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INTELLIGENCE PREPARATION OF THE BATTLEFIELD (AUTOMATED IPB(A). --ETC
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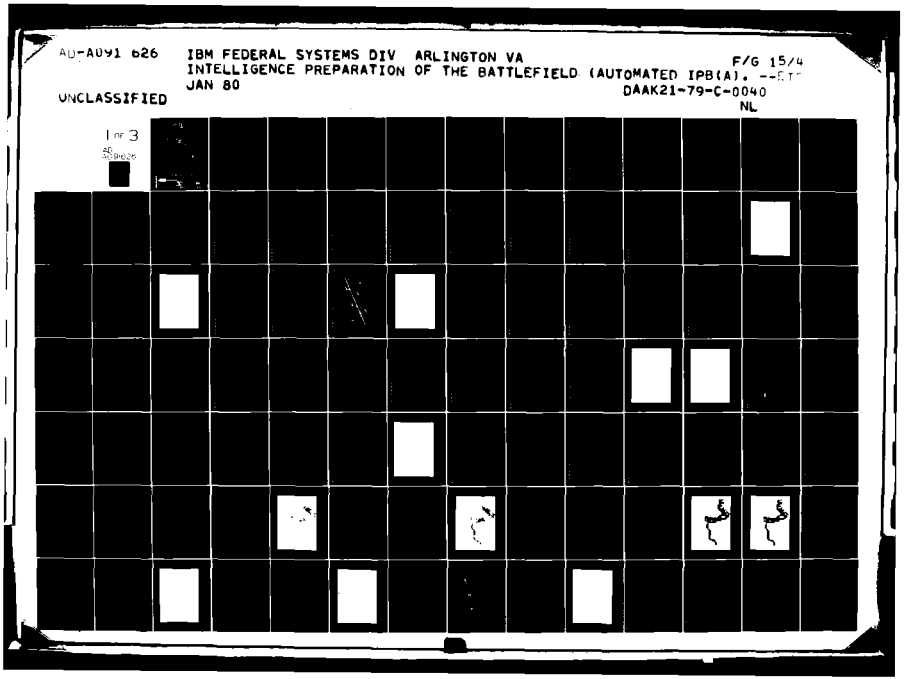

LEVEL III

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INTELLIGENCE PREPARATION OF THE BATTLEFIELD (AUTOMATED) (IPB(A)) SOFTWARE FUNCTIONAL DESCRIPTION

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INTELLIGENCE PREPARATION OF THE BATTLEFIELD (AUTOMATED)

IPB(A).

PHASE II.

SOFTWARE FUNCTIONAL DESCRIPTION.

Submitted to:

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ABSTRACT

This software functional description contains performance requirements and functional descriptions of the application and system software required to support automated Intelligence Preparation of the Battlefield (IPB(A)) functions in an All Source Analysis System (ASAS), as currently defined by USAICS. The ASAS is a land-mobile, tactical intelligence processing center planned for Army deployment during the mid to late 1980's.

The functional descriptions were developed for the Battlefield Systems Integration Directorate of USA DARCOM and are based on experience gained in the development and demonstration of laboratory capabilities during the IPB(A) Phase II period concluded in January 1980. The functions are described in terms such that there is no dependency on specific commercial hardware or software.

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SECTION 1. SCOPE

This software functional description contains performance requirements and function descriptions of the application and system software required to support automated Intelligence Preparation of the Battlefield (IPB) functions in an All Source Analysis System (ASAS), as currently defined by USAICS. The ASAS is a land-mobile, tactical intelligence processing center planned for Army deployment during the mid to late 1980's.

This document was developed for the Battlefield Systems Integration Directorate of USA DARCOM during the IPB(A) Phase II period starting 21 March 1979 and concluding in January, 1980. The functional descriptions are based on experience gained in the development and demonstration of laboratory capabilities during this contract. The functions are described in terms such that there is no dependency on specific commercial hardware or software.

SECTION 2. APPLICABLE DOCUMENTS

The documents utilized in the development of the functional descriptions include:

1. Tactical Intelligence Applications Experimentation (TIAX) Report, Phase A Final Report, prepared by IBM Federal Systems Division, dated 20 October 1978.

2. Tactical Intelligence Applications Experimentation (TIAX) Review, prepared by IBM Federal Systems Division, dated 6 June 1979.

3. Tactical Intelligence Applications Experimentation (TIAX) Report, Phase II Interim Report, prepared by IBM Federal Systems Division, dated 17 August 1979.

4. Draft Training Circular No. 30-27 dated 1 August 1979 entitled Intelligence Preparation of the Battlefield.

5. FM 30-102, Opposing Forces, Europe.

6. FM 100-5, dated 1 July 1976 entitled Operations.

7. FM 21-30, Military Symbols.

8. IAG-13-U-78, Soviet Army Operations, U.S. Army Intelligence and Security Command Intelligence and Threat Analysis Center dated April 1979.

9. FM 30-5, Combat Intelligence dated October 1973.

10. FM 30-40, Handbook on Soviet Ground Forces dated 30 June 1975.

11. DDI-1120-10-77, Soviet Tank Battalion Tactics, Defense Intelligence Agency dated August, 1977.

12. FM 30-10, Military Geographic Intelligence (Terrain) dated March, 1972.

13. TC 30-11, Army Tactical Weather dated April, 1977.

14. FM 6-20, Field Artillery Tactics and Operations.

15. FM 101-5, Command and Control of Combat Operations.

16. An Analytical Approach to Terrain Analysis and Allocation of Combat Power, prepared by U.S. Army Intelligence Center and School, dated May 1978.

SECTION 3. FUNCTIONAL REQUIREMENTS

This section addresses the software functional requirements necessary to support IPB functions in the ASAS. It includes introductory material that places the IPB analyst position in an ADP system environment and describes an operational context in which the system will function. A brief summary of the IPB operational concept is also covered (for further details refer to Tactical Intelligence Applications Experimentation (TIAX) Report, Phase A Final Report, dated 20 October 1978).

Although the "system to support the IPB analyst" is mentioned throughout please note that IPB will not be supported by a stand-alone system; rather, this functional description assumes that IPB will be one of many functions to be supported by the ASAS.

IPB Operational Concept

Figure 3-1 illustrates how preplanned IPB products are utilized during hostilities to support the G-2's development of the realtime intelligence estimate and to focus collection resources on higher yield areas of interest.

The upper right portion of Figure 3-1 shows the process of receiving intelligence inputs and developing the current situation display through correlation and fusion processes. This is assumed to be a continuous process of receiving inputs, assessing their significance to the current military situation, and updating the military situation display if warranted. This function will be performed by the current situation analyst in the ASAS with the resulting display being provided to the IPB analyst's station as well as others in the CRT form.

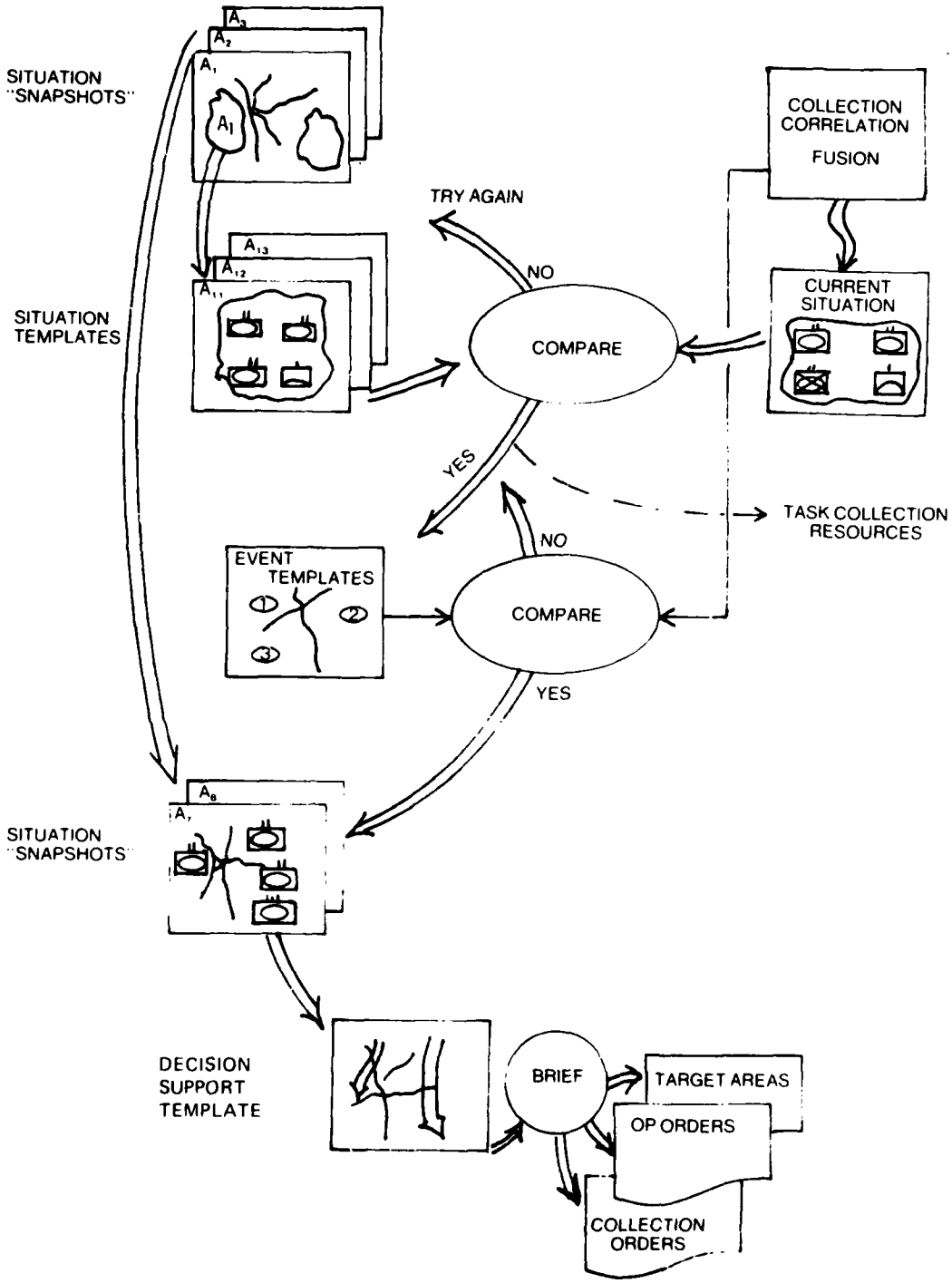


Figure 3-1. Operational Concept

The IPB products (developed during the battle planning phase) are shown on the left side of the illustration. In the realtime process the IPB analyst is constantly searching his situation templates file trying to match one with the current real time situation display. This is a visual comparison process. He does not expect to find an exact match, and will frequently draw on his other IPB files (snapshots, doctrinal templates, terrain overlays, etc.) to try to rationalize observed differences in the situation displays. When he thinks he may have a match, his first actions are to try to confirm his hypothesis. He does this by accessing his event templates and event matrixes to determine what enemy activities should be observable in the next few hours if the enemy is indeed at the point in his option that the analyst suspects. He next requests that collection resources place a priority on collecting data about the events selected from his event matrix in the sequence and at the locations (NAIs) indicated. He cues the input processing system to alert him immediately upon receipt of any returns to these specific collection requests. He further places a time limit on how long he is willing to wait to receive verifying information. If the system notifies him that no confirming data has been received by the specified time, he would probably drop that hypothesis. Several of these hypotheses may be working in parallel with one another. Thus, system support in eliminating those that are not verified would be helpful.

When confirming data is received that anticipated events have indeed been observed, the probability is significantly increased that the enemy has been detected in a certain option and at a specific point in that option. The analyst can therefore proceed more positively to exploit that knowledge. Toward developing an intelligence estimate, the analyst references his snapshot file, selects one several hours hence, and updates it based on current situation knowledge. This forms the basis of the estimate of where the enemy will be, at what time, and

in what strength if he continues in the option he is presently pursuing with terrain and weather already taken into account. This graphic would be used to brief the commander so that appropriate countermoves can be initiated. In addition, event templates can be exploited to not only focus collection resources again but also notify the Fire Support Element (FSE) of what targets can be expected at which locations over the next several hours. Preplanned operations orders can be finalized for deployment of friendly forces to meet the enemy. Terrain analyses completed in advance by the G-2 staff would be available to the FSE and maneuver sections for support in planning fires allocation and friendly force movements to interdict.

Although certain IPB techniques can be usefully applied at any echelon, the concept presented here is felt to be most practical at echelons no lower than division, where larger enemy force elements must be monitored, and where a reasonable automated data processing capability will be resident in the center. Also, the continuation of this basic process throughout a battle situation demands local ability to modify the IPB products stored in the system, and to develop new ones as enemy courses of action vary.

Time Phasing of IPB Activities

Figure 3-2 illustrates the general time relationships of the major IPB areas of activity. Long prior to hostilities for known areas of concern, support agencies will have developed basic map data, terrain data, and doctrinal data in a form tailored to an operational mission. It would include map and terrain data for the assigned area of interest and doctrinal data for the enemy expected to be encountered, but would be independent of the specifics of the military situation. The data would be provided in machine readable form, and would be "provisioned" to the operating forces upon departure. If the mission involved an

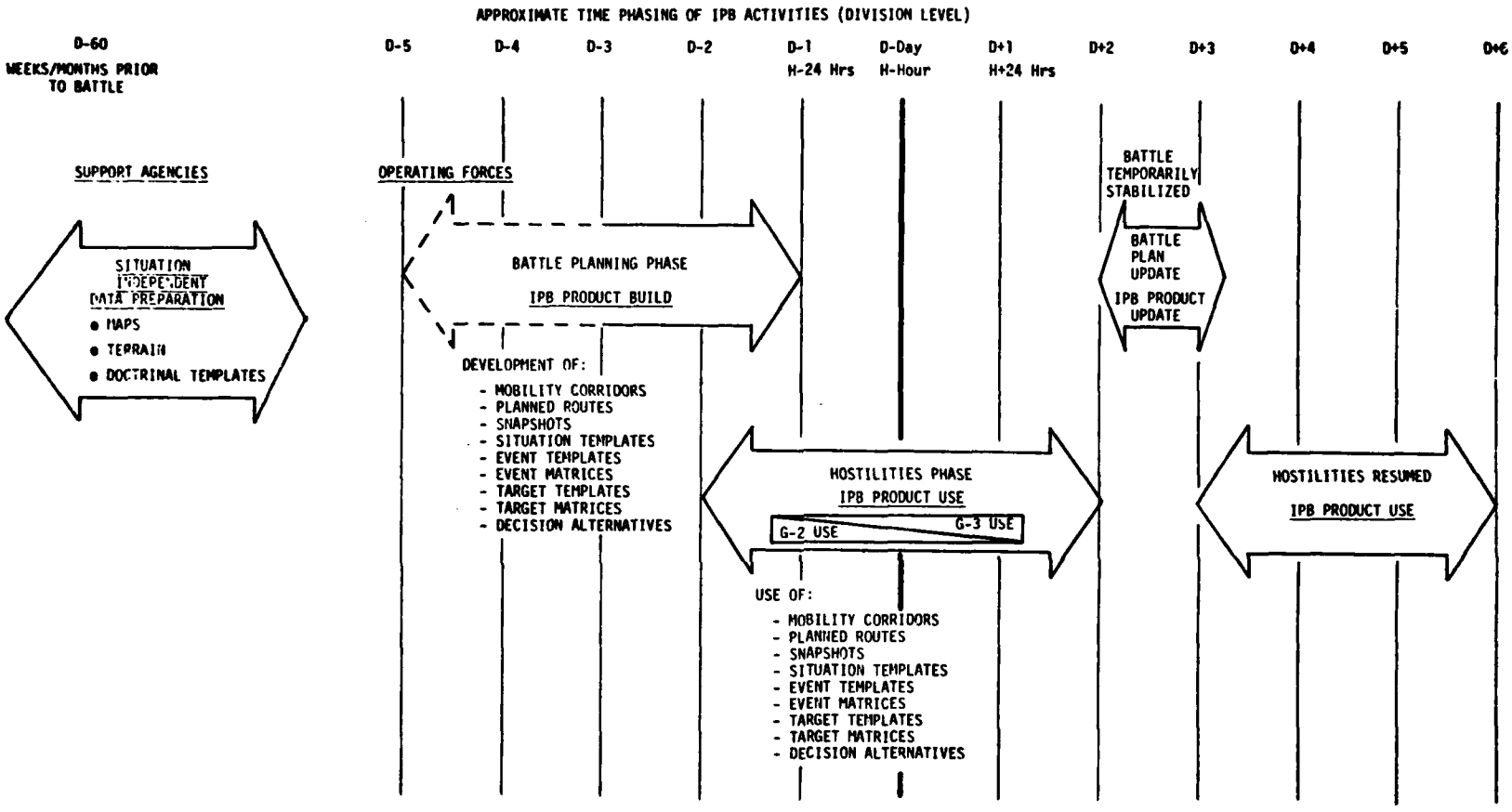


Figure 3-2. IPB Time Phasing

area of the world for which limited data is available, the data preparation phase would be much closer in time to the hostilities phase.

As the operating forces approach their destination, the Battle Planning Phase would begin. Based on command guidance regarding enemy options for which to plan, IPB product sets for each option would be built. The early portions of the build phase would involve terrain analyses to define mobility corridors, and then enemy templating to fit enemy forces to the terrain. It is during this phase that many of the special automation aids to the analyst described in this document come to play, enabling IPB graphics to be built rapidly. The results of the planning phase are the standard IPB products listed in the illustration. They would be stored in the system for use during the hostilities phase.

The hostilities phase commences upon indications that enemy movements toward attack have begun. Early in this phase the G-2 staff is using its various intelligence resources to monitor enemy activity, looking for indications of initial movement to attack. The G-2 staff is also using IPB products developed during the planning phase to assist in recognizing the enemy forces detected (see Figure 3-1, IPB Operational Concept). It is during this part of the hostilities phase that IPB products will be of significant value to the G-2 in (1) intergrating the current situation display, (2) recognizing the possible significance of certain observed force configurations or event sequences, (3) focusing collection resources on higher probability areas of interest, and (4) systematically building confidence at an early stage that the enemy option and point in the option have been determined.

Upon determination of enemy intent, the G-2 next develops a graphic estimate of the situation (i.e., predicted enemy force configuration fitted to terrain) using IPB products as a basis. G-3 functions can intensify their assessment and reaction planning at that point, contrasting achievable alternatives for the commander's review and decision. As indicated in the illustration, IPB product use during hostilities is largely by G-2 in the early stages, phasing toward heavy use by G-3 functions as real time battle planning commences.

The need to update IPB products during normal planning phases after hostilities commence is also indicated. The degree of thoroughness in enemy templating will vary with the battle situation, but automation tools such as are prescribed in this document make it feasible for the IPB process to be useful throughout the battle, not just prior to the initial conflict.

IPB Functions

The automated IPB software functions that support the operational concepts are shown in Figure 3-3. They are composed of two principal categories:

1. IPB application functions
2. ADP system functions

The IPB application functions represent the user oriented, IPB functional requirements, and are described in Section 3.1. The system functions represent the ADP oriented functional requirements, which support the application functions, and are described in Section 3.2. Overall system performance/capacity requirements are presented in Section 3.3.

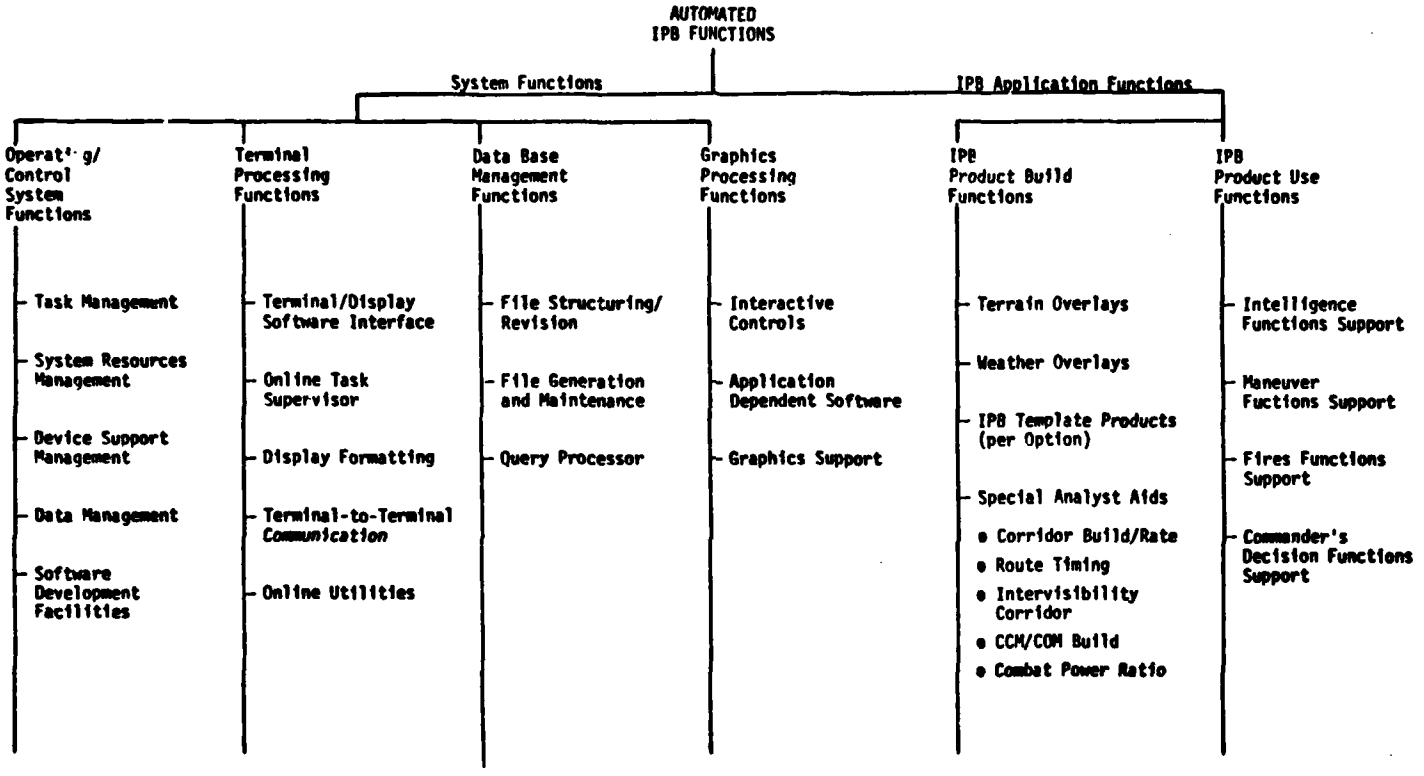


Figure 3-3. Automated IPB Software Functions

IPB ADP Configuration

The ADP system configuration that will support the IPB functions is shown in Figure 3-4. The principal IPB elements in the configuration are the IPB analyst positions in the ASAC and the ASAS computer. IPB interfaces with other mutually interactive ASAC and TOC functions are also shown.

The IPB analyst position is supported by the following ADP:

1. Color Grapics CRT terminal including alphanumeric keyboard function keyboard, and cursor controller.
2. Alphanumeric CRT terminal including alphanumeric keyboard
3. Color Graphics monitor for display of the current situation
4. Graphics data tablet
5. Color Graphics hard copy.

Both the color graphics and the alphanumeric CRT terminals require the full range of interactive capability. The color graphics monitor is one of an assumed internal network of video monitors for display of the current situation. It would not have the interactive capabilities ascribed to the IPB terminals. The graphics data tablet is included for the following intended uses:

1. To enter graphic data (probably map related but not necessarily) by manually tracing lines/contours on the input data (drawing or map) registered in position on the tablet.
2. To correlate a display screen position to a map position through use of the tablet cursor and a map registered on the tablet.

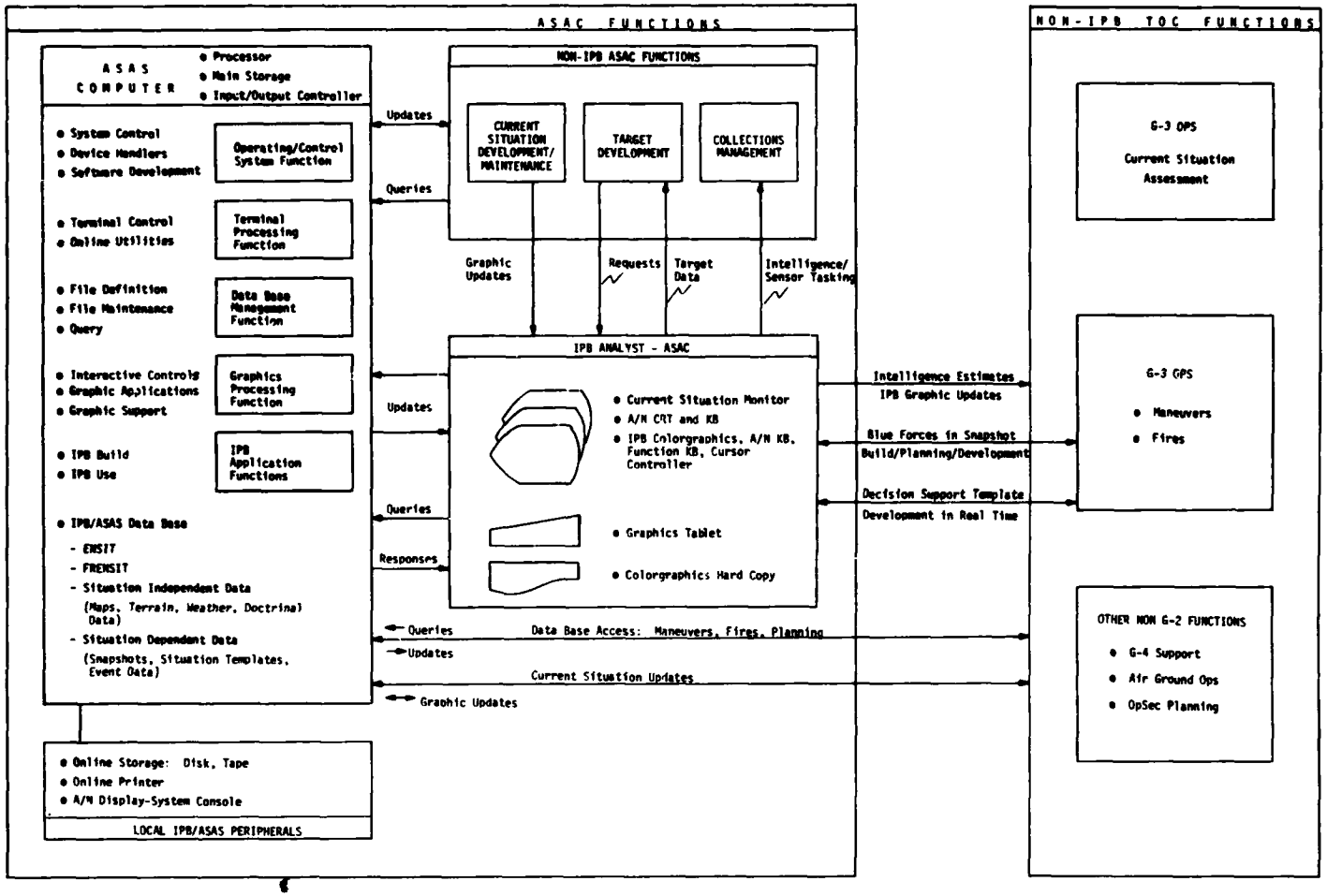


Figure 3-4. IPB ADP System Configuration

The intended use of the color graphics hard copy is to provide a flexible and cost effective means to distribute IPB graphic products.

