy enemy force Why part is more feasible.

- What parts. No comments.

- How parts. Relative strength is major determinant of How parts. Of particular importance is the manner in which the different How parts change relative strengths.

-- How parts must gain the relative strength required at all points. In other words, they must implement the principles of war Mass and Economy of Force.

-- Relative strength allows elimination of a number of How parts.

- Who parts. No comments.

- Where parts. No comments.

- When parts. No comments.

6. PROPOSAL. The next session should consist of a sample problem-solving session, attempting to implement the ideas described in this and preceeding sessions.

END

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