The ASAS computer will provide ADP support to all the ASAC functions, including IPB, and will be composed of the main processor, main storage, and input/output controllers. The local ADP peripherals required for IPB will include disks, magnetic tapes, online printer, and an ADP operator's system console. The IPB oriented data base will contain enemy and friendly situation data, IPB situation independent data (maps, terrain, weather, doctrinal templates), and situation dependent data (snapshots, situation templates, event templates).

The IPB analyst will interact with the following ASAC functions:

1. Current Situation Maintenance - This interface provides the IPB analyst with graphic updates of the current situation.

2. Collection Management - This interface provides the IPB analyst the means to specify and prioritize intelligence data needs critical to the IPB process.

3. Target Development - This interface affords the IPB analyst the means to provide IPB products that could support target development, as well as coordinate development of IPB products to ensure that targeting considerations are incorporated.

The IPB analyst will also interface with the following TOC functions:

1. Current Situation Assessment
2. Maneuvers
3. Fires

These interfaces are required during both the preparation and planning phase of IPB product development, and the more time critical utilization of the IPB products during hostilities. These interfaces will require exchange of graphics to assure a common perception of the tactical and analytical situations. Interfaces are also shown that will provide for update and query of the data base.

3.1 IPB APPLICATION SOFTWARE FUNCTIONS

3.1.1 IPB(A) Source Data Requirements and Data Entry Functions

This section will describe the basic data inputs required to allow automated IPB functions to begin operations. It will specify the form and content of the data to be provided for input to the ASAS data base and subsequent use by IPB analysts. Five general categories of input data are addressed:

- Map data
- Terrain data
- Weather data
- Doctrinal data
- Current Situation data

3.1.1.1 Lines of Communication (LOC) Map Data

LOC map data shall be supplied as follows:

a. magnetic tape storage
b. UTM/MGR system coordinates
c. sixteen bit words

d. vector format with alphanumeric annotation keyed to location

e. map reference data accessible for display on an alphanumeric device

The vector data shall be divided into at least six categories and each category shall consist of one or more classes as indicated in the following table:

CATEGORY	CLASS
Roads	Interstate/Autobahns, Primary, Secondary, Connecting
Streams	At least three as a function of fording and bridging requirement
Railroads	TBD
Airfields	TBD
Bridges	5 classes of bridge width
Town Boundaries	One
A/N Annotation	One

Each vector "Category" shall be separately identifiable so that when entered into the IPB system it is addressable by a graphic display function key/cursor combination. Further, elements within each Class in a given Category shall be entered, to the extent possible, as single vector elements so that they can be changed, modified or deleted as single entries by the operator.

In addition to the vector data for depicting the line maps on the graphic display, map reference data shall be supplied in alphanumeric form by category and coordinate. This is included so that the analyst can get more detailed data about specific graphically displayed items through the A/N display. This shall be accomplished by cursor identification of the graphically displayed element in conjunction with a function key to query the data base.

This map reference A/N data shall include but not be limited to:

- Railroads - Name, gauge, capability (trains per day per direction, etc.), electrified or not
- Bridges/Tunnels - Name, length, width, highway/railroad, type, load bearing capacity, etc.
- Roads - Route number/name, class, capacity, construction type, etc.
- Inland Hydrography - Name, width (bank to bank), depth as a function of month, velocity as a function of month, bank height, bank slope, stream bottom material at 500 meter intervals.
- Airfield - Name, civilian/military, runway length, number of runways.

Two sets of map data are required: 1:250,000 scale and 1:50,000 scale. In addition, 1:1,000,000 scale maps shall be provided in hard copy form to serve as indexes. These maps shall include (in addition to standard map data for that scale) grids that associate magnetic tape library numbers with geographic areas, referencing these to paper copy map sheet numbers.

Some generalization of the hard copy 1:250,000 and 1:50,000 maps shall be accomplished during their digitization. This generalization shall be attained by reducing the number of vectors of all classes of all categories by a factor of 5 to 10 compared to the paper map sheets. The results of such a reduction is shown in Figure 3.1.1-1, an example of a graphically displayed 1:50,000 digitized map. The map includes an area 15 kilometers by 20 kilometers and four categories of data: roads, streams, bridges, and town boundaries. Three classes of roads are depicted by three colors (white, green, yellow); two classes of bridges (white and yellow); three classes of streams (cyan, blue, magenta). The railroads, airfields and A/N annotation categories have been deleted. Tick marks and grid labels are not shown since these are not part of the source data; rather, they shall be internally generated by the graphics system. The total vector word count for such a graphic but including tick marks, grid labels and annotation is less than 2,000.

3.1.1.2 Terrain Data

The IPB/TIAX Final Report Phase A detailed how terrain subfactor data (slope, soils, vegetation) currently developed for manual use in acetate overlay form can be converted to the IPB(A) five-part mobility scale. To support the IPB processes the level of detail of terrain data is generally less than that required for most military applications. This is due primarily to the simplified use of five-part mobility scale and three-part intervisibility scale, and the use of 500 meter resolution. These simplifications significantly reduce the data collection, terrain analysis, and terrain data storage requirements for the IPB process.

The discussion that follows describes the terrain data requirements required to support IPB using the five-part mobility and intervisibility scales. The five-part scale represents a new method of describing basic terrain data in terms of its effect on mobility and intervisibility.

Figure 3.1.1-1 1:50,000 Folger Lines of Communication

In order to relate these new definitions to more conventional (and detailed terrain data) additional tables are provided describing the relationship between the more conventional data and the IPB method of terrain data representation (see Appendix E). It should be noted, however, that for IPB only key conventional terrain data discriminants need to be collected and analyzed.

Six categories of terrain data shall be required for the automated IPB system: terrain elevation, surface configurations, vegetation, soils, wetlands, and built-up areas. The following data shall be supplied on magnetic tape for each 500 meter square:

Number of Characters Per Square	Data Category
4	Coordinates
1	Soil-Mobility (5 types)
1	Surface Configuration-Mobility (5 types)
1	Surface Configuration-Intervisibility (3 types)
1	Vegetation-Mobility (5 types)
1	Vegetation-Intervisibility (3 types)
1	Vegetation-Tree Heights (4 types)
4	Elevation-Intervisibility
1	Built-Up Areas (2 types)
1	Wetland Areas (5 types)
Total 16	

Terrain data shall be digitized to 500 meter x 500 meter squares center-to-center. The UTM/MGR coordinate origins used shall be common to all maps and LOC data.

Rivers and streams whose widths are less than 500 meters are presented as linear vector data which is added to the area wetlands to form a composite wetlands overlay.

Figure 3.1.1-2 identifies the several types of data required within a given category. The upper portion of the chart deals with vegetation, surface configuration, soils data, and wetlands in terms of impact on ground force mobility. Each category is broken down into the IPB(A) five-part mobility scale; also shown are the equivalent conventional data types used by the U.S. Army Engineering Topographic Lab (ETL).

The lower portion of the chart indicates the vegetation and surface configuration data required to support IPB(A) intervisibility requirements. The 3-part intervisibility scale is shown down the left side of the chart. The section "Other Requirements" rounds out the definition of terrain source data requirements for areas where terrain analysis data does not exist in conventional form.

Figure 3.1.1-3 is an example of a surface configuration (slope) overlay on a map background at 1:50,000 scale as it would appear on the CRT. Slope data (only) is represented in terms of its impact on ground force mobility. In the example, each block represents 500 meters by 500 meters. The color coding is red = stop, magenta = very slow, yellow = slow, cyan = inhibited and green = go. This representation is built from the characters pertaining to mobility within the basic 16-character data block per 500 meter square.

IPB(A) TERRAIN DATA REQUIREMENTS FOR MOBILITY AND INTERVISIBILITY

IPB(A) MOBILITY CATEGORY	VEGETATION		SURFACE CONFIGURATION		SOILS		WETLANDS	
	IPB(A) CATEGORY DESCRIPTION	EQUIVALENT ETL CATEGORIES	IPB(A) CATEGORY DESCRIPTION	EQUIVALENT ETL CATEGORIES	IPB(A) CATEGORY DESCRIPTION	EQUIVALENT ETL CATEGORIES	IPB(A) CATEGORY DESCRIPTION	EQUIVALENT ETL CATEGORIES
1 (STOP)	CONIFEROUS: 4m≤Ht.<20m CLOSURE≥50% DECIDUOUS: Ht.<7Om CLOSURE≥75% SWAMP/PEAT CUTTING	C7, C8, D8, D12, C8, E12, J, M	60% SIGNIFICANT ESCARPMENTS AND EMBANKMENTS	F	FAT ORGANIC CLAYS; PEAT, HUMUS, OTHER ORGANIC SOILS	14,15	WIDTH>1000m	SPOT WIDTH AND DEPTHS
2 (VERY SLOW)	CONIFEROUS: Ht≥5m CLOSURE≥75% DECIDUOUS: Ht≤5m CLOSURE≥50%	C12, D11	45-60%	E			WIDTH>40m AND DEPTH>5.5m	SPOT WIDTH AND DEPTHS
3 (SLOW)	DECIDUOUS: Ht≤5m MIXED: HT≤7Om CLOSURE>50%	D9, D10, E7, E11	30-45%	D	ORGANIC SILTS OR LEAN ORGANIC CLAYS	11	WIDTH>6m AND DEPTH>5.5m	SPOT WIDTH AND DEPTHS
4 (INHIBITED)	CONIFEROUS: Ht≤5m DECIDUOUS Ht≤5m CLOSURE>5%	C9, C11, D7, E9, E10	10-30%	C				
5 (GO)	ALL ELSE	A, B, F, G, H, I, L C_1-C_6, D_1-D_6, E_1-E_6	0-10%	A, B	ALL TYPES - EXCEPT ORGANIC BASED SOILS (* IDENTIFY SEPARATELY)	1, 2, 3, 4, 5, 6, 7, 8, 9*, 10*, 12, 13, 16	ALL ELSE	SPOT WIDTH AND DEPTHS

IP3(A) INTERVISIBILITY CATEGORY	VEGETATION		SURFACE CONFIGURATION		OTHER REQUIREMENTS
	IPB(A) CATEGORY DESCRIPTION	EQUIVALENT ETL CATEGORIES	IPB(A) CATEGORY DESCRIPTION	EQUIVALENT ETL CATEGORIES	
V3 (DIRECT FIRE)	OPEN VEGETATION	A, B, G, L, C_9, E_9 C_1, D_1, E_1	FLAT TERRAIN (0-10%)	A, B	FOR INTERVISIBILITY: • FROM VEGETATION DATA, AVERAGE TREE HEIGHT IN FOUR CATEGORIES: 1 - 0 METERS 2 - 3 METERS 3 - 12 METERS 4 - 25 METERS FOR INTERVISIBILITY AND MOBILITY: • BUILT UP AREA OR NON-BUILT UP AREA (7 CODES) FOR MOBILITY: • LOCATION OF FLOOD PLAINS
V4 (CLOSE COMBAT)	MEDIUM DENSITY VEGETATION	F,H,I,G_9,D_{10},E_{10}, C_6-E_6,C_2-E_2,C_{11}-E_{11},C_7-E_7,C3-D_3	ROLLING TERRAIN (10-30%)	C	
V5 (COVER/ CONCEALMENT)	DENSE VEGETATION	J,K,M,C_{12},D_{12}, E_{12},C_8,D_8,E_8, C_4,D_4,E_4	RUGGED TERRAIN (>30% + ESCARPMENTS, CUTS, FILLS)	D, E, F	

Figure 3.1.1-2. IPB(A) Terrain Data Requirements for Mobility and Intervisibility

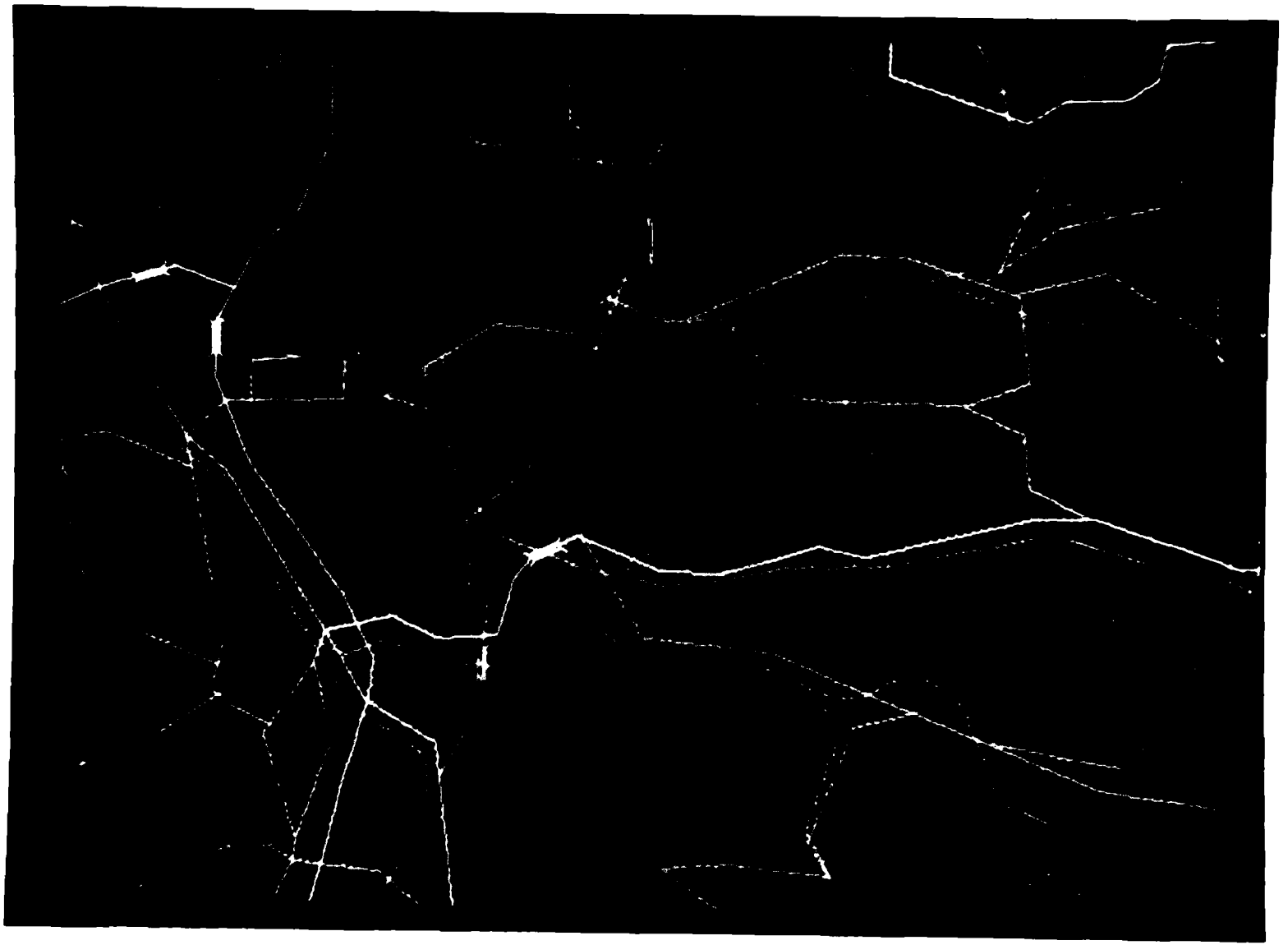


Figure 3.1.1-3 1:50,000 Folger Map and Slope

With the data coded in this fashion the following types of overlays can be displayed by the IPB analyst:

- Surface Configuration (slope)
- Vegetation
- Soils
- Wetlands
- Built-Up Areas
- Intervisibility
- Crosscountry Matrix

3.1.1.3 Weather Data

Two types of weather data shall be required to support the IPB process:

- Daily forecast reports
- Climatic data

The daily forecast reports shall be provided as hard copy products consisting of alphanumeric and facsimile data. The alphanumeric data shall be supplied as normal 12 hours, 24 hours, etc., forecast, weather observations, weather warnings, etc., teletype data. This data shall be used to initialize the IPB system, as discussed in paragraph 3.1.2.1

for the region(s) of interest. It is used by the operator to interactively update terrain subfactor and LOC data. The facsimile data consists of graphic weather map data and shall include a crude map, location and type of weather activity, direction of movement, cloud cover, temperature and precipitation. It shall be supplied through conventional weather facsimile devices and shall be manually input into the IPB system through the graphic tablet and A/N terminal. Figure 3.1.1-4 is an example of the resulting weather overlay as stored in the IPB analyst files. A primary use of this weather overlay is as an aid for correlating the weather situation with the analyst area of interest.

As an example of climatic data, fog data would be stored as vectors on magnetic tape for input into the IPB system. It shall be logged on the tape as a function of location (UTM/MGR coordinate) and expected time of occurrence (month of year, time of day--AM/PM). The data is prestored on the basis that certain areas of the world are predictably conducive to recurring morning/evening ground fog. Figure 3.1.1-5 is an example of such a predicted fog layer which is expected to exist in the confines of the high river banks of the Granbury region. In addition to fog data the IPB system shall have the capability to receive/store other types of climatic information represented graphically for use with background maps.

3.1.1.4 Doctrinal Data

Doctrinal data on enemy forces are used to represent a number of options and courses of action including:

Movement to Contact
Meeting Engagement
Quick Attack

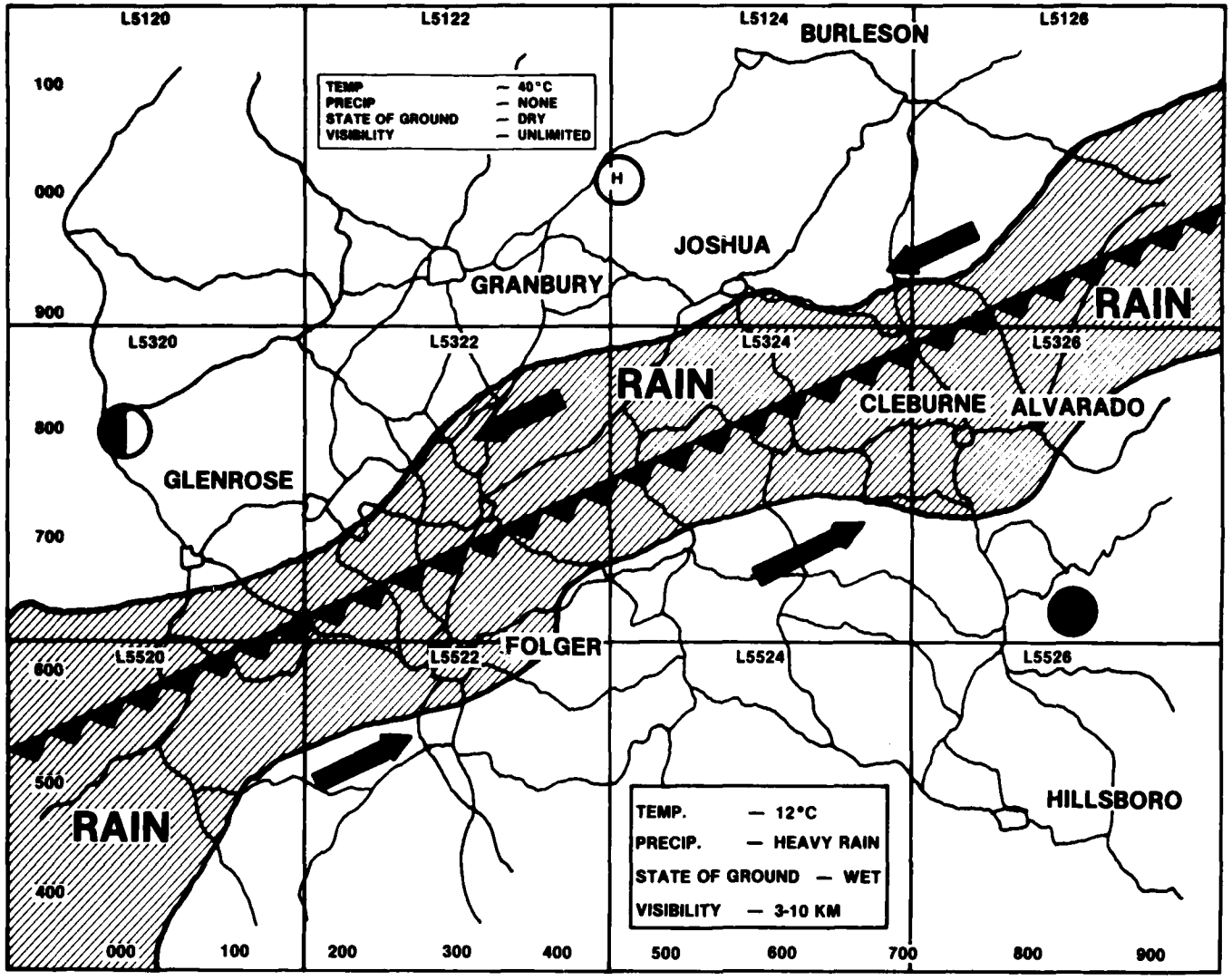


Figure 3.1.1-4. Weather Map Display Graphic

Figure 3.1.1-5 Fog Overlay on Map

Deliberate Attack
Pursuit
Hasty Defense
Deliberate Defense
Retrograde
Withdrawal
Assault River Crossing
Amphibious Operations
Airborne Assault

Doctrinal data required for IPB shall include the following categories of templates:

1. Doctrinal Option Template

   A graphic showing one of several alternative enemy battle plans based on doctrine without consideration of terrain or weather factors. It generally portrays maneuvers by the higher echelons, i.e., regimental or division sized units. It covers the period from commencement of a major action to the achievement of a major objective.

2. Doctrinal Template

   A graphic showing composition and disposition of an enemy unit based on doctrine without consideration of terrain and weather factors. It can be constructed for various types of units at any echelon. It will vary depending on enemy mission.

3. Doctrinal Event Menus

Tabular listings of critical events/indicators which are characteristic of enemy operations and maneuvers and can be related to particular phases of an enemy option sequence. They are prepared separately for each option/maneuver type and reflect enemy doctrine without consideration of terrain and weather.

4. Doctrinal Target Menus

Tabular listings of targets/target areas. Target Menus are similar in concept to the Doctrinal Event Menus. They represent planned targets based on doctrine without consideration of terrain and weather. They represent key targets/target areas which if interdicted by friendly fires action can produce a slowing or deterrence of the enemy's option execution.

Each of the four categories of doctrinal data are discussed in the paragraphs which follow. Descriptions of their content are provided. The forms required for input to the IPB automated system are given.

3.1.1.4.1 Doctrinal Option Templates

IPB requires the graphic portrayal of all types of friendly and enemy operations, offensive and defensive. Each option template should depict a basic form or category of troop maneuver; e.g., envelopment. All variations of a basic maneuver should be covered separately, i.e., single envelopment separately from double envelopment. Generally, these templates portray maneuvers by division or higher echelon forces.

Content

Each option template shall include the identification of the enemy or friendly nation and the option portrayed. It shall be developed at a scale of either 1:250,000 or 1:50,000, and the scale used must be indicated. All significant dimensions are to be labeled. All symbols shall be in accordance with the standard symbol set, i.e., FM 21-30. The focal point shall be identified, that is, the point or line from which most dimensions/distances are measured such as the Line of Contact. Significant items which should be depicted include:

- Objectives
- Depths
- Areas
- Zones
- Frontages
- Lines of Coordination
- Lines of Control
- Phase Lines
- Line of Contact
- First and Second Echelon Forces
- Direction of Movement

Each template shall be given a name/title and marked with the date of preparation, agency/office preparing, scale to which drawn, and a brief descriptive phrase. Figure 3.1.1-6 is an example of a doctrinal option template portraying an enemy double envelopment option at a 1:250,000 scale.

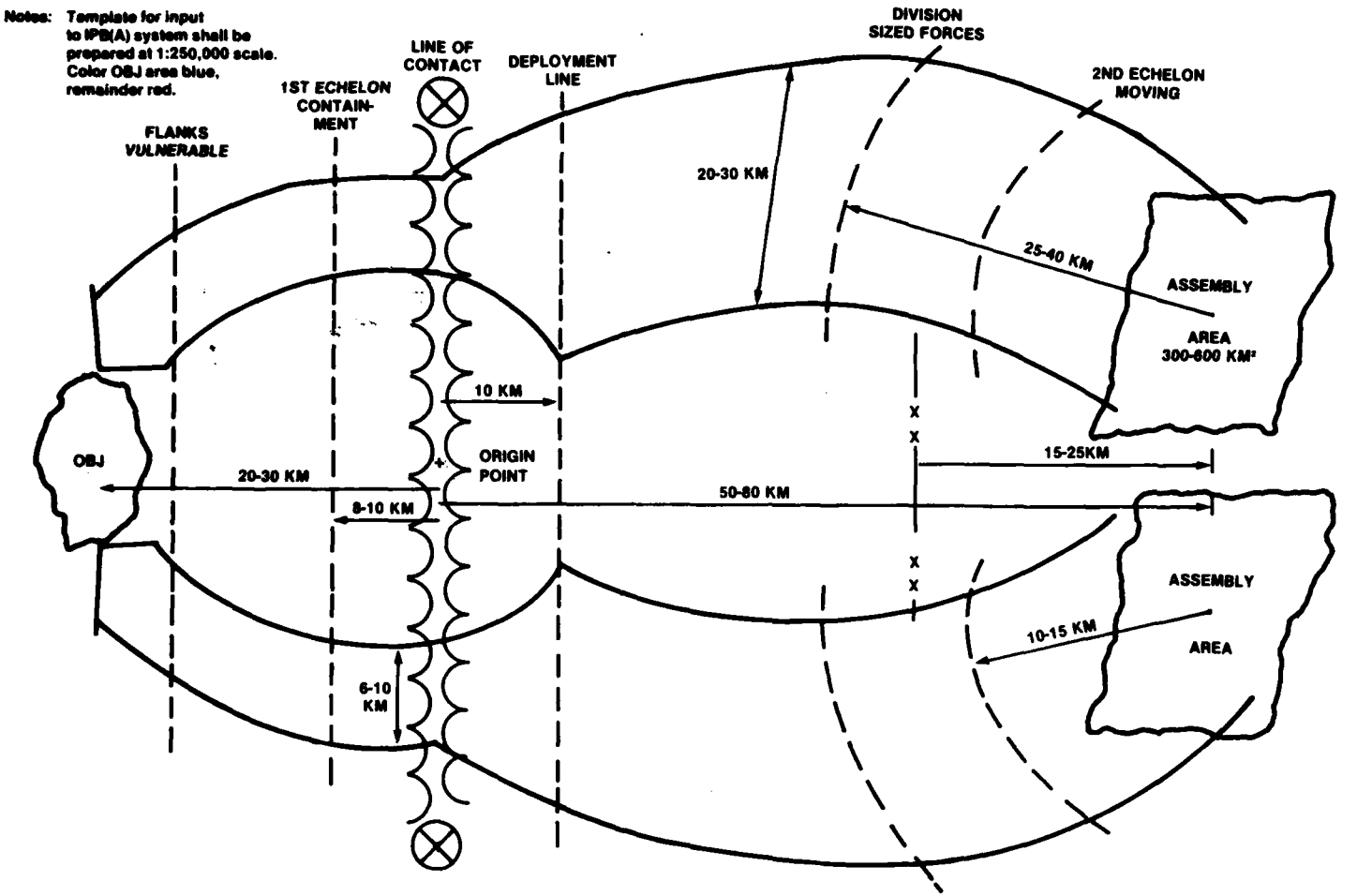


Figure 3.1.1-6. Double Envelopment Option Doctrinal Template - Division Size Forces in Each Attack

Format

These templates should be sketches or diagrams drawn to scale. Lines and symbols are to be drawn as they are to be seen on the graphics terminal. Any item which is to be in a specific color and/or blinking on the graphics terminal must be so marked on the template. For those templates drawn at a 1:250,000 scale, tick marks denoting 10 kilometers should be included, and for 1:50,000 scale tick marks denoting each 2 kilometers. An origin point should be labeled. The origin is the point used by the system to locate and orient the template on the screen. It must be visible so the operator can use it in conjunction with the cursor to manipulate the template on the screen, or to delete it.

Data Form/Mode

These templates should be issued on magnetic tape in a file which conforms to the system data base conventions. Each record in the file will contain the name/title, type of doctrinal template, originating agency/office, date prepared, scale, brief description and the graphic imagery itself.

A less desirable but adequate form would be to issue the template drawn on 8½ x 11 paper.

3.1.1.4.2 Doctrinal Templates

These templates are used to graphically represent enemy unit composition and disposition in each option and course of action previously itemized. They are prepared to reflect doctrine without consideration of terrain and weather factors. Generally the templates shall depict maneuver and fire units from division through the battalion echelon. Special and non-organic units (assigned from an Army or higher

echelon) shall be incorporated into division and/or regimental templates and will be called division slice or regimental slice templates.

Content

Doctrinal templates shall be drawn to scale. The preferred scale for division templates is 1:250,000. The preferred scale for regiment and battalion templates is 1:50,000. All significant dimensions shall be labeled. Templates shall be constructed using standard military symbols. Templates shall depict significant military data including line-of-contact, phase lines, coordination lines, frontages, depths, direction of movement and unit boundaries.

A sample template for a motorized rifle regiment in a movement to contact is shown in Figure 3.1.1-7. Figure 3.1.1-8 is a sample for a motorized rifle regiment in a breakthrough attack.

Format

These templates should be sketches or diagrams drawn to scale. Lines and symbols are to be drawn as they are to be seen on the graphics terminal. Any item which is to be in a specific color and/or blinking on the graphics terminal must be so marked on the template. For those templates drawn at a 1:250,000 scale, tick marks denoting 10 kilometers should be included, and for 1:50,000 scale, tick marks denoting each 2 kilometers. An origin point should be labeled. The origin is the point used by the system to locate and orient the template on the screen. It must be visible so the operator can use it in conjunction with the cursor to manipulate the template on the screen, or to delete it.

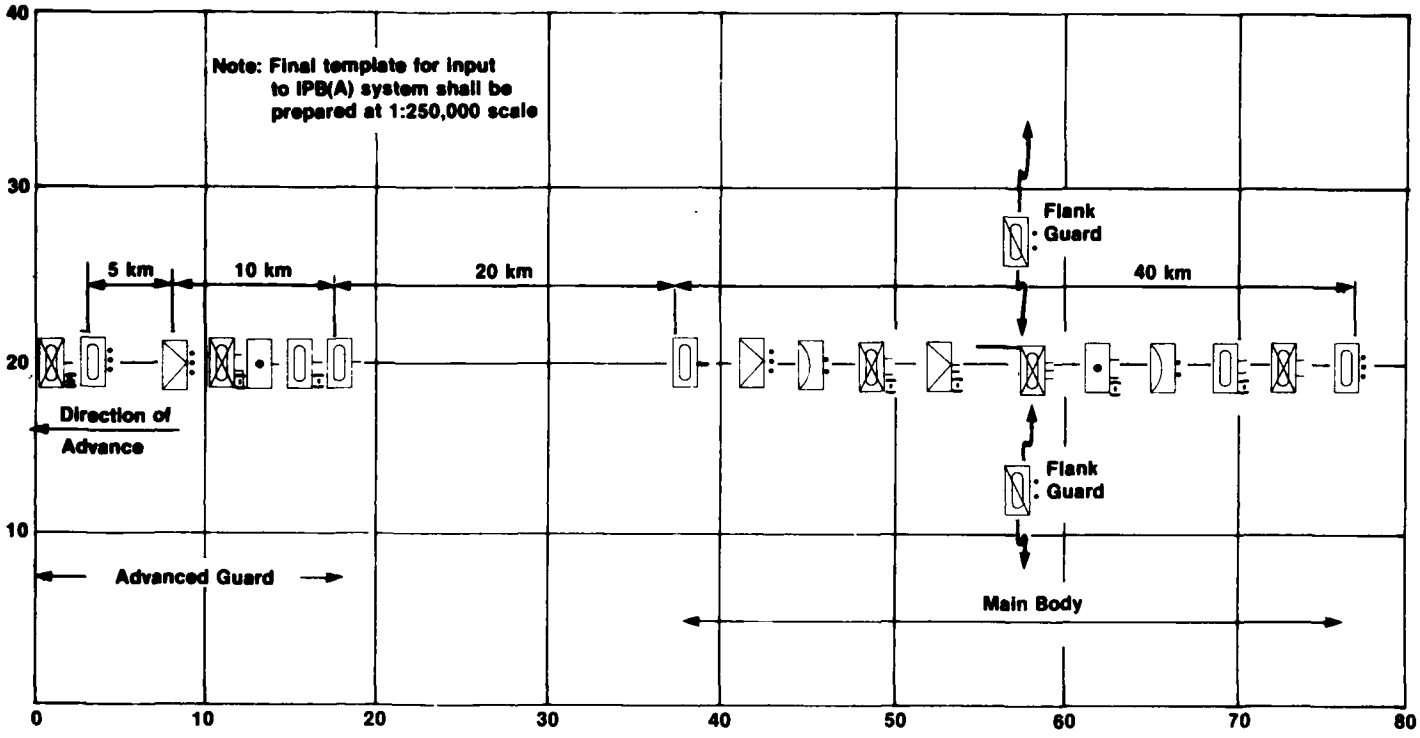


Figure 3.1.1-7. Doctrinal Template - Motorized Rifle Regiment in Movement to Contact

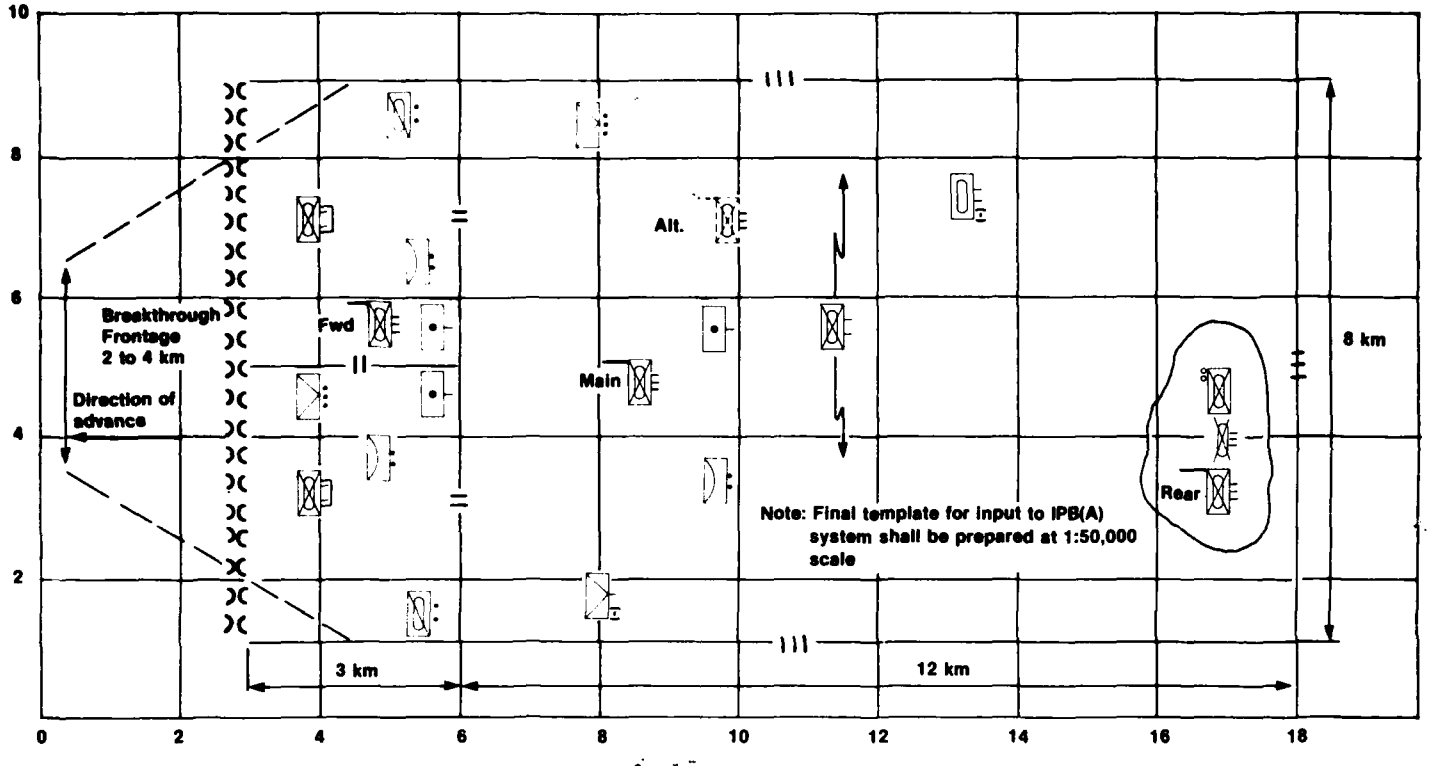


Figure 3.1.1-8. Doctrinal Template - Motorized Rifle Regiment in a Breakthrough Attack

Data Form/Mode

These templates should be issued on magnetic tape in a file which conforms to the system data base conventions. Each record in the file will contain the name/title, type of doctrinal template, originating agency/office, date prepared, scale, brief description and the graphic imagery itself.

A less desirable but adequate form would be to issue the template drawn on 8½ x 11 paper.

3.1.1.4.3 Doctrinal Templates - Event Menus

Event menus are lists of detectable events which are characteristic of enemy operations/military maneuvers. They can be prepared from descriptions of enemy doctrine. These menus are used to prompt the IPB Analyst when he is preparing the Event Matrix and to speed his finalization of the matrix by saving key strokes. Event menus should be prepared for the types of operations that are expected to be encountered, for example:

- March to Contact
- Meeting Engagement
- Quick Attack
- Deliberate Attack
- Pursuit
- Hasty Defense
- Deliberate Defense
- Withdrawal
- Airborne Assault
- Assault River Crossings
- Amphibious Operations

Events reflecting combat support and combat service support operations supporting the main maneuver or special operation should be included in the menu. The criteria for including an event in the doctrinal menu are (1) Is it detectable? and (2) Is it an indicator?.

Content

Each menu should contain its title, the event name of each event and a brief description of that event, leaving blank spaces where location or other specific information might logically be added when the menu is applied in a given situation. Figure 3.1.1-9 is an example of an Event Menu for Assault River Crossings.

In addition, each menu should contain a short name/title, originating agency/office, date prepared, nationality of the enemy to which applicable, and type of doctrinal template.

Format

The menu is an alphanumeric columnar format which can be read on the A/N CRT screen. The lengths of the fields of data are disciplined by the conventions of the CRT and the data base system. All of the menus will be contained in a file and Figure 3.1.1-9 represents an output product from the file. The top line is the title. Multipage menus are handled by page numbering (line 2). Columnar headings include the means to select a specific event. The Event Name is abbreviated so as to fit within the field size. The Event Description may also contain readily understood abbreviations and blank spaces for additional specific data.

RIVCRME

DOCTRINAL EVENT MENU FOR RIVER CROSSINGS

PG 1 OF 2 PGS

EVENT NAME	DESCRIPTION	SELECT
BRIDGE EQT	PONTON BRIDGE EQT ENTERS RGMT SPLY AREA	-
ENGR ACTVTY	FERRY SITE PREPARATION VICINITY OF	-
PATROL ACTVTY	INTENSIFIED PATROL/RECCE RIVER BANKS VICINITY OF	-
CROSS EQT	TRACKED AMPHIB/FERRIES MASSING/ASSEMB VICINITY OF	-
COMBAT ACTVTY	INCREASED PRESSURE TO SECURE FAR BANK OF RIVER VICINITY OF	-

THE ACCEPTABLE COMMANDS ARE:

DEMM - RETURN TO DOCT-EVENT MAT-MENU

EM - CALL EVENT MATRIX SKELETON

ENTER COMMAND HERE

Figure 3.1.1-9. River Crossing Doctrinal Event Menu Example

Data Form/Mode

These menus should be issued on magnetic tape in a file which conforms to the system data base conventions. Each record in the file will be identified by the short name/title of the event menu.

A less desirable but adequate form would be to issue the menu on punched cards.

3.1.1.4.4 Doctrinal Target Menus

Doctrinal target menus are lists of potential targets which are inherent to a specific type of enemy unit and the kind of activity or operation in which that unit is engaged. They are prepared from descriptions of enemy doctrine, knowledge of enemy TO&E and equipment characteristics. They are closely related to doctrinal templates. Doctrinal target menus are used to prompt the IPB analyst when he is preparing the Target Analysis Matrix. They are designed to foster standardization and to save excessive key strokes in preparing the target analysis matrix. Menus shall be prepared for each combination of enemy unit type and military operation expected to be encountered, for example, Tank Battalion in Deliberate Attack, or Tank Battalion in Water Obstacle Crossing.

The criteria for including potential targets are: (1) Is it detectable? and (2) Is it vital/important to the enemy's success, i.e., a critical node? A target is defined to be anything the commander may want to shoot at, intercept or jam.

Content

Each menu should contain a title, the types of targets, brief descriptions of the targets and indications of the permanence of the targets. Examples of types of targets are: emitter, shooter, mover, area, or interdiction. Examples of target descriptions are:

- CP
- Artillery batteries
- SAM radar/SAM
- Target acquisition radar
- MET radar
- Fire control radar
- Rocket/Missile position
- VHF radio
- DF equipment
- Troop concentration
- Supply dump
- CSS trains

Permanence describes the relative time the target is expected to be stationary. Permanence may be expressed as:

- Moving (and continuing to move)
- Moving - expected to stop
- Stationary (and continuing to be stationary)
- Expected to move

Figure 3.1.1-10 is an example of a Doctrinal Target Menu for a Motorized Rifle Regiment in the Attack. Figure 3.1.1-8 was used in conjunction with enemy doctrine and types of equipment associated with the subordinate units. Note that the menu lists a certain target type

DOCTRINAL TARGET MENU FOR
MRR IN ATTACK

PG 1 OF 1 PGS

TARGET TYPE	TARGET DESCRIPTION	PERM	SELECT
EMIT	RGT CP	EXP	
		MOVE	
EMIT	SAM RADAR	EXP	
		MOVE	
SHOOT	SAM	EXP	
		MOVE	
SHOOT	ROCKET/MSL POSITION	STA	
AREA	BDE TRAIN	STA	
SHOOT	ARTY BTYS	STA	
EMIT	TGT ACQUIS RADAR	STA	
EMIT	DF EQUIP	MOVE	

Figure 3.1.1-10. Doctrinal Target Menu for a Motorized Rifle Regiment in Attack

only once although it may be used several times on a target analysis matrix. Thus the first entry in the menu is the regimental CP even though the target analysis matrix may include the Forward, the Main and the Rear CPs. The column on the right labeled "Select" provides the means by which the IPB analyst can select target items for automatic inclusion in the target analysis matrix.

In addition, each menu should contain a short title/name, originating agency/office, date prepared, nationality of the enemy to which applicable and the type of template.

Format

The target menu is alphanumeric in format and is used on the A/N CRT screen in columnar format. The menus are contained in a file in a format compatible with the data base management system. Understandable abbreviations are permissable. Lengths of fields of data are disciplined by the conventions of the data base system. Constraints imposed on lengths by the CRT size may be overcome by using more than one line to display the contents of a data field. Figure 3.1.1-10 represents an output product of the file rather than the precise format required of the data source.

Data Form/Mode

These menus should be issued on magnetic tape in a format amenable to entry into the system data base. Each record in the file will be identified by the short name/title of the event menu.

A less desirable but adequate form would be to issue the menu on punched cards.

3.1.1.5 Current Situation Data Requirements/Assumptions

Current Situation data is required for both enemy and friendly forces in order to support the IPB(A) function. In a fielded ASAS, it is assumed that both the graphic and tabular current situation data would be continuously monitored and updated and would be available in a timely manner to the IPB(A) analyst.

The following paragraphs state general requirements which the IPB(A) function places on the ASAS maintained current situation capability. A detailed description of content and formats is not attempted at this time based on the fact that the Army is about to commence a major ASAS design study which it is assumed will develop these specifications.

General Content

The current situation data base shall contain order of battle type factors (for example unit name, type, strength, composition and disposition) which in general shall permit graphic representation of forces on map backgrounds. The data base content and organization shall also permit response to tabular queries.

Data Manipulation and Display

It is assumed that an ASAS function (not IPB(A)) shall maintain/update a CRT graphic monitor referred to herein as the current situation master monitor or display. At the IPB(A) station, the IPB(A) analyst must be able to:

1. Access the master current situation update onto his slaved monitor.

2. Focus on certain areas of the current situation display and offset and rescale his current situation monitor. It shall be possible to modify the scale of the slaved display without interrupting or disrupting the master display.

3. Access all or part of the master current situation update onto his IPB graphic screen. For example, he shall be able to display blue force only, red force only, blue/red artillery units only, forces of regimental or higher echelon only, etc.

4. Access current situation graphics onto his IPB graphic screen. Initialize a cursor identified query about it and have results automatically displayed on his tabular screen.

Figures 3.1.1-11 and 3.1.1-12 are samples of the form in which it is assumed the current situation will be provided.

3.1.2 IPB Product Build Function

Figure 3.1.2-1 is an overview of the process the IPB analyst uses to build automated IPB products for subsequent use by G-2/G-3 staff personnel.

The source data items under Inputs would be developed by support agencies and "provisioned" in appropriate sets to units in the field. They have the common attribute of being situation independent; their preparation requires application by specialists of considerable technical information. They could be modified in the field, but the basic set would be provided by support agencies. Preceding sections described in more detail the source data requirements.

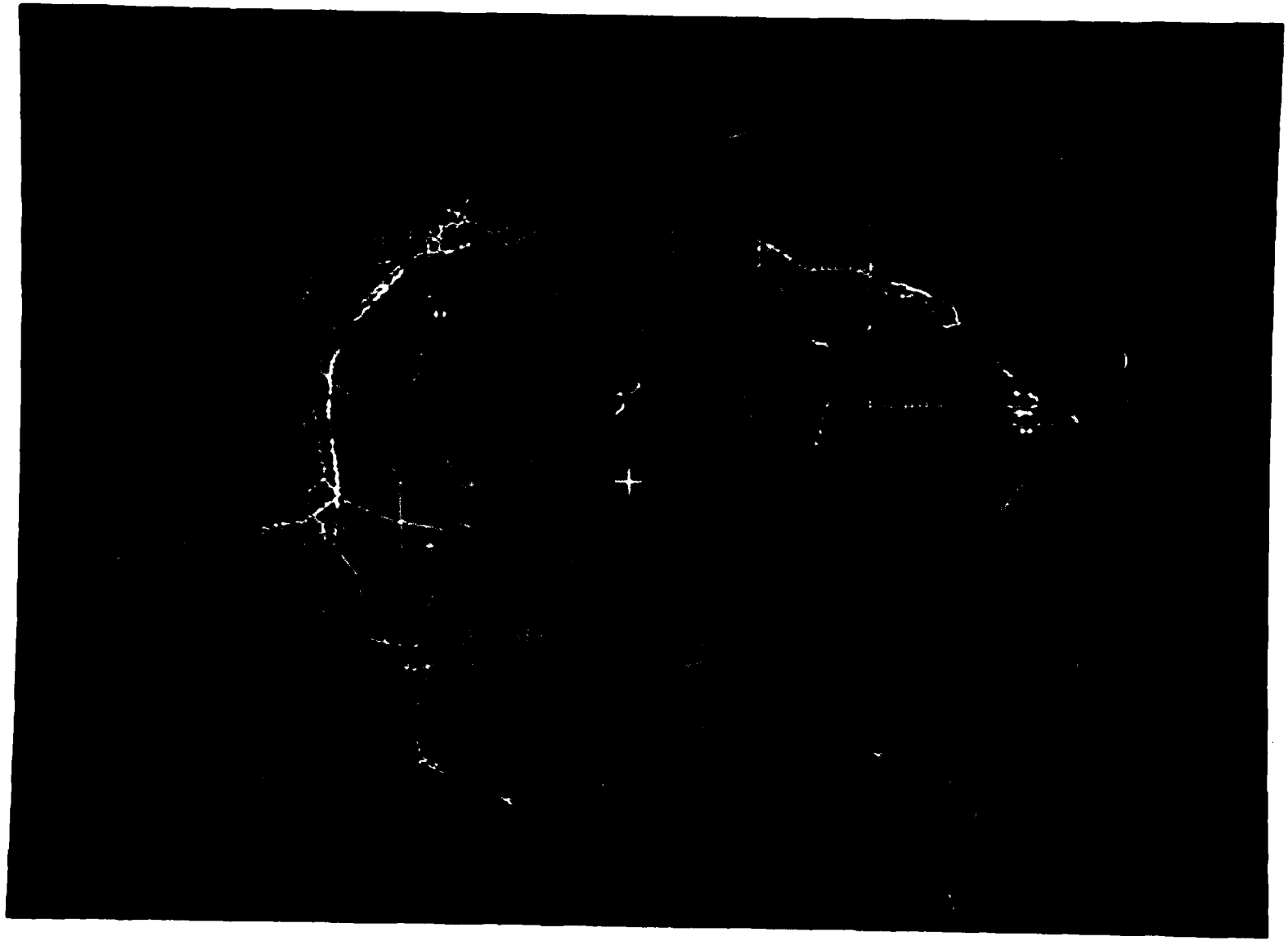


Figure 3.1.1-11 1:250,000 Current Situation

Figure 3.1.1-12 1:50,000 Expanded Current Situation

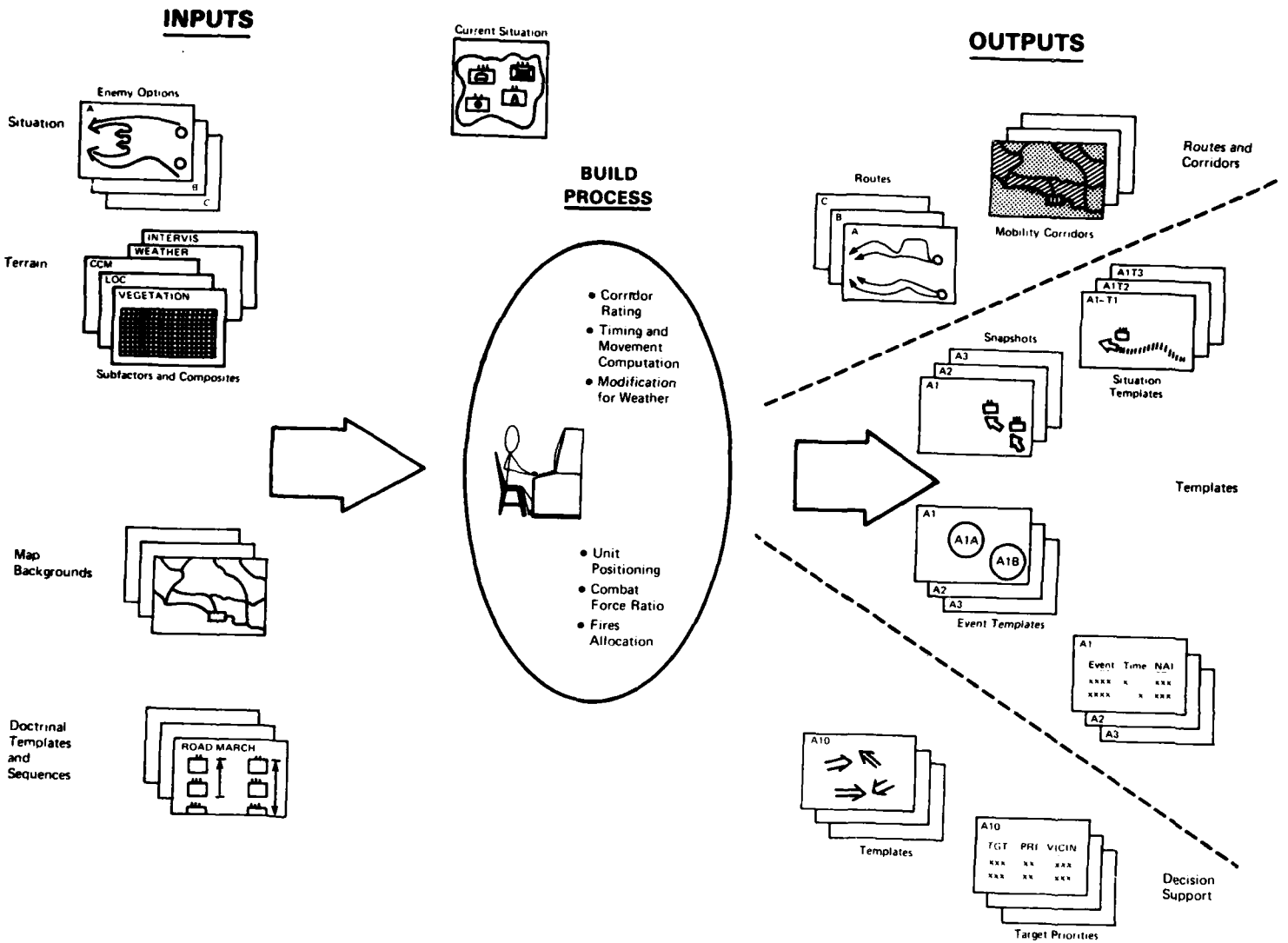


Figure 3.1.2-1. Build Process

Inputs

The analyst has available doctrinal descriptions of major options employed by enemy forces to achieve their objectives in various military situations.

Doctrinal templates of enemy forces at the echelons of battalion and higher are available. They provide the analyst with graphic representations of high interest force elements in road march, pre-combat and combat formation.

The inputs include digitized terrain information which defines individual and combined terrain factors (slope, vegetation, dry and wet soils, and crosscountry mobility) effects on armored vehicle mobility. Further information is included on road and river classifications and their effect on armored vehicle and wheeled vehicle mobility.

Map backgrounds for graphic screen display at varying scales and levels of detail are available in the IPB data base. In support of these graphic data sets, the IPB data bases include detailed technical data in tabular form. Examples are detailed technical data on lines of communications; detailed terrain subfactor characteristics, and detailed weather effects characteristics.

Processing Algorithms

Processing functions are available to the analyst in the IPB software programs. These allow him to input real time computation parameters at his station and cause the system to immediately compute information on corridor mobility ratings, force movements and timings; changes to composite mobility ratings caused by weather; combat power ratios, and intervisibility corridor ratings. More detailed descriptions of the

special automated processes and analyst aids be elsewhere in this document.

Outputs

Outputs or products which are prepared ahead of a battle and stored for real time use by the analyst are shown on the right hand side of Figure 3.1.2-1. With a basic set of maps, terrain data, and doctrinal templates, operating units can begin development of the products illustrated under Outputs as soon as they have a specific military situation with which to deal. It can be the "current situation" as understood prior to an initial attack (or during the battle), or it could be a contingency situation for which operating plans must be developed. In order to develop the basic IPB products illustrated, there must be an enemy force at a known or estimated location, friendly forces having a mission to deal with the enemy, and hypothesized enemy objectives and options for achieving these objectives. With these ingredients, the IPB process can begin to function. The following sections describe how terrain composite overlays are built with IPB software, how weather information is used in this process to affect mobility rating and how the IPB 4-step templates are built.

3.1.2.1 Weather Data Utilization

The IPB analyst shall be able to input weather forecast data (Section 3.1.1.3) into the system. This process shall occur twice per 24 hours on the average and shall be accomplished through operator interaction with an alphanumeric display and light pen. With the light pen, the operator shall be able to specify, from a set of A/N menus, the appropriate weather condition for the selected area of interest and forecast time period. The result of this process will

be subfactor overlays or composite subfactor overlays (soils, CCMs, COMs, intervisibility, etc.) reflecting the integration of current weather information with terrain data for the areas of interest.

Five menus shall be required (see Figure 3.1.2-2):

- Weather Update Menu List
- Intervisibility Overlay Initialization Menu
- Crosscountry Mobility (CCM) Overlay Initialization Menu
- Line of Communication (LOC) Overlay Initialization Menu
- Combined Obstacles Matrix Current Weather Update Menu

Figure 3.1.2-3 shows a flow of operator/machine functions necessary to input weather data. Hard copy weather forecasts are utilized in addition to the weather overlay to determine appropriate weather parameters. The Weather Update Menu List is called up on the A/N display. The analyst also calls the current weather map on the graphic display. Through the graphic cursor, the operator inputs the coordinates for the area of interest and the coordinates appear on the A/N display. The analyst then identifies by light pen the box associated with the overlay to be updated and the selected menu shall appear. This menu shall contain the time and date of the last update and the parameters selected for that last update shall be indicated by a symbol inside the appropriate boxes. When the analyst identifies a parameter by light pen, time and date are automatically updated. Those items in Figure 3.1.2-2 bounded with dashed lines, i.e., snow depth and ice thickness, shall not appear unless/until the snow covered and/or frozen blocks are selected.

The effect of the menu inputs is to select appropriate tables (see Figure 3.1.2-4) for modification of the terrain data codes to reflect mobility values that take weather conditions into account.

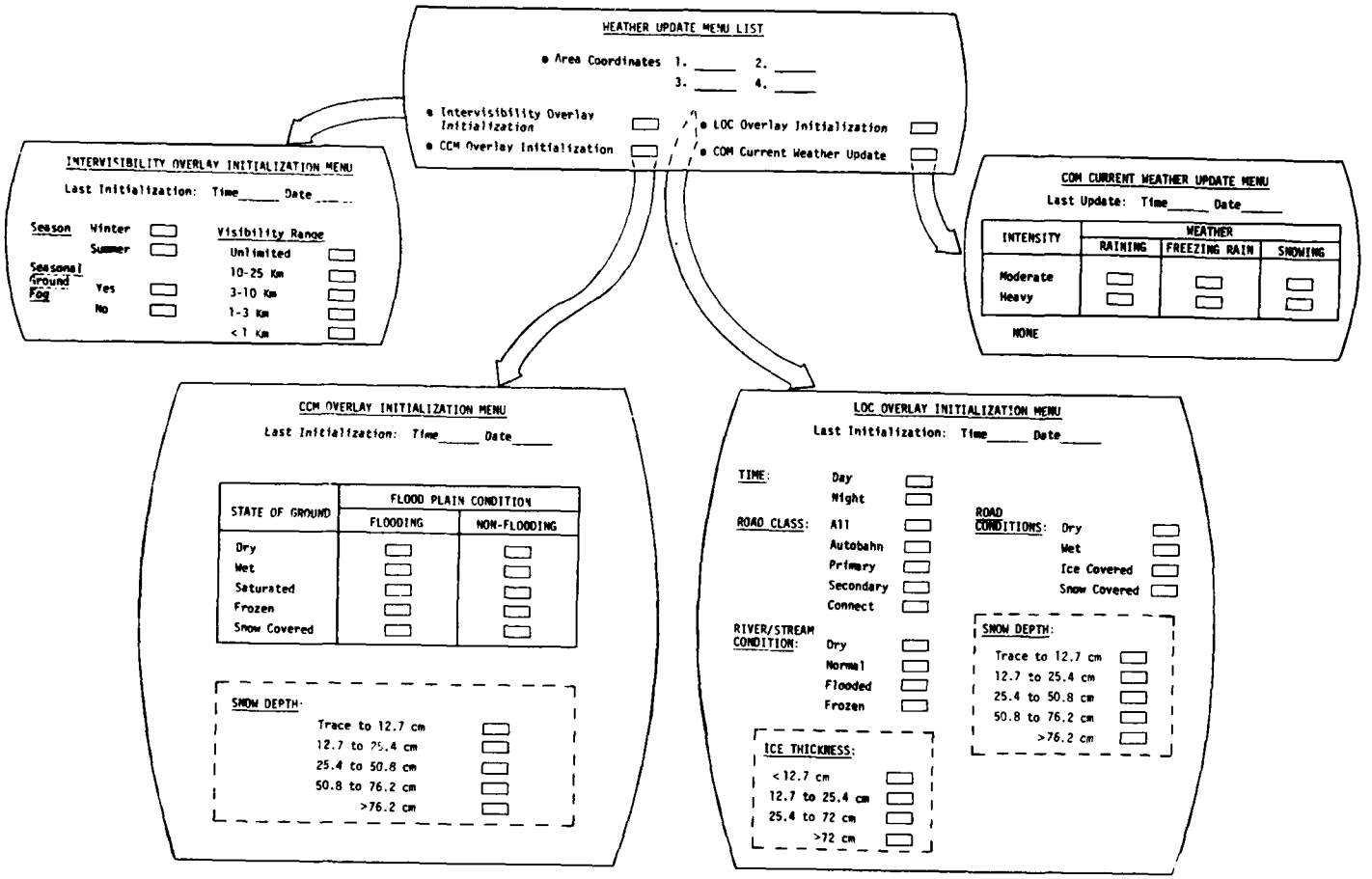


Figure 3.1.2-2. Weather Update Menus

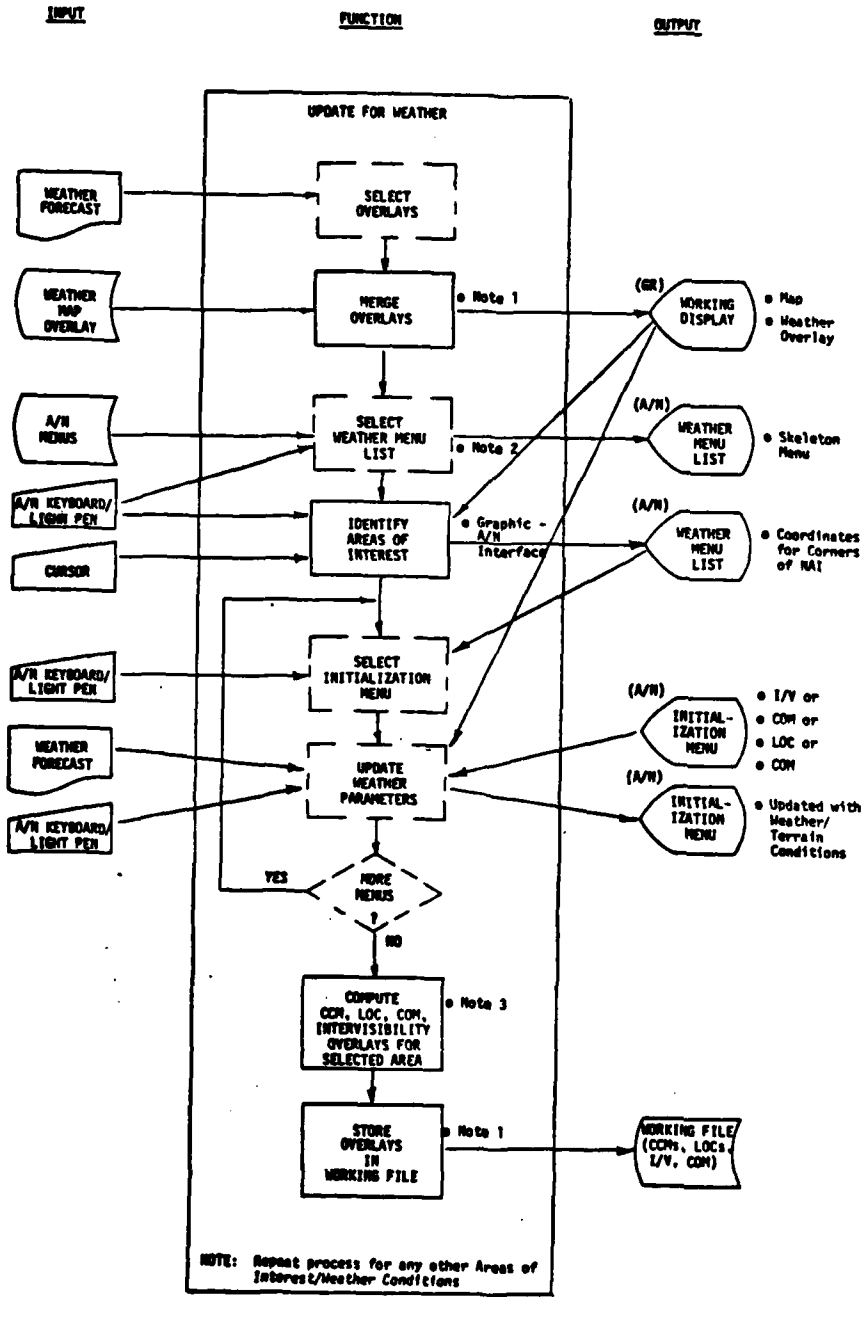


Figure 3.1.2-3. Weather UPdate Flow

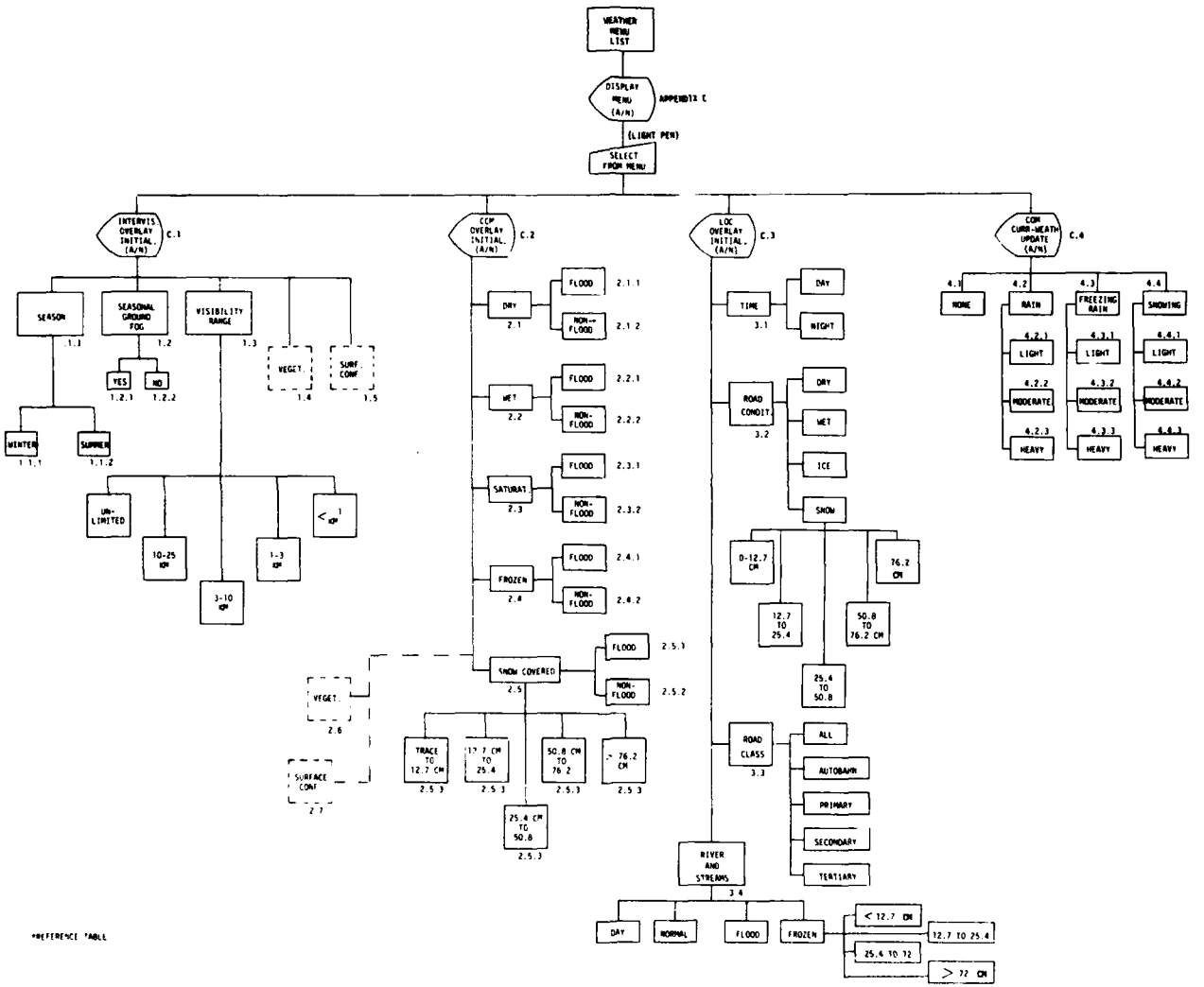


Figure 3.1.2-4. Weather Menus Referenced to Factor Tables

The numbers outside the boxes in Figure 3.1.2-4 are reference numbers to specific tables contained in Appendix C.

3.1.2.2 Terrain Composite Overlays

3.1.2.2.1 Combined Obstacles Matrix (COM)

A combined obstacles matrix of an area is a composite of the lines of communication (LOCs) and the crosscountry movement (CCM) overlays of the area. It shall present the characterization of the crosscountry terrain and lines of communication in terms of the IPB(A) five categories of mobility. An example of a COM with 1:50,000 scale detail is shown in Figure 3.1.2-5. Each color in the figure conveys relative mobility of military ground forces across the terrain. Since weather, season, etc., shall affect both CCMs and LOCs they will normally be developed on an approximate daily basis using operator inputs of weather information in conjunction with basic terrain data to form composites.

Crosscountry Mobility (CCM) Overlay

The CCM overlay shall be a composite of soils, vegetation, surface configuration and built-up area subfactor effects. The subfactor effects shall be automatically compiled according to the method discussed in Section 3.1.2.1 Weather Data Utilization.

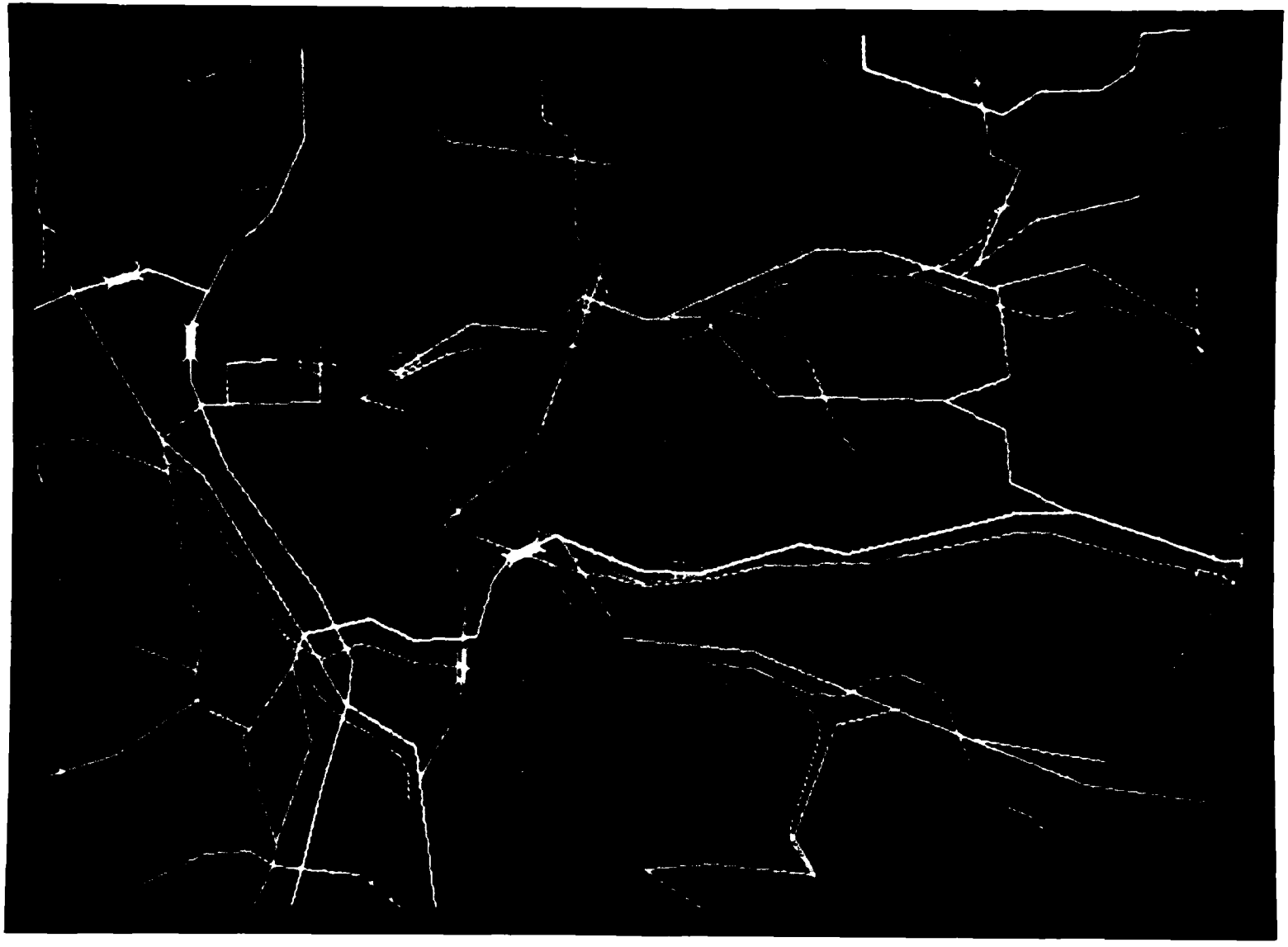


Figure 3.1.2-5 1:50,000 Folger Combined Obstacles Matrix

For data stored in ETL format or IPB(A) simplified format, the process of assembling the necessary subfactor data into a composite overlay reflecting the effect of all terrain subfactors on mobility is illustrated in Figure 3.1.2-6. The method of converting existing terrain analysis data into IPB(A) subfactor data has been discussed in detail in Section 5 of TIAX Phase A Final Report.

The flow of man/machine interactions required to implement the process is shown in Figure 3.1.2-7 and is summarized as follows:

- Input weather effects as discussed in Section 3.1.2.1. Note that it is not necessary to perform this operation if weather conditions have not changed since the last update.

- The analyst, through the graphic terminal, selects the area of interest and the function to be performed, e.g., display CCM for selected area.

- The IPB analyst shall be aware (through reconnaissance, etc.), of the currency of the terrain subfactor data (soils, vegetation, slopes, built-up areas) used to make a CCM. If, in his judgment any of this data lacks validity, due to engineering, military or other effects, he shall modify the data through the graphics terminal as required.

- The computer shall translate the stored terrain code to appropriate IPB(A) mobility factors using the automatically selected tables.

- The computer shall multiply the Surface Configuration mobility factor times the Vegetation mobility factor times the Soils mobility factor times the Built-Up Areas mobility factor.

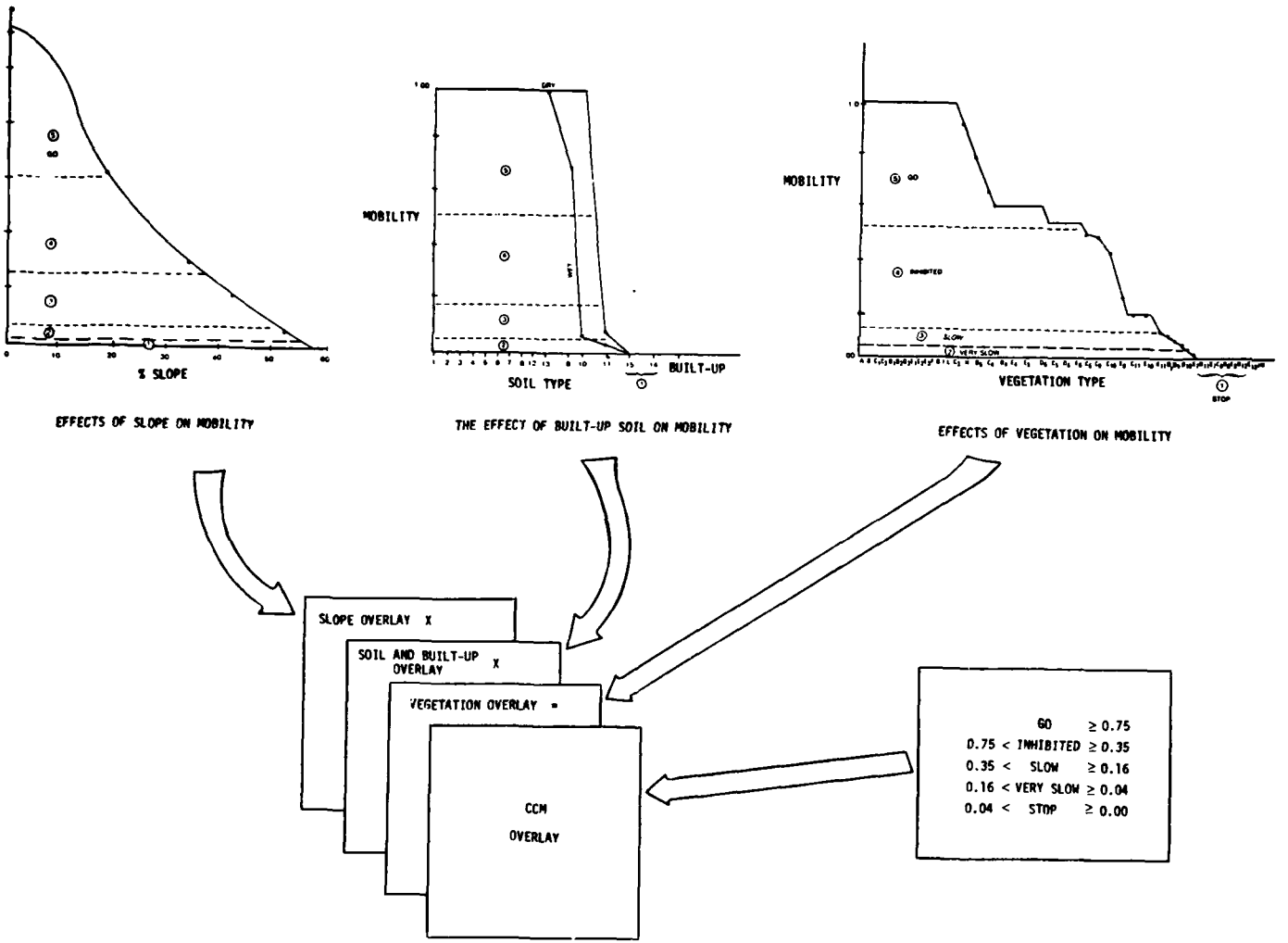


Figure 3.1.2-6. CCM Computation

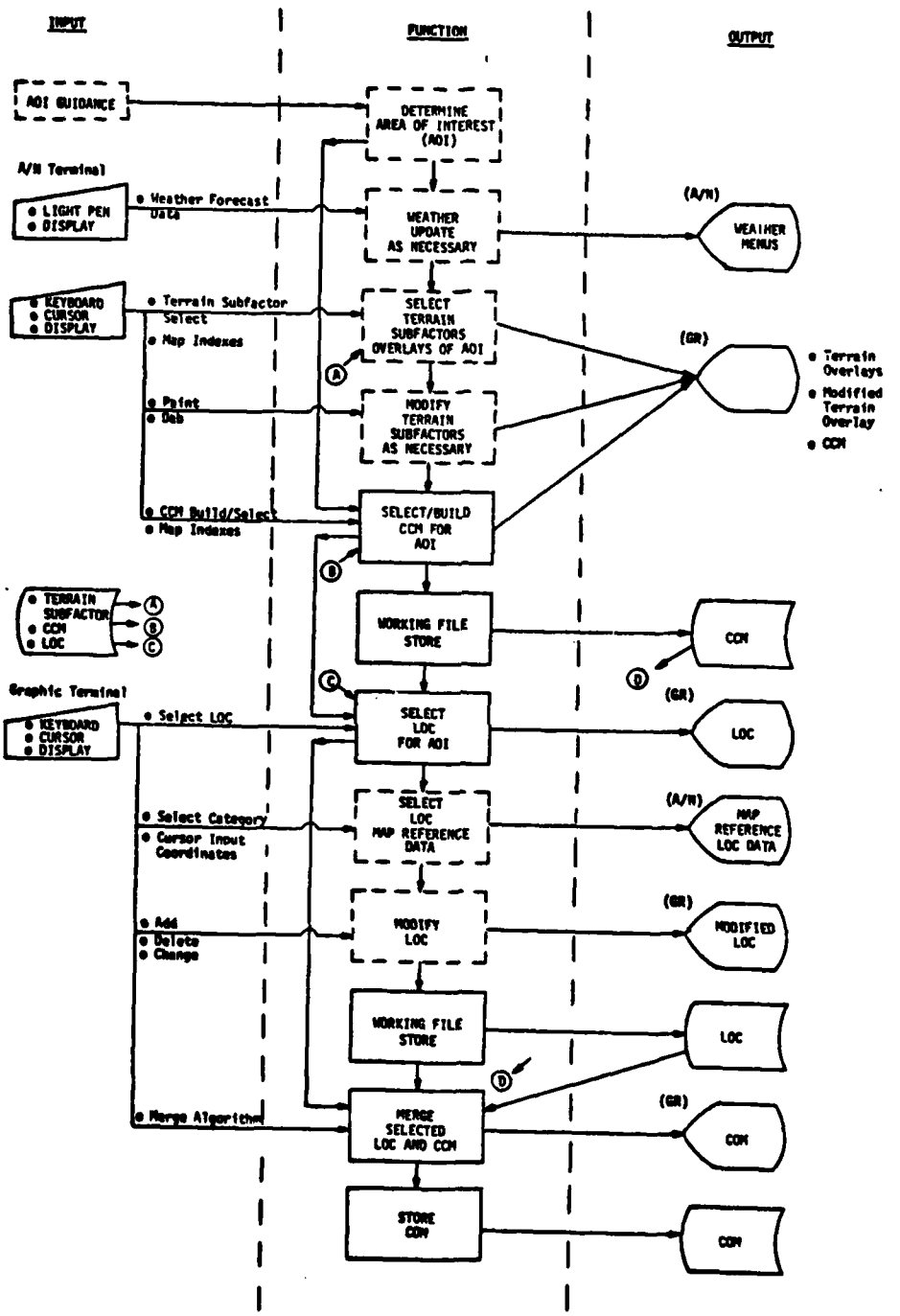


Figure 3.1.2-7. COM Build Process Flow

With this done, a normalized crosscountry mobility factor is determined.

- Depending on the computed value, the 500 meter square is rated go, inhibited, slow, very slow, stop.

- This process shall be repeated by the computer for the total area selected, stored in a working file and graphically displayed when desired. On a 19-inch diagonal CRT, at a scale of 1:50,000, an area 15 km x 20 km can be displayed in 1,200 blocks 500 meters square.

Lines of Communication (LOC) Overlay

The LOCs shall be provided as source data in vector and A/N form (See paragraph 3.1.1.1) and shall be categorized according to class at this stage. Like the subfactor overlays and the CCM itself, the LOCs are echelon independent. Echelon is accounted for during the corridor build process and route timing. The method of classifying the various LOC categories has been discussed, in detail, in Section 5 of the IPB/TIAX Phase A Final Report.

Figure 3.1.2-7 shows that, to the analyst, the CCM and LOC select processes are very similar. He validates weather effects, selects the area for display and can modify the source data. This ability to modify LOC source data, in a military environment, is of paramount importance to the analyst because of the vulnerability of roads, bridges, tunnels, etc., to attack. The destruction or impairment of any of these items is information critical to the analyst's determination of mobility corridors.

An additional feature shall also be provided for the LOC function, viz., Map Reference data. This can be any A/N data containing important technical characteristics relative to the LOC. Although the item shall be identified by graphic cursor input, the data shall be displayed on the A/N display so as to keep the graphic display uncluttered.

Combined Obstacles Matrix (COM) Build Process

Figure 3.1.2-7 shows the COM build process. In the figure, two paths shall be available to the analyst once the area of interest has been decided upon. The one path, with arrows out of the left side of the functional boxes is highly automatic. Here, the analyst simply calls up and graphically merges the CCM and LOC overlays of the area through the graphic terminal (keyboard, cursor and display).

The analyst shall also be able to call up as separate items the soils, vegetation, slope, LOCs, or CCM overlays.

The second path in the figure, with arrows from the center of the function boxes, is highly interactive. It assumes that the analyst must initialize the system for weather, modify certain of the terrain subfactor overlays due to new information, build a new CCM, examine and modify the LOCs for the area (e.g., blown bridges) and finally create the COM through the merge process.

The main purpose of the COM shall be to aid the IPB analyst to identify and build potentially favorable corridors of movement of enemy forces as described in the following section.

3.1.2.2.2 Mobility Corridors

Figure 3.1.2-5 in the previous section is a color photograph of the combined obstacles matrix (COM). This portrays the net effect of all terrain influences on mobility onto one display. With this total mobility picture, plus knowledge of the enemy's present location and an assumption about his probable objectives, the analyst can identify potentially favorable corridors of movement for enemy forces.

The mobility corridor overlay shall be built from the data contained on the COM. The mobility corridor overlay highlights the best routes for enemy movement across the terrain in question. Mobility corridors are established for a particular force echelon.

The corridor build and rate process shall be both iterative and interactive and requires analyst awareness of the tactical environment. The process consists, in summary, of the following basic steps:

- Build a crosscountry corridor on the COM
- Determine the effect of river and stream crossings on the crosscountry corridor
- Build road corridors
- Cause the system to rate the overall corridor using a single color corresponding to the lowest rated (choke point) segment contained in the corridor.

The analyst shall not be constrained to performing the above four steps in specific sequence. He may, at any time, intermix the building of road or crosscountry corridors, or look for alternate paths around the observed choke point(s) to make the corridor more acceptable.

Implicit to this process is the ability of the analyst to subdivide a force into lower echelons (e.g., army into division, divisions into regiments, etc.). This provides the capability of using multiple smaller corridors to comprise enough throughput for higher echelons to attain their military objectives.

The mobility corridors shall also be modifiable at any time to reflect implementation of friendly obstacle plans. These include preplanned minefields, obstacles, blocking positions, etc., that can change the mobility corridor picture. This modified mobility corridor normally reflects a reduction in the number of corridors available or the mobility rating within a corridor.

Figure 3.1.2-8 is a description of process flow for building a mobility corridor. The following paragraphs elaborate on each element of the process. Additional details on corridor rating are also included in Appendix D.

Initialization

The IPB system shall be initialized through the graphics function keyboard by selecting the echelon expected to traverse the corridor and the COM of interest. Map scale shall be included, automatically, as header information and weather effects through the previously discussed weather menu input COM build process.

Crosscountry Corridor

1. The analyst through the graphics function keyboard selects the crosscountry corridor build function. Using the graphics cursor he draws a line on the CRT tracing the desired course on the COM.

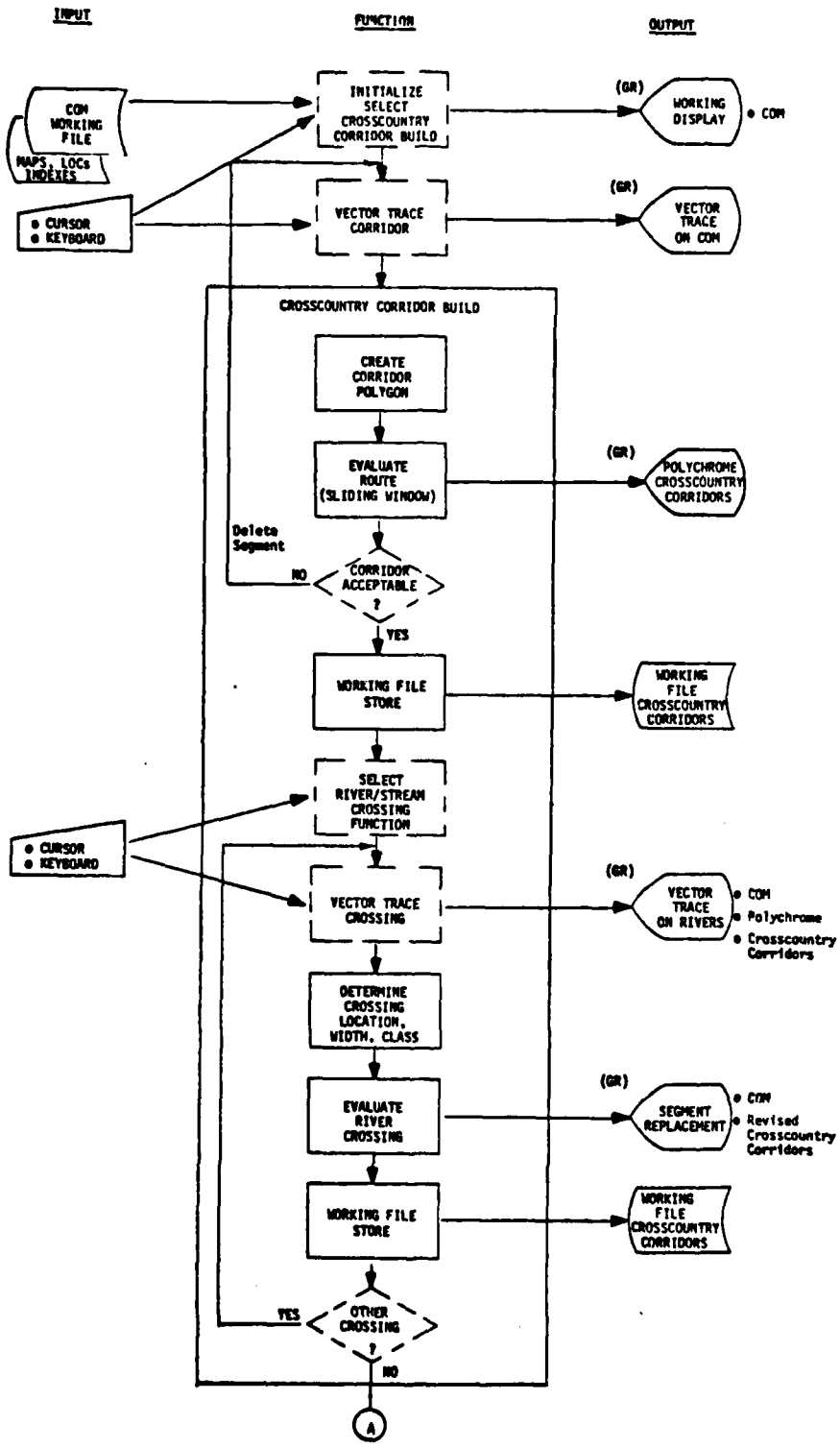


Figure 3.1.2-8. Mobility Corridor Process Flow
(Sheet 1 of 2)

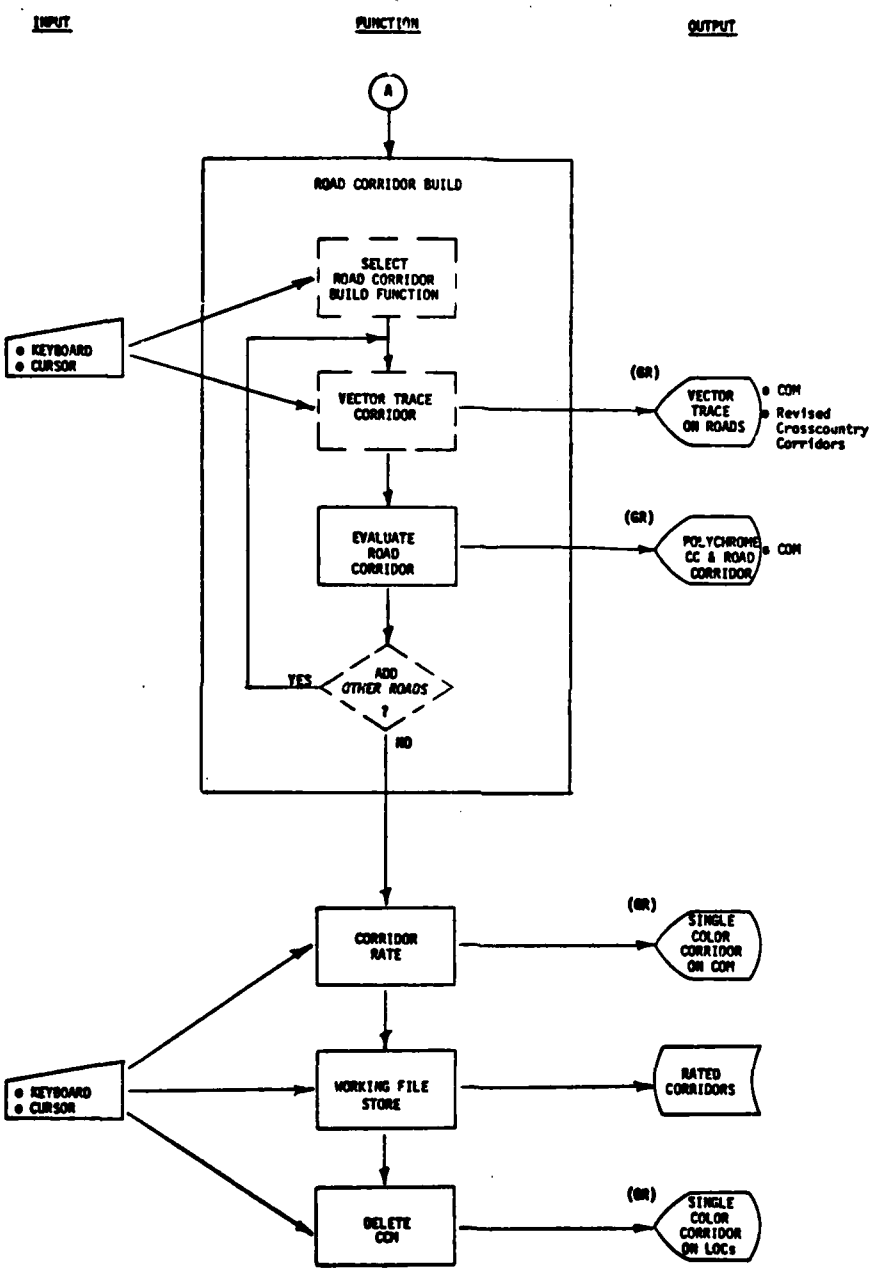


Figure 3.1.2-8. Mobility Corridor Process Flow
(Sheet 2 of 2)

2. When the desired course has been completed by the analyst, a polygon is created whose sides are parallel to the vector trace and ends are normal to the vector trace (see Figure 3.1.2-9). The width of the polygon is a function of echelon; the length is (approximately) equal to the vector trace. This polygon is used for computational purposes (Appendix D) along with a sliding window.

3. A sliding window constructed and controlled by the system shall then be used to build the corridor (Appendix D). The length of the window shall be equal to the width of the corridor and its orientation shall be normal to the vector drawn by the analyst (Figure 3.1.2-9).

   The window width shall be equal to the 500 meter COM blocks. This dimension shall be changeable through the graphic function keyboard. The numbers of COM blocks falling inside the sliding window and their mobility values shall be determined and computed in terms of a given echelon according to the algorithm in Appendix D. When the window has traversed the length of the vector trace, a polychrome corridor shall be displayed to the analyst on the graphics screen (Figure 3.1.2-10). The color of the segments of the corridor corresponds to the IPB(A) five-part mobility rating: green = go, cyan = inhibited, yellow = slow, magenta = very slow, red = no go. An outline of the outside edge of the corridor (polygon) shall also appear along with the corridor.

   The pattern of the corridor (vertical, diagonal, horizontal, etc., cross-hatching) designates the echelon for which the evaluation was done. In the case of Figure 3.1.2-10, the pattern is for a regiment.

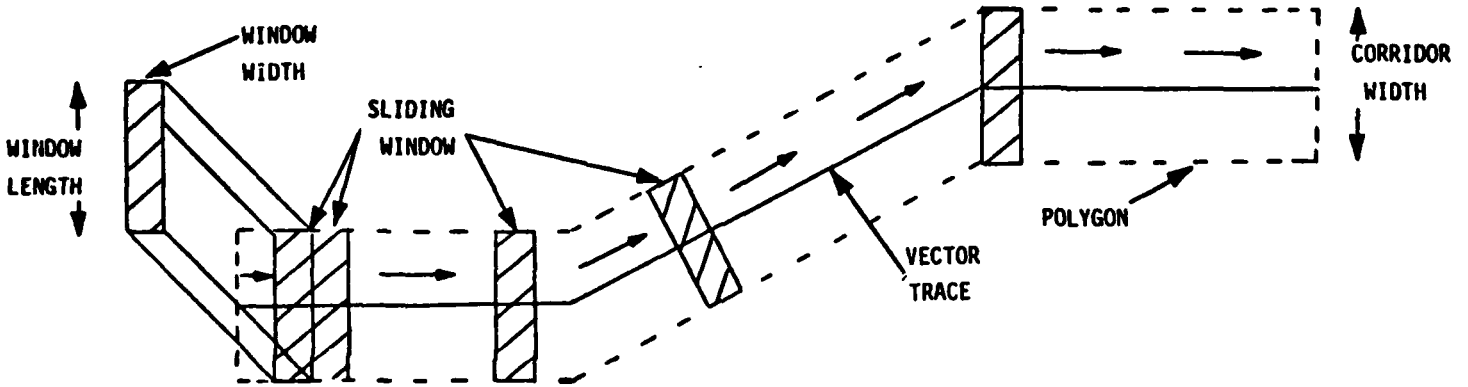


Figure 3.1.2-9. Crosscountry Corridor Polygon

Figure 3.1.2-10 Polychrome Crosscountry Corridor on COM

For additional details on the specific values and algorithms to be used in computing the windows within a corridor, refer to Appendix D.

4. If, upon examining the polychrome corridor, the analyst finds unacceptable choke points, the corridor may be upgraded by finding an alternate path(s). To do this, the analyst shall utilize a modify corridor function, which permits him to delete the unacceptable segment(s) of corridor, trace new paths around the choke point and have the new segments automatically rated. When the analyst is satisfied he merges the modified corridor with the originally defined corridor.

River and Stream Crossing

The analyst selects the River Crossing function and using the width of the previously determined crosscountry corridor to determine the width of the river crossing to be considered as well as the location of the crossing. The rivers and streams shall be available in the data base coded as to their effect on mobility (either blue, cyan or magenta as defined in IPB/TIAX Phase A Final Report). The analyst, using the graphic cursor, draws a line on or nearly on that portion of the river to be crossed. A program search is done to locate the river/stream, measure the width of the crossing and determine the stored mobility classification. The computer then calculates the mobility rating for that segment of corridor, compares this value with the determined values of the corridor for that terrain segment and stores the lower of the two mobility ratings. That segment of corridor is then color coded according to this stored mobility rating.

Road Corridor Build

The analyst, using the graphic function keys, selects the LOC Corridor Build function and draws a line on or near the road to be used. The search algorithm locates the road segment and identifies its stored mobility classification. Then, through the use of the algorithm discussed in the following section, the road corridor rating shall be automatically determined and graphically displayed for the selected road segment and echelon. Figure 3.1.2-11 shows an example of the result of such an analysis merged with the previously determined crosscountry corridor. Again, the color of the corridor represents the IPB(A) five-part mobility scale and the pattern represents the echelon.

Computation of Road Corridor

The Road Corridors shall be rated according to the following set of rules. First, the rate of delivering a force as a function of echelon in equivalent battalions per hour is defined as follows:

$$A_E = S_D V_T \left(\frac{E_E}{L_{DE}} \right) \quad \frac{bn}{hr} \qquad (1)$$

where,

A_E = battalions per hour for echelon of type "E"

V_T = normalized speed for a given road rating (see table "a" of Figure 3.1.2-12)

S_D = doctrinal speed (see table a, Figure 3.1.2-12) for product $V_T S_D$)

Figure 3.1.2-11 Polychrome Crosscountry and Road Corridor on COM

ROAD RATING	SPEED ($V_T \times S_D$)	NORMALIZED SPEED (V_T)
White	25 km/hr	1.0
Green	25 km/hr	1.0
Cyan	12 km/hr	0.5
Yellow	6 km/hr	0.25
Magenta	2 km/hr	0.0825

(a) Road Speed

ECHELON TYPE	DOCTRINAL ROAD LENGTH (L_{DE})		EQUIVALENT NUMBER OF BATTALIONS (E_E)
	SINGLE COLUMN	PARALLEL COLUMN	
Battalion	5 km	N.A.	1 Bn/Bn
Regiment	25 km	N.A.	5.5 Bn/Reg
Division	145 km	80 km	22 Bn/Div

(b) Echelon Parameter

ROAD CORRIDOR RATING		ROAD CORRIDOR CATEGORY BOUNDARIES
GO	(Green)	$A_E \geq 4.2$
INHIBITED	(Cyan)	≥ 2.1 $A_E < 4.2$
SLOW	(Yellow)	≥ 0.9 $A_E < 2.1$
VERY SLOW	(Magenta)	≥ 0.25 $A_E < 0.9$
STOP	(Red)	$A_E < 0.25$

(c) Road Corridor Category Boundaries

Figure 3.1.2-12. Doctrinal Data for Roads

E_E = equivalent number of battalions for echelon type "E" (battalions/echelon type) (see Figure 3.1.2-12, table b for values of E_E)

L_{DE} = doctrinal road length of echelon type E (kilometer/echelon type) (see Figure 3.1.2-12, table b for value of L_{DE})

Using the doctrinal data contained in tables "a" and "b" of Figure 3.1.2-12 and the corridor boundaries listed in table "c" of the same figure, the table contained in Figure 3.1.2-13 is generated. The table converts the computed value of A_E into road corridor rating. This table shall be changeable offline to reflect doctrinal differences associated with the rates of movement and equipment capabilities and the organization of specific enemy forces.

Corridor Rating

Upon satisfactory completion of the corridor build process using roads, crosscountry and river and stream effects, the analyst, through graphic cursor and function key input shall paint the total corridor the color of the lowest rated segment (choke point) within the corridor (see Figure 3.1.2-14). The analyst shall be able to delete the CCM portion of the COM and keep the corridor(s) and roads merged as shown in Figure 3.1.2-15.

3.1.2.2.3 Intervisibility Corridors

The IPB(A) approach to intervisibility is explained in the TIAX Phase II Interim Report published 17 August 1979. The approach is similar to the way mobility corridors are constructed in that it uses a base intervisibility overlay on which a vector is traced along a

ROAD TYPE	BATTALION		REGIMENT		DIVISION			
	A_E FOR SINGLE COLUMN	RATING	A_E FOR SINGLE COLUMN	RATING	A_E FOR SINGLE COLUMN	RATING	A_E FOR DOUBLE COLUMN	RATING
White	5 Bn/Hr	Go	5.5 Bn/Hr	Go	3.79 Bn/Hr	Inhibited	6.875 Bn/Hr	Go
Green	5 Bn/Hr	Go	5.5 Bn/Hr	Go	3.79 Bn/Hr	Inhibited	N.A.	
Cyan	2.4 Bn/Hr	Inhibited	2.6 Bn/Hr	Inhibited	1.82 Bn/Hr	Slow	N.A.	
Yellow	1.2 Bn/Hr	Slow	1.3 Bn/Hr	Slow	.91 Bn/Hr	Slow	N.A.	
Magenta	0.4 Bn/Hr	Very Slow	0.4 Bn/Hr	Very Slow	.30 Bn/Hr	Slow	N.A.	

Figure 3.1.2-13. Road Corridor Rating Data

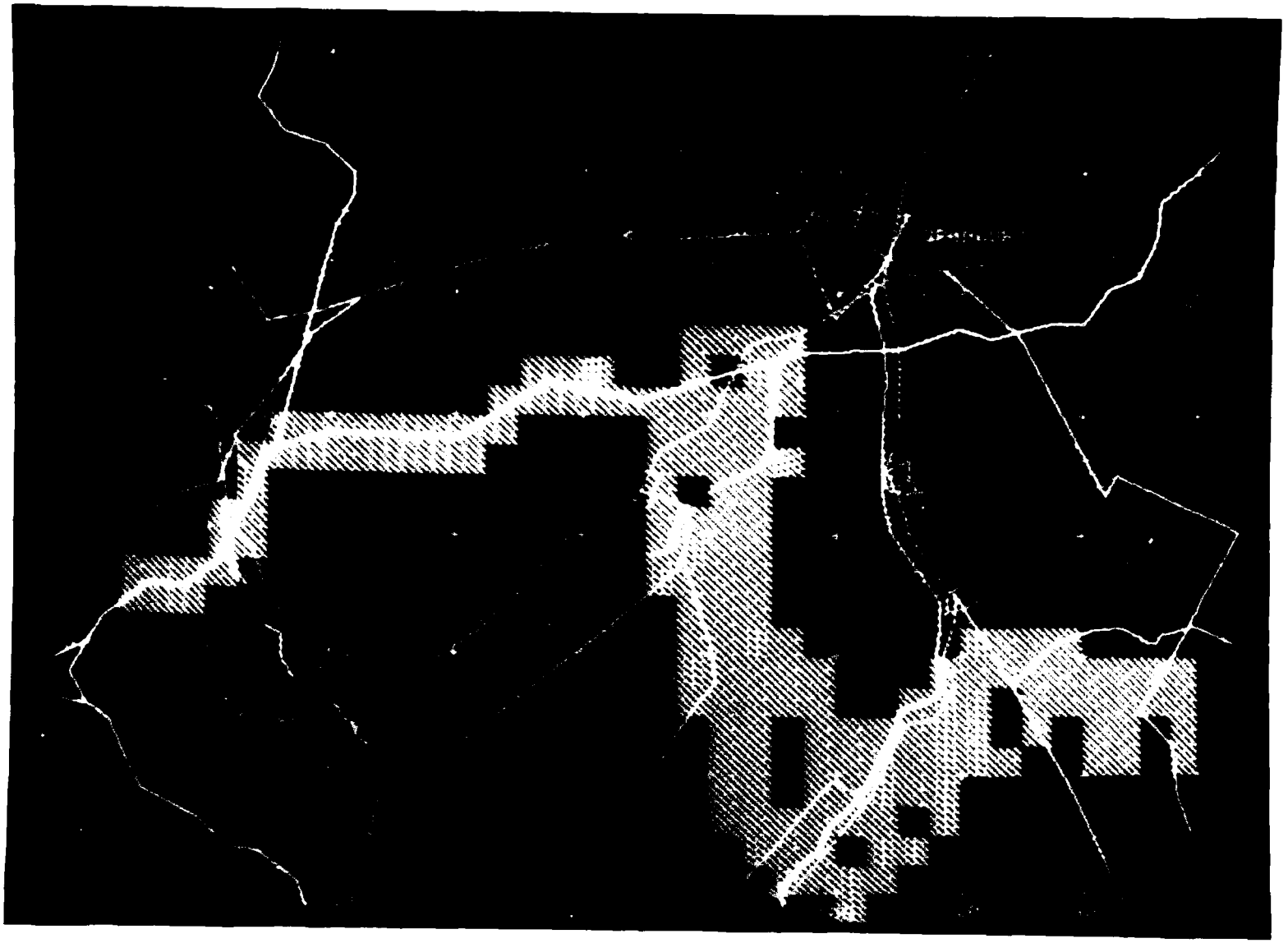


Figure 3.1.2-14 Rated Regimental Corridor on COM

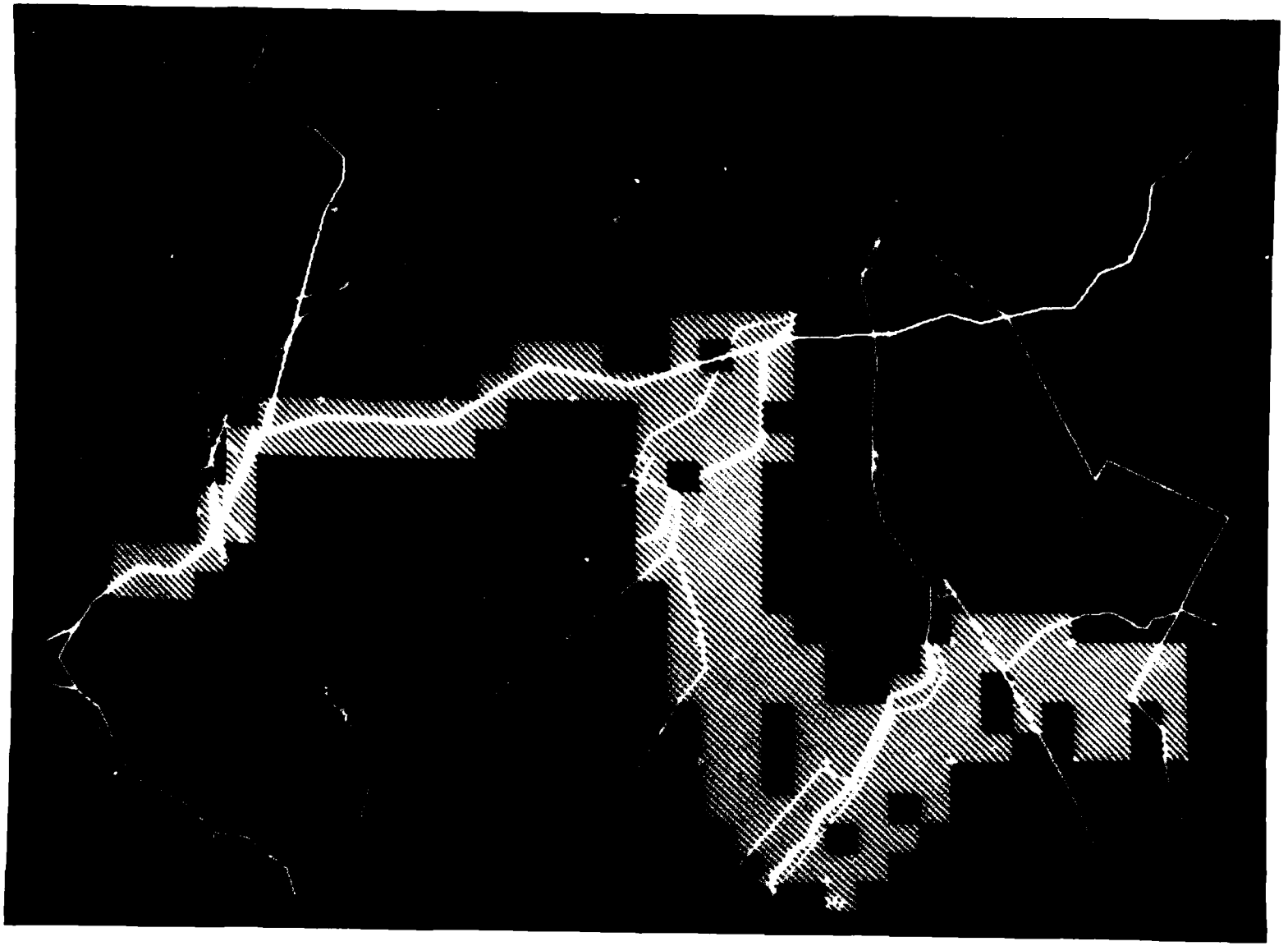


Figure 3.1.2-15 Rated Corridor on Map

given direction from a selected vantage point to build an intervisibility corridor. The flow of man/machine functions required to build intervisibility overlays and corridors is illustrated in Figure 3.1.2-16. As shown, the process requires that an intervisibility overlay first be constructed for the area of interest. This overlay in itself is quite useful to address certain intervisibility considerations. When a particular line-of-sight (LOS) is defined to the system the intervisibility corridor build process is involved.

The following sections will describe in more detail the intervisibility overlay and intervisibility corridor build processes.

Intervisibility Overlay

The intervisibility overlay is built by logically combining (see Figure 3.1.2-17) classes of vegetation with surface configuration and built-up areas. The same terrain source data is used to build the intervisibility overlay as was used for the CCM build process. At the top of the illustration are charts that cross-reference the terrain data types with the three intervisibility codes. Code definitions are listed at lower left, and the logic used to form the overlay is indicated in the center. Figure 3.1.2-18 is a photograph of a CRT version of an intervisibility mosaic. In the photo the most dense green dot pattern portrays the V5, Cover and Concealment category; the least dense green dot pattern portrays the V4, Close Combat Engagement category; the empty (black) squares portray V3, Direct Fire Weapons category.

The steps necessary to build an intervisibility overlay are as follows:

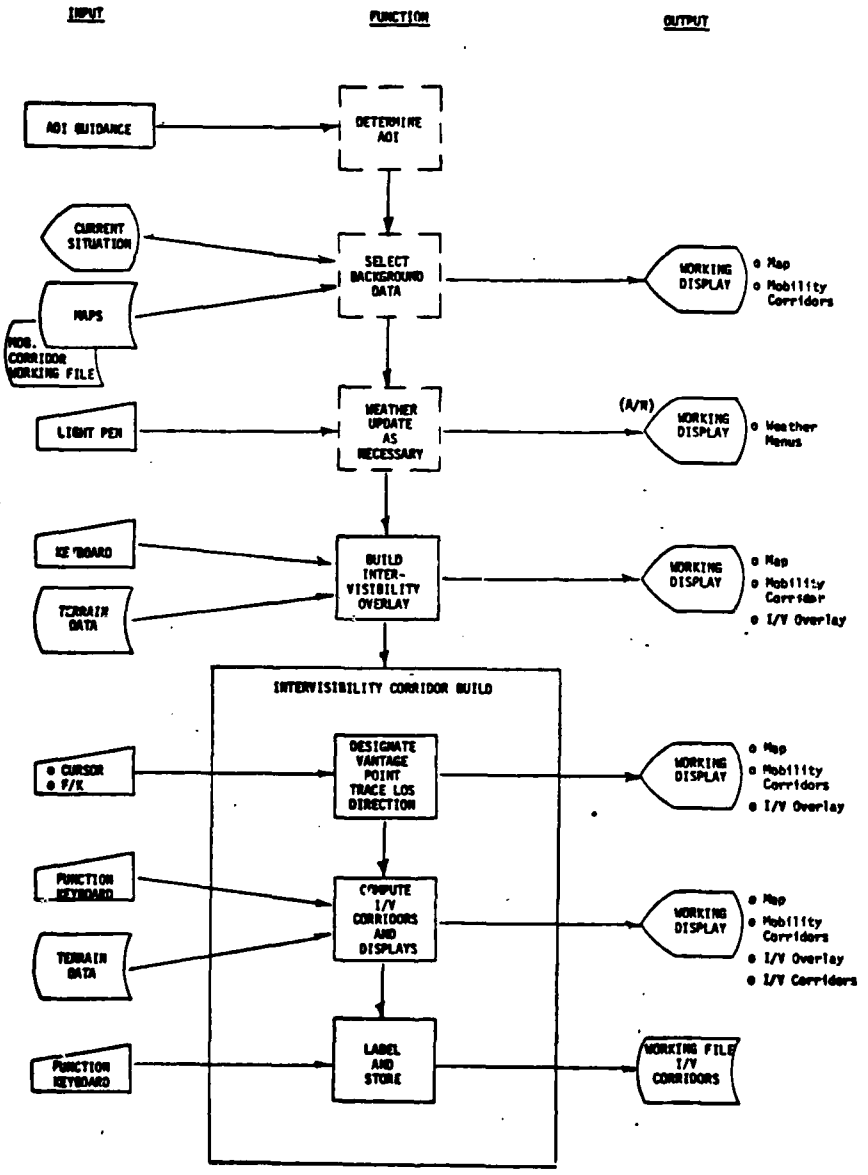


Figure 3.1.2-16. Intervisibility Overlay/Corridor Build

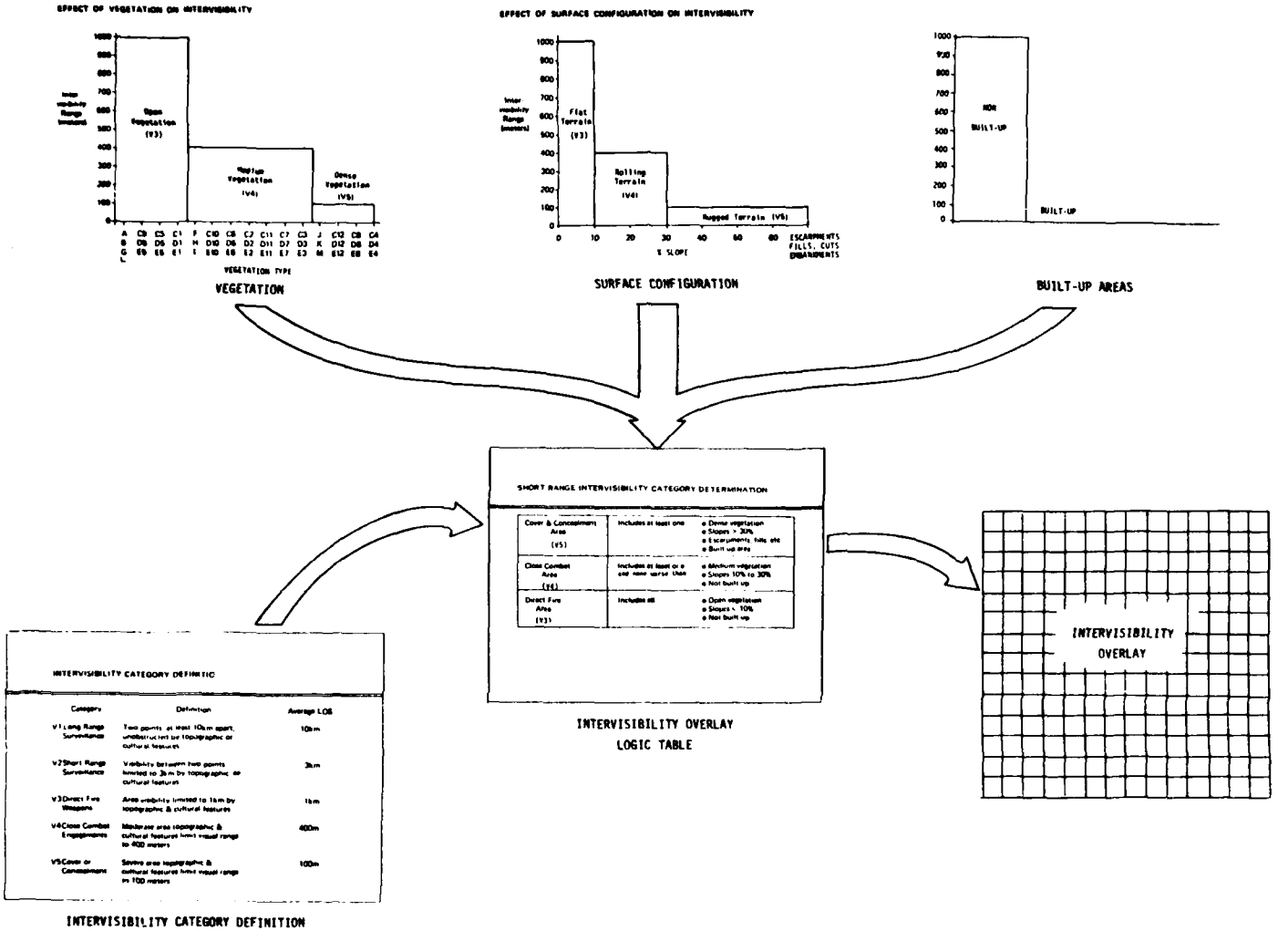


Figure 3.1.2-17. Intervisibility Overlay Build

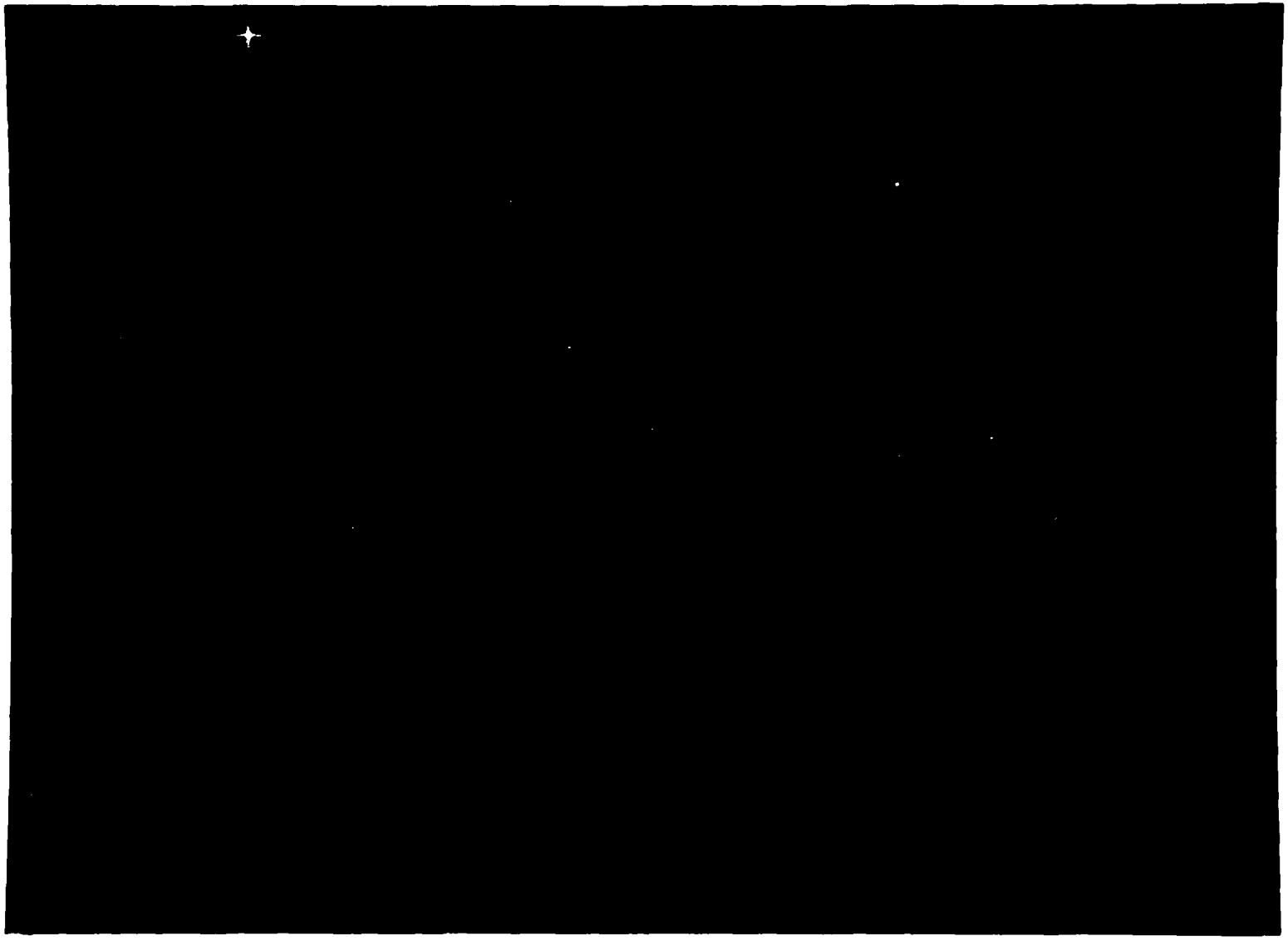


Figure 3.1.2-18 Example — Intervisibility Overlay

- Input weather/season effects as discussed in Section 3.1.2.1. (Note that it is not necessary to perform this operation each time an intervisibility overlay is to be built.)

- The analyst through the graphic terminal shall select the area of interest and the function to be performed, e.g., display intervisibility overlay for selected area.

- The computer shall modify the stored terrain data codes into appropriate IPB(A) intervisibility codes using the weather factor tables as defined by operator inputs.

- The computer logically combines the surface configuration intervisibility factor with the vegetation intervisibility factor with the built-up area intervisibility factor. With this done, the intervisibility factor for that 500 meter square is determined.

- Depending on the value determined, the 500 meter square is rated as Cover and Concealment, Close Combat or Direct Fire.

- This process shall be repeated by the computer for the total area selected by the analyst. It shall be stored in a working file and graphically displayed when desired. On a 19-inch diagonal CRT, at a scale of 1:50,000, an area of 15 km x 20 km can be displayed utilizing 1,200 intervisibility blocks.

Intervisibility Corridors

The construction of the intervisibility corridors shall be dependent on both the military situation and line-of-site (LOS) interest. Again, the terrain source data used for the mobility and intervisibility build processes shall be used.

The determination of intervisibility corridors requires the inclusion of two factors (in addition to others previously mentioned) to each 500 meter block code: average tree height and average elevation. Average tree height is determined from vegetation data and classified into four categories: 25 meters, 12 meters, 3 meters and 0 meter. Average block elevation can be determined from the topographic map.

The process to be followed by the analyst in building an intervisibility corridor is flow charted in Figure 3.1.2-16 and includes the following steps:

- The initialization step took care of selecting appropriate terrain data as affected by weather/seasonal effects. Weather data inputs would also limit LOS as a function of atmospheric attenuation.

- The analyst, through graphic cursor and function keys, selects the area of interest, map, intervisibility overlay, indicates the desired LOS direction, and locates the vantage point.

- The system automatically computes the intervisibility corridors and presents a graphic display like that shown in Figure 3.1.2-19. In the figure, the very dense green dot pattern represents the areas which are masked from observation from the selected vantage point by intervening terrain. Those unmasked pattern blocks, then, are visible to the observer and constitute the intervisibility corridors.

In making the calculation, the observer's field of view is considered unlimited unless/until obstructed due to intervening terrain elevation. The observer is assumed to be at the center of the vantage point block, 3 meters above the average terrain elevation of the block.

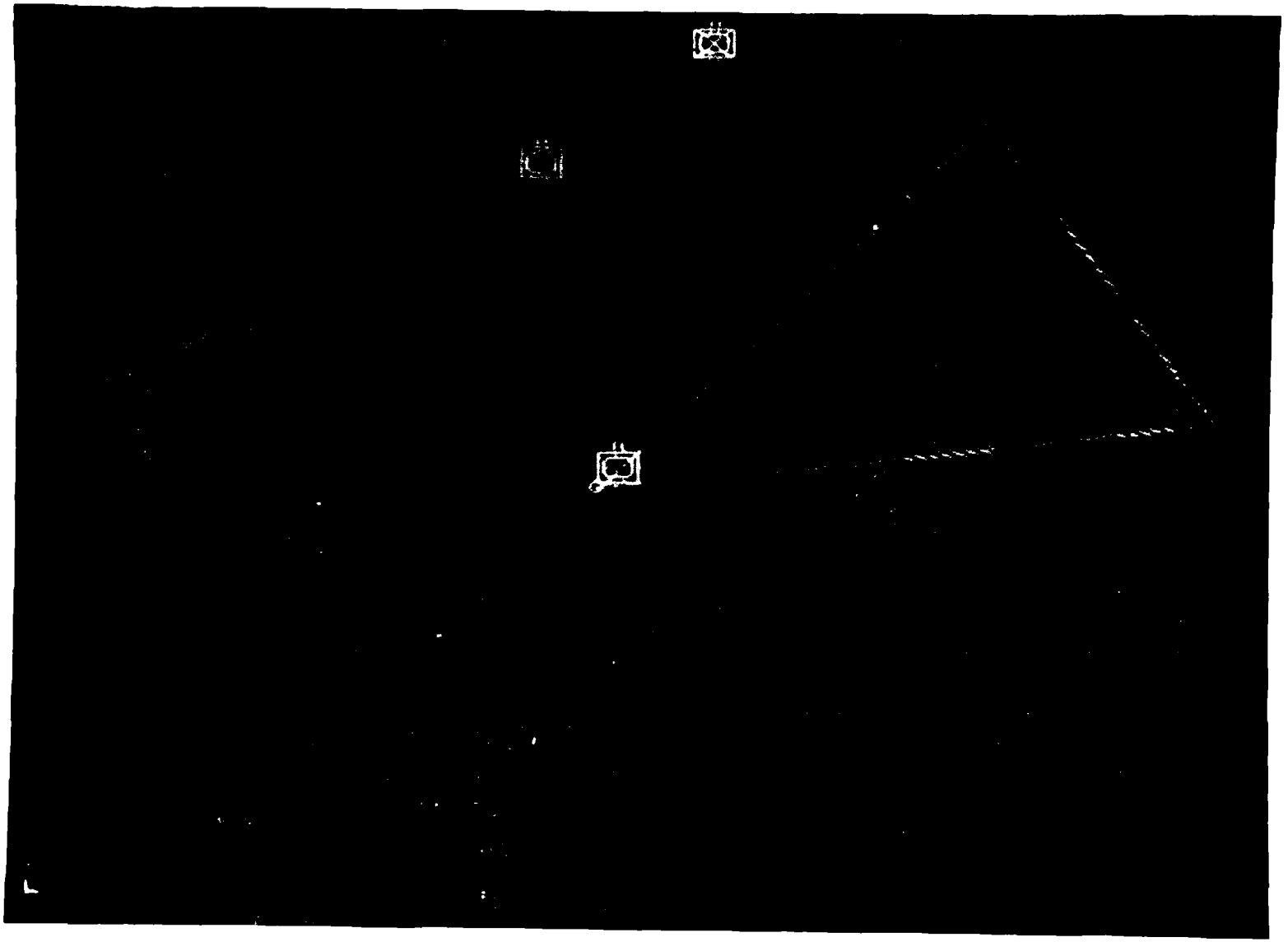


Figure 3.1.2-19 Example — Intervisibility Overlay and Corridor

When an area is blocked due to elevation, the original intervisibility overlay pattern is replaced by the most dense pattern. If no elevation blockage occurs, the original intervisibility overlay pattern remains.

Figure 3.1.2-20 illustrates the elements of the problem. For positive elevation angles to the observed area, an intervening block can mask the observed block if the elevation angle to the intervening block can mask the observed block if: (1) the elevation angle to the intervening area is negative in value and has a smaller absolute value than the absolute value of the elevation angle to the observed area, or (2) has a positive elevation angle. The convention used for elevation angles is: positive if above the horizontal and negative if below the horizontal. The angle would be calculated as follows:

$$\text{elevation angle} = \arctan\left(\frac{A + B - C}{D}\right)$$

where, A = average tree height of intervening areas
B = average ground elevation of intervening or observed area
C = average ground elevation of observer area plus 3 meters
D = distance from center point to center point of the two blocks under consideration

Development of an intervisibility corridors overlay involves the calculation of elevation angles between the observer and all intervening blocks in the defined area and then comparing these elevation angles to determine where masking by intervening blocks takes place.

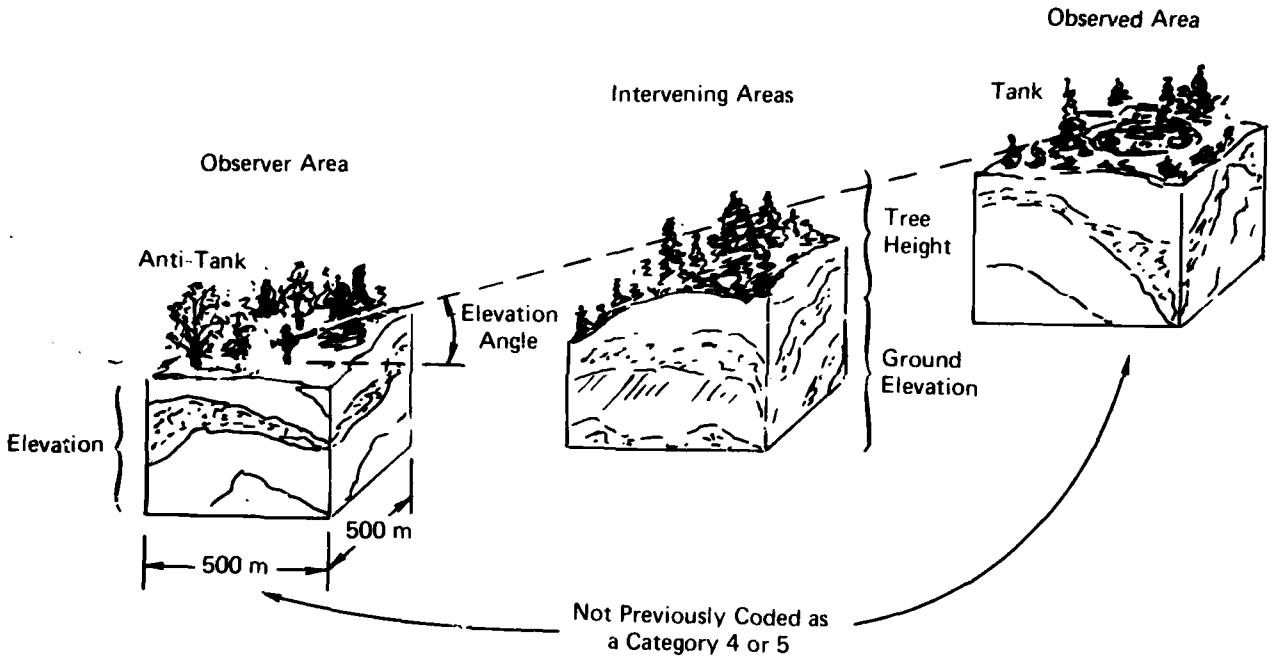


Figure 3.1.2-20. Intervisibility Corridor Determination

3.1.2.2.4 Route Timing Calculation and Display

To perform route timing, the analyst shall input the three parameters listed below. Map scale (1:50,000 or 1,250,000) shall be included as part of the map record and shall not be a required input. Then, using the graphic cursor and the previously defined mobility corridor, the analyst shall trace a vector across the corridor to be traversed. Upon completion of the trace the computed times shall automatically appear. Figure 3.1.2-21 is a photograph of a graphic display showing the calculated Arrival Times for two routes computed by two different methods: incremental and cumulative. The IPB system shall also compute cumulative and incremental Pass Times. The following are definitions of terms pertinent to an explanation of the process:

- Arrival Time - the time the head of the column and the unit being measured reaches a designated point, line or object

- Pass Time - the time between when the first element of the unit being measured passes a given point and when the last element passes the same point

- Length of a Column - the length of roadway (corridor) occupied by a column in movement, including the gaps inside the column measured from the front to the rear, inclusive.

The three input parameters of category, class and mode, are described in the following subparagraphs:

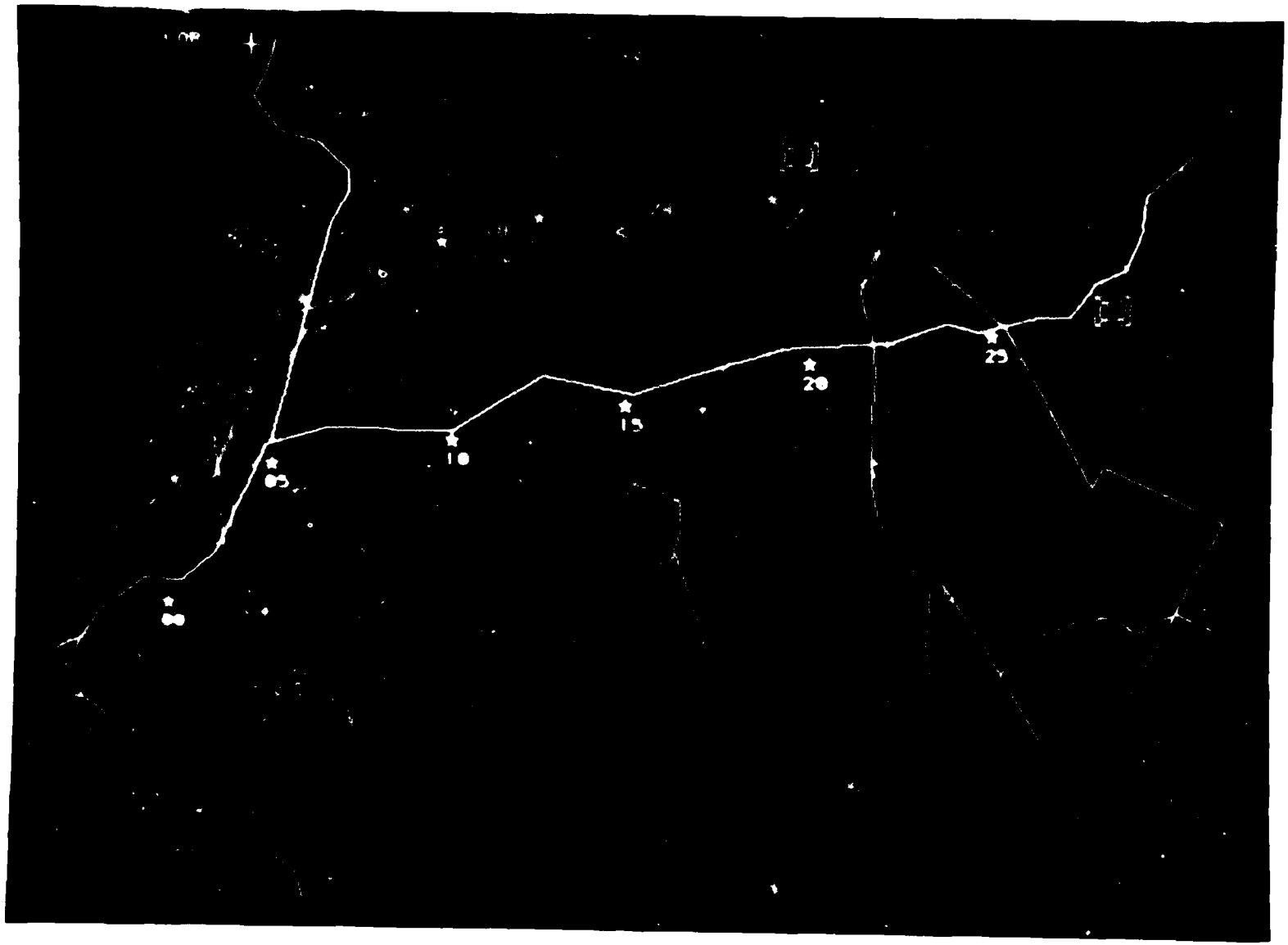


Figure 3.1.2-21 Route Timing

1. Category - The analyst shall select category as either roads or crosscountry. The doctrinal speed of a unit on a road is different from the doctrinal speed for crosscountry movement. Category is determined by visual inspection of the corridor.

2. Class - The mobility category (color) of the element being timed. For road corridors there are five classes: white, green, cyan, yellow, magenta. For crosscountry corridors there are four classes: green, cyan, yellow, magenta.

   Class is also determined by visual inspection of the corridor. The corridors shall be monochrome, coded at the lowest rated color for similar categories.

3. Mode - One of four time modes shall be selectable by the analyst:

   Mode 1 = Incremental Pass Time
   Mode 2 = Incremental Arrival Time
   Mode 3 = Cumulative Pass Time
   Mode 4 = Cumulative Arrival Time

   Pass versus Arrival time designates the method of calculation by the system.

   Pass times shall be calculated as:

$$T_p = \frac{(A + B)}{C} \qquad (1)$$

Arrival times shall be calculated as:

$$T_A = \frac{A}{C} \qquad (2)$$

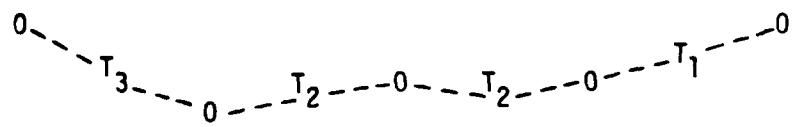
Where, A = Length of road segment to be traversed by unit (km)

B = Doctrinal column length of unit (km)

C = Speed of travel (km/hr)

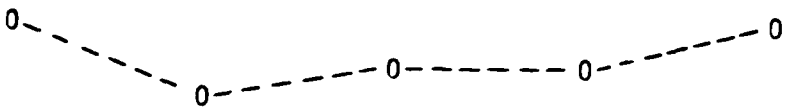
Incremental versus Cumulative time characterizes the data to be displayed.

Incremental Time - In this mode, the analyst shall designate time point positions through cursor placement and position entry. When two time points have been entered, the time to move between the two points shall be calculated and displayed midway between the points.

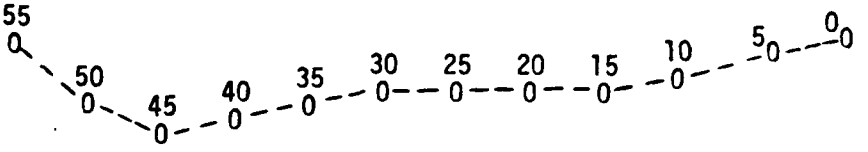


$T_1 \neq T_2 \neq T_3$

Cumulative Time - For this mode, the course shall be traced as in the Incremental time mode.



However, upon completion of the course trace, the input course trace positions shall be deleted from the display and the course shall be divided into equal time increments and the time shall be placed in close proximity to the time symbol.



Default values for the time increments, as a function of scale shall be included. However, for greater flexibility, the operator should also be able to manually select values, e.g., 5 min, 10 min, 15 min, 30 min.

It should be noted that Echelon is not a required initialization parameter. The timing computation is based on the fact that for cross-country movement, a green corridor is equivalent to 12 km per hour, cyan corridor equivalent to 6 km per hour, yellow is 3 km per hour, magenta is 1 km per hour and red is zero. Further, the color of the corridor is based on the echelon travesing the corridor. Since, a green corridor for battalion may be a different rate for a different echelon, and since the analyst input the corridor color, timing implicitly accounts for echelon.

3.1.2.3 IPB Template Products

There are 10 IPB templates or matrixes which are to be created using basic input data and the IPB system capabilities. They are:

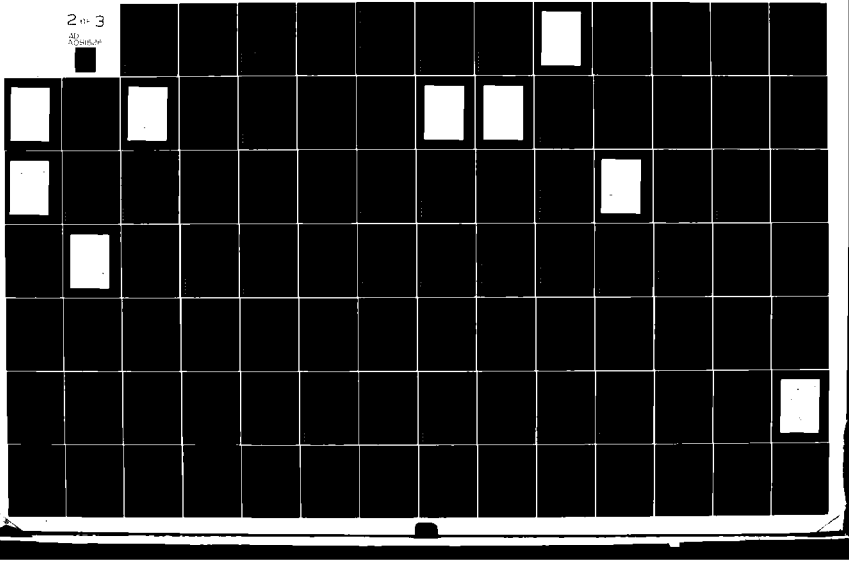
- Planned Routes
- Snapshot lines
- Snapshots
- Situation templates
- Event matrixes
- Event templates
- Target analysis matrixes
- Target templates
- Decision alternative templates
- Decision support templates

The following subsections describe which software functional capabilities are required, how these capabilities are used by the IPB analyst and contain an example of that IPB product.

3.1.2.3.1 Planned Routes

Figure 3.1.2-22 shows the software support required to build planned routes. The basic inputs to this function are the current situation display and the doctrinal template(s) for enemy option(s). Using these items with maps and terrain data the IPB analyst determines the most logical routes (of advance) the enemy would use to reach his objectives. He does this by reviewing on the graphics CRT a merged set of overlays: a map with the current situation and one of the enemy option doctrinal templates. The purpose of this review is to determine the graphic area wherein the enemy operation will likely occur by identifying potential routes.

AD-A091 626 IBM FEDERAL SYSTEMS DIV ARLINGTON VA F/G 15/4
INTELLIGENCE PREPARATION OF THE BATTLEFIELD (AUTOMATED IPB(A), --ET
JAN 80 DAAK21-79-C-0040
UNCLASSIFIED NL



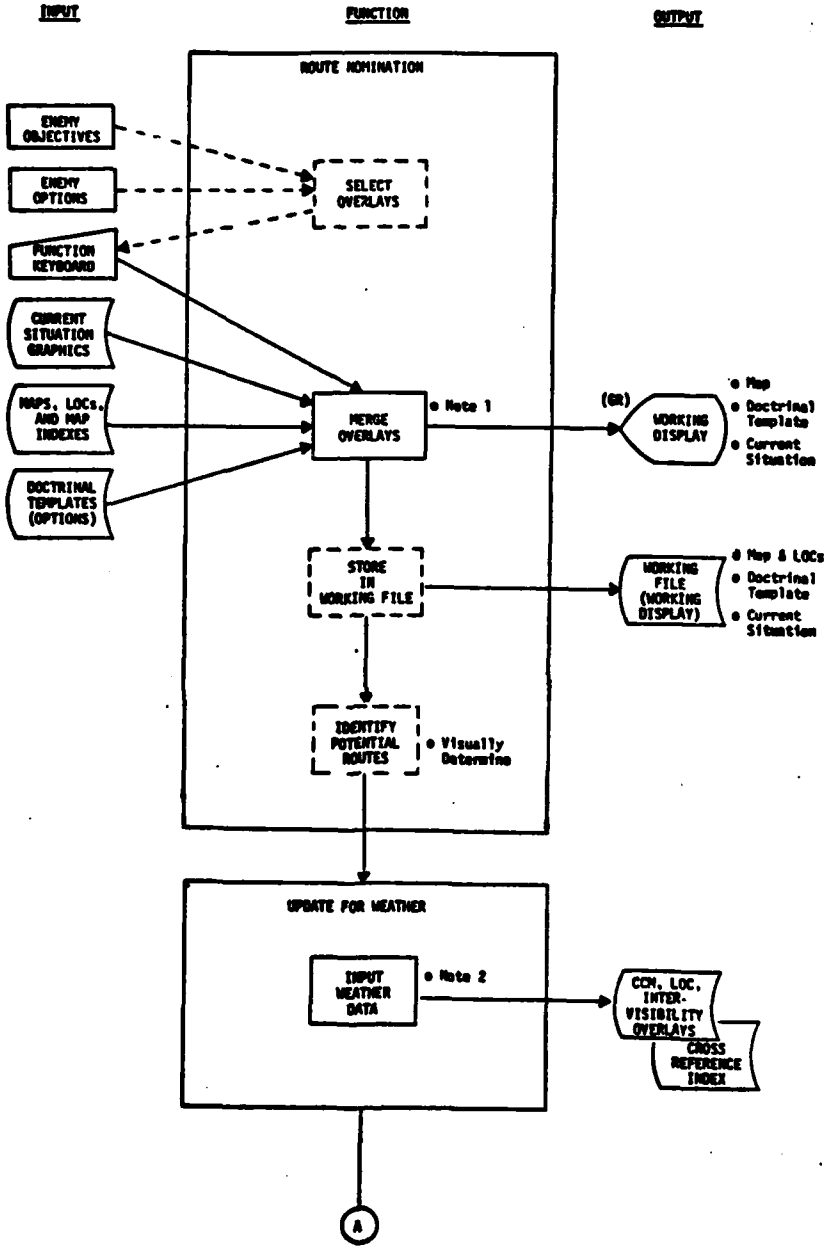


Figure 3.1.2-22. Function: Planned Routes (Sheet 1 of 4)

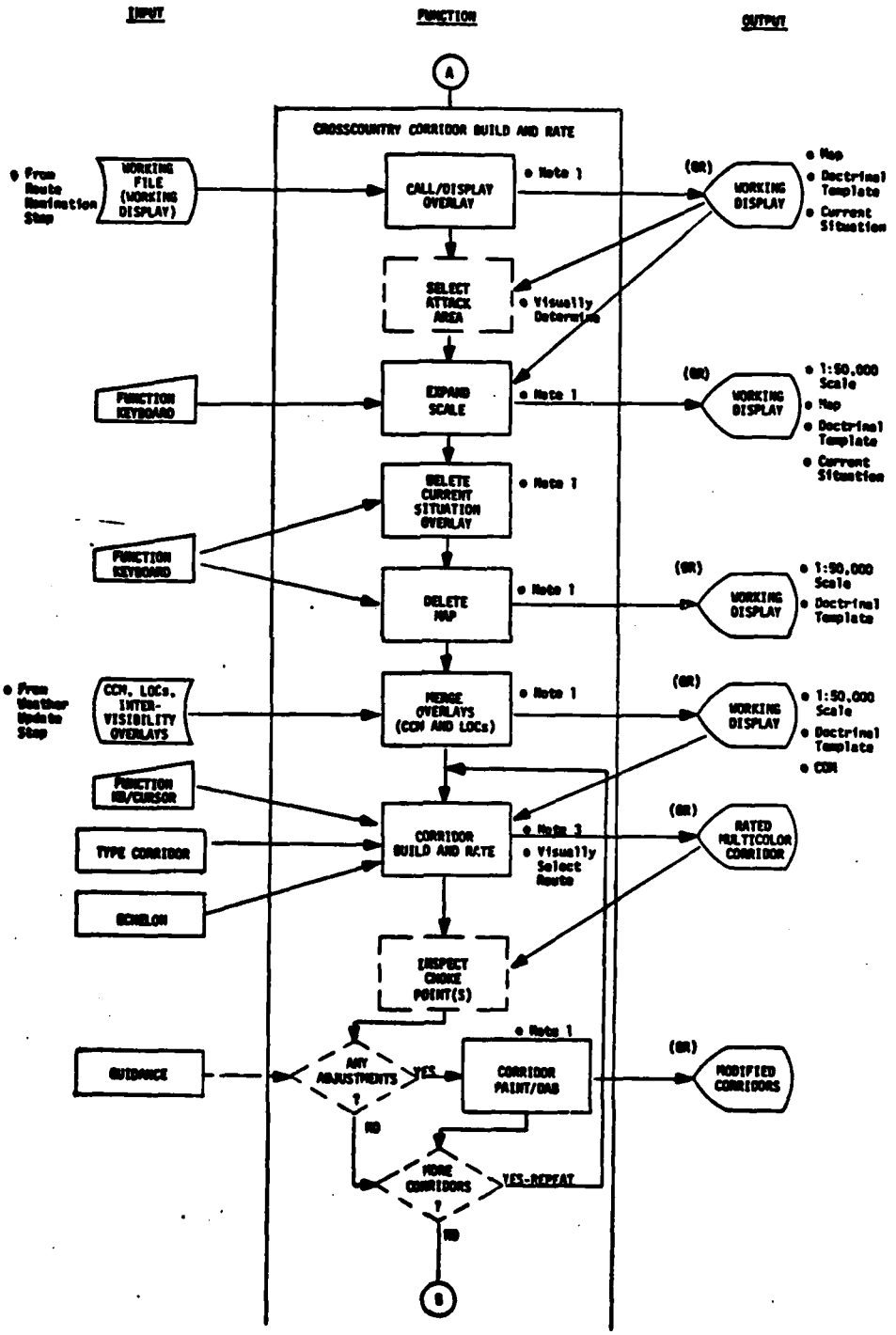


Figure 3.1.2-22. Function: Planned Routes (Sheet 2 of 4)

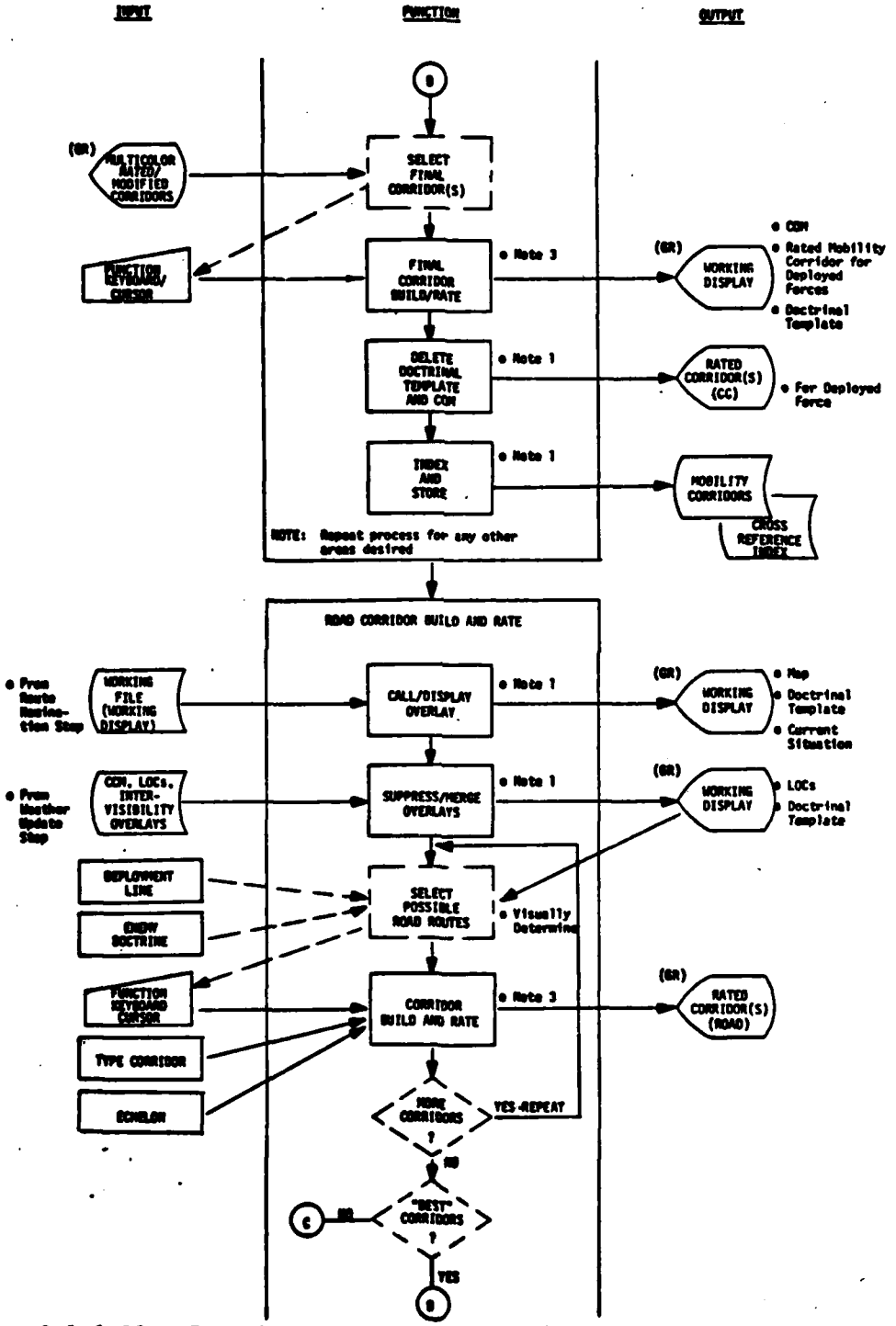


Figure 3.1.2-22. Function: Planned Routes (Sheet 3 of 4)

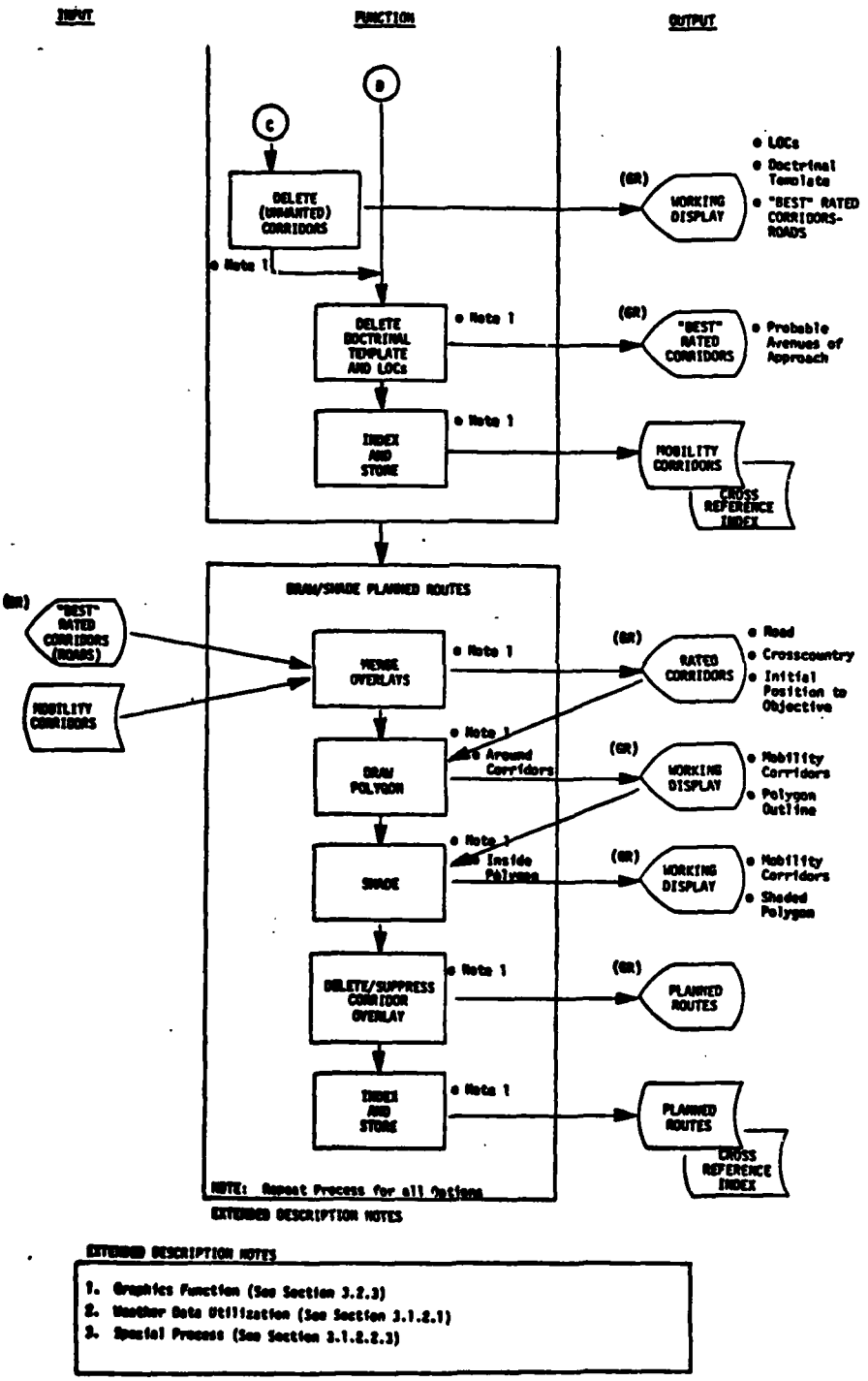


Figure 3.1.2-22. Function: Planned Routes (Sheet 4 of 4)

The next subfunction begins with the IPB analyst calling up an A/N menu of formats and selecting from it the format for applying weather conditions to mobility. Figure 3.1.2-23 is an example of the first menu and Figure 3.1.2-24 is an example of a weather input format. The purpose of this subfunction is to ensure the appropriate weather conditions are used in mobility analysis. The IPB analyst interactively chooses mobility and intervisibility conditions wihtin the areas encompassing the potential routes using menus, light pen and/or keyboard and latest weather forecasts (see Section 3.1.2.1 for details). Once the appropriate conditions have been specified, the CCM computation algorithm prepares the CCM, LOC and COM. The intervisibility overlay can also be prepared at this time. These can be viewed on the graphic CRT and are stored for later use.

Next the corridor painting and rating process is used to determine the best road and crosscountry corridors for that enemy option. Then the system graphic function software for shading polygons is employed to color code the corridors superimposed upon the map of the area. The resultant product--Planned Routes--can be viewed and stored on a work file for later use. Figure 3.1.2-25 is an example of a completed Planned Routes scene. It is overlayed on a 1:250,000 scale map and depicts the optimum routes for advance of two enemy second echelon divisions to execute a double envelopment option.

3.1.2.3.2 Snapshot Lines

The snapshot lines build function is depicted in Figure 3.1.2-26. Its purpose is to determine those key points in each option where snapshots will be developed. It results from merging the situation with doctrine and terrain in the area of interest.

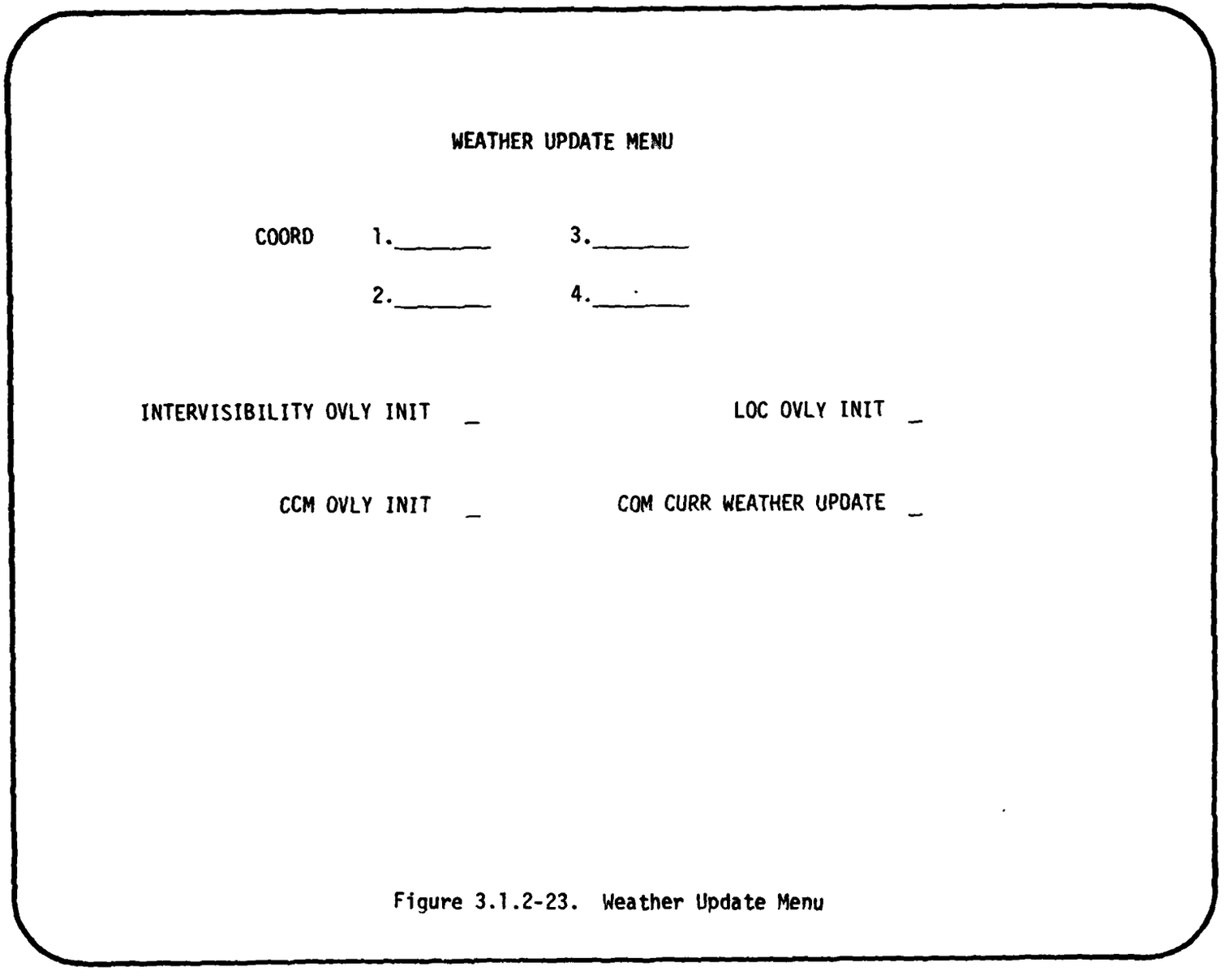


Figure 3.1.2-23. Weather Update Menu

CCM OVERLAY INITIALIZATION MENU

LAST INIT. TIME ____ DATE __-__-__

FLOOD PLAIN CONDITION

STATE OF GROUND	FLOODING	NON-FLOODING	SNOW DEPTH	
DRY	_	_	TRACE TO 12.7CM	_
WET	_	_	12.7 TO 25.4CM	_
SATURATED	_	_	25.4 TO 50.8CM	_
FROZEN	_	_	50.8 TO 76.7CM	_
SNOW COVERED	_	_	> 76.2CM	_

SELECT I/V MENU _ LOC MENU _ COM MENU _ NAI MENU _

Figure 3.1.2-24. CCM Overlay Initialization Menu

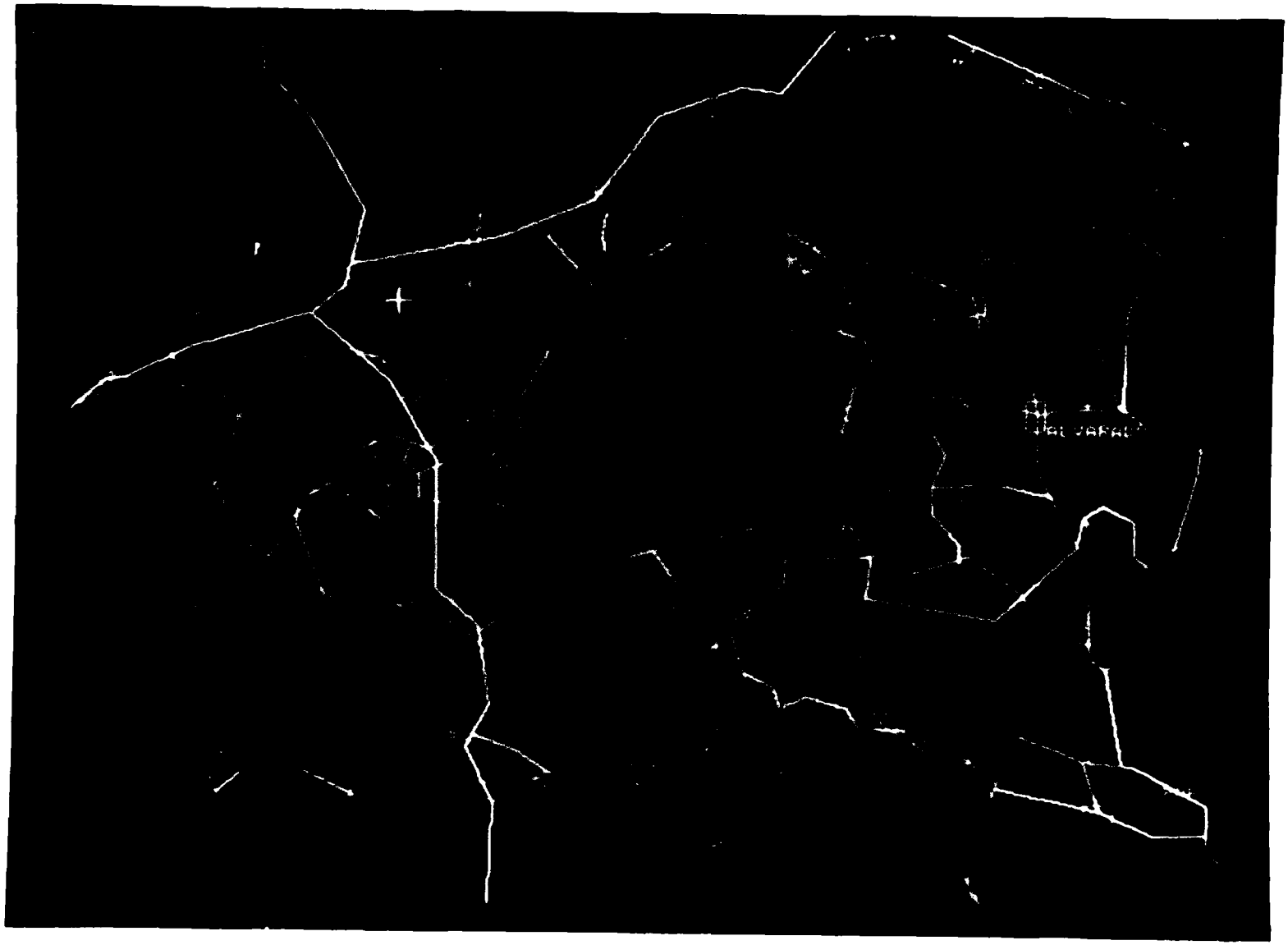


Figure 3.1.2-25 Planned Routes Example

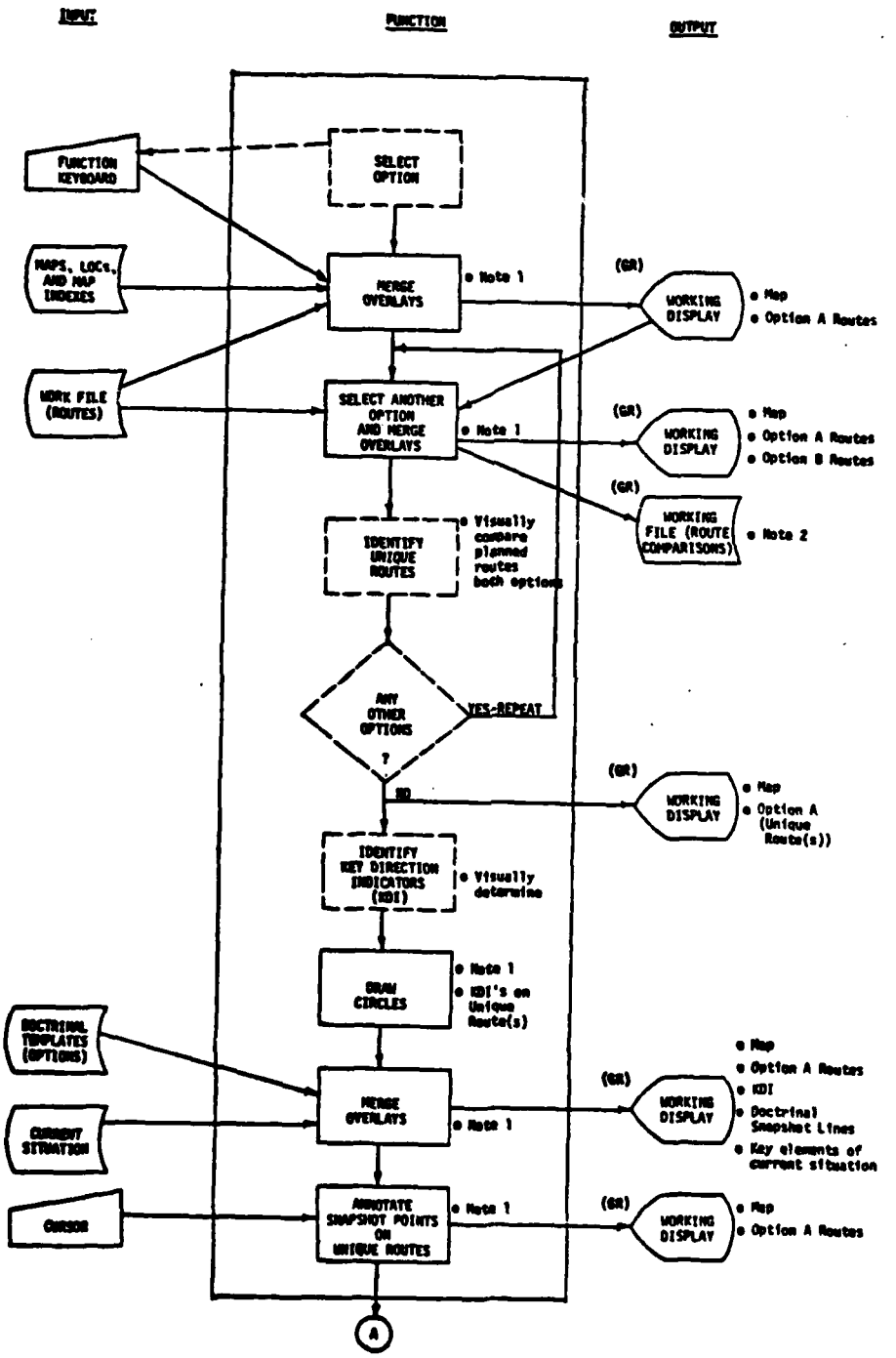


Figure 3.1.2-26. Function: Snapshot Lines (Sheet 1 of 2)

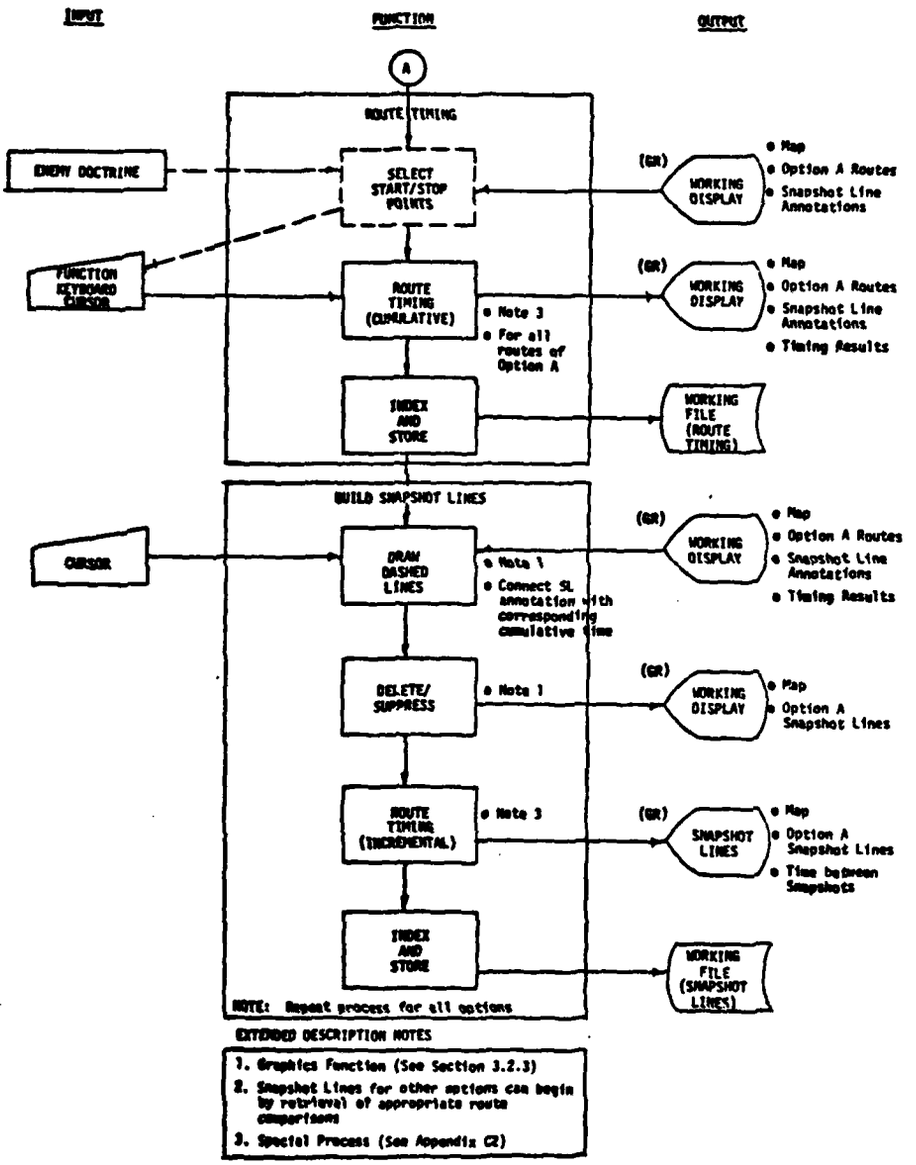


Figure 3.1.2-26. Function: Snapshot Lines (Sheet 2 of 2)

The IPB analyst selects the enemy option for which he wants to develop snapshots. Through the function keyboard he selects the planned routes overlay for that option and an appropriate map background. With this composite display on the graphic CRT he also merges the planned routes overlay for other enemy options (in a different color) one at a time. The two-color display permits the analyst to determine visually which portions of the selected option are unique to it. At the same time he can identify visually any key direction indicators (turns) on that unique route which would aid in determining if the enemy were executing that option. These indicators are marked on the display by drawing circles at those geographic locations. The analyst next calls the doctrinal option template for the selected option from the doctrinal template file and merges this template on the graphic CRT. (The analyst may use system graphic functional capabilities to suppress certain portions of the display to reduce clutter, if necessary.) The doctrinal template is positioned by superimposing its focal point with the corresponding point on the display and setting its direction to fit the display.

Since uniqueness is a key criterion for snapshots, the unique route(s) for the selected option are the basis for the next step. The analyst uses the Annotate functional capability to mark positions on the unique route(s) where snapshots are desired. This process is done by visually adjusting the doctrinal lines to the terrain and the key elements of the current enemy situation. The geographic locations along the key route in that option at which snapshots should be plotted have now been determined.

Next the analyst must work out where other enemy force elements within that option should be plotted on each snapshot. To do this the analyst employs the functional capability to do Route Timing (see Section 3.1.2.2.4). He will normally accomplish route timing beginning

at the line of contact and working rearward toward the assembly areas, or known enemy unit locations. This procedure is based on enemy doctrine that attacking forces will attempt to reach line of contact simultaneously. On the unique route the analyst utilizes the cumulative capability of the Route Timing algorithm. Then he applies the same capability to the other route(s) in that option. The display which contains the results of the route timing algorithms is stored on the working file.

The IPB analyst next assembles a display on the graphic CRT which consists of a map background, the planned routes for the option being considered, the snapshot line annotations and the cumulative route timing results. He uses the system graphic function draw dashed lines and connects the time associated with the snapshot line annotations on the unique route with the same times on the other route(s) in that option. Once all snapshot lines have been drawn the display may be de-cluttered by suppression/deletion of the time results and the planned routes.

The last step is to again use the route timing algorithm to develop the elapsed time between snapshots. The analyst utilizes the incremental capability of the route timing algorithm, marking the snapshot lines as the points for timing computation. The resulting display is indexed and stored on the working file.

Figure 3.1.2-27 is an example of the completed snapshot lines overlay as stored in the IPB analyst's file. The process is repeated for each enemy option.

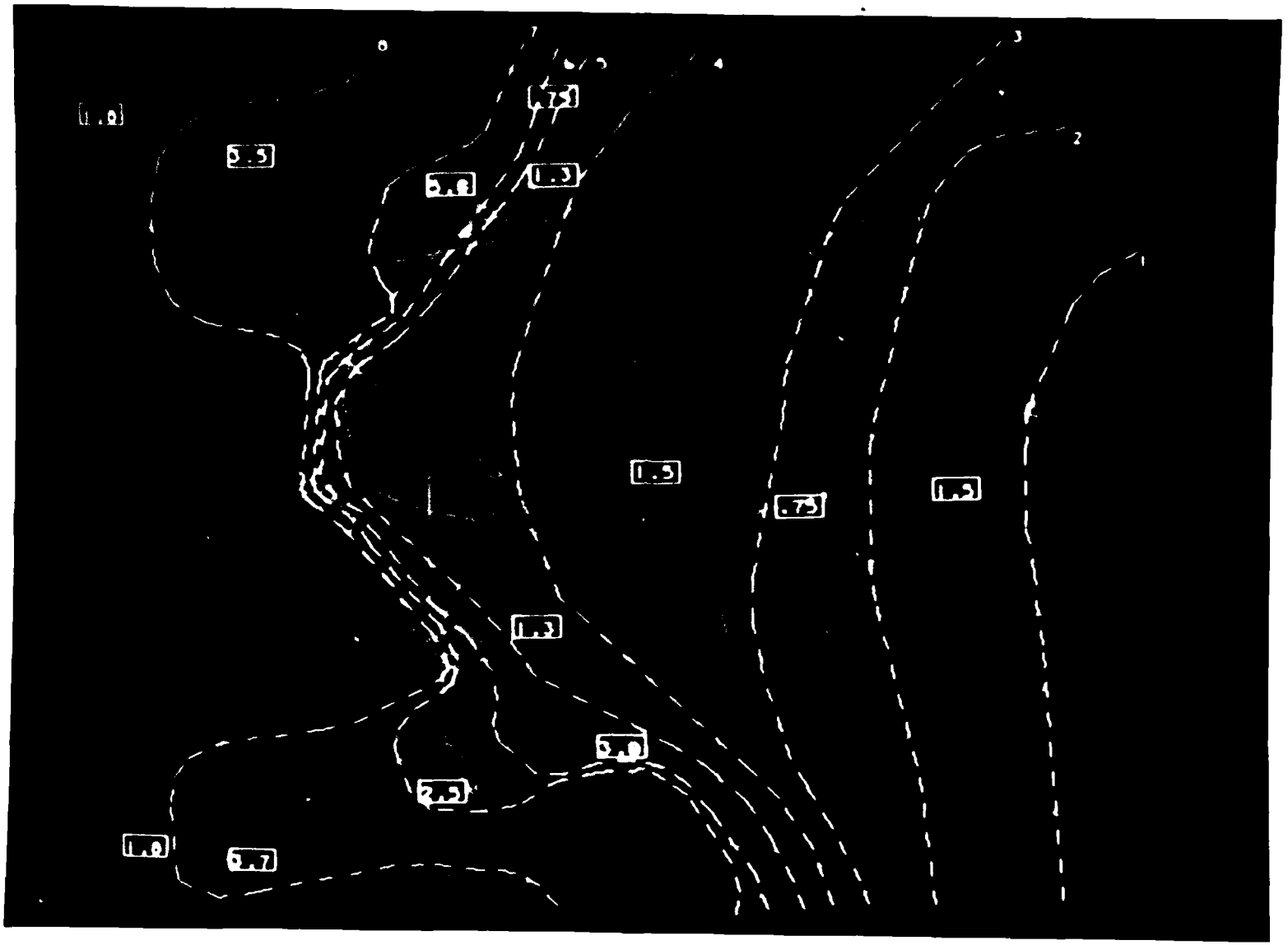


Figure 3.1.2-27 Snapshot Lines Example

3.1.2.3.3 Snapshots

Figure 3.1.2-28 is a representative snapshot at 1:250,000 scale. Each situation snapshot is a graphic of postulated overall enemy unit locations at an instant in time in a single option on analyzed terrain. Some 5 to 8 snapshots along mobility corridors are prepared to represent the execution of one option from inception to objective.

Figure 3.1.2-29 diagrams the building of one snapshot, snapshot A2. Working from his knowledge of enemy options and from examination of the Option A Planned Routes and Snapshot Lines templates, the analyst identifies the next snapshot he will build. For Snapshot A2, he selects the appropriate 1:250,000 scale LOC map; he selects the Option A Snapshot Lines template. On input key command, the system automatically merges these overlays at a selected scale. He may also merge the mobility corridors overlay associated with the planned routes on the screen as a third overlay.

The analyst begins building snapshot symbols. He overlays on the working display a doctrinal template of a regiment in road column formation. He aligns the main body lead symbol of the doctrinal template with the intersection of the A2 snapshot line and the mobility corridor. He reorients the doctrinal template to the direction of overall movement. Then he builds the unit symbols which are to be a part of the overall template. He repeats this process on each corridor. To place additional units which are attached from higher echelons, he overlays division slice doctrinal templates. He proceeds in this manner to build, symbol by symbol, a representation of the entire force defined in this option and course of action.

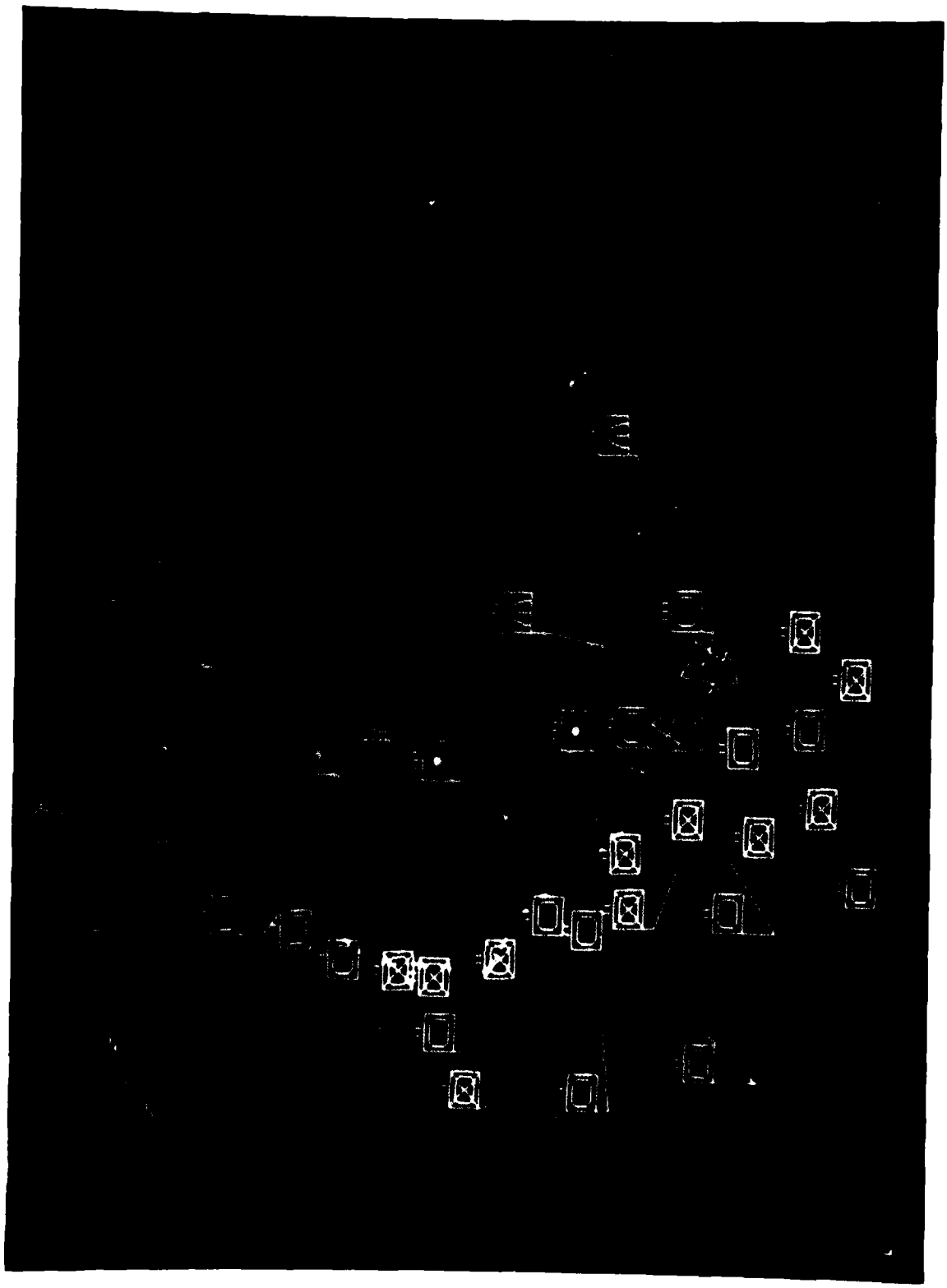


Figure 3.1.2-28 Snapshot Example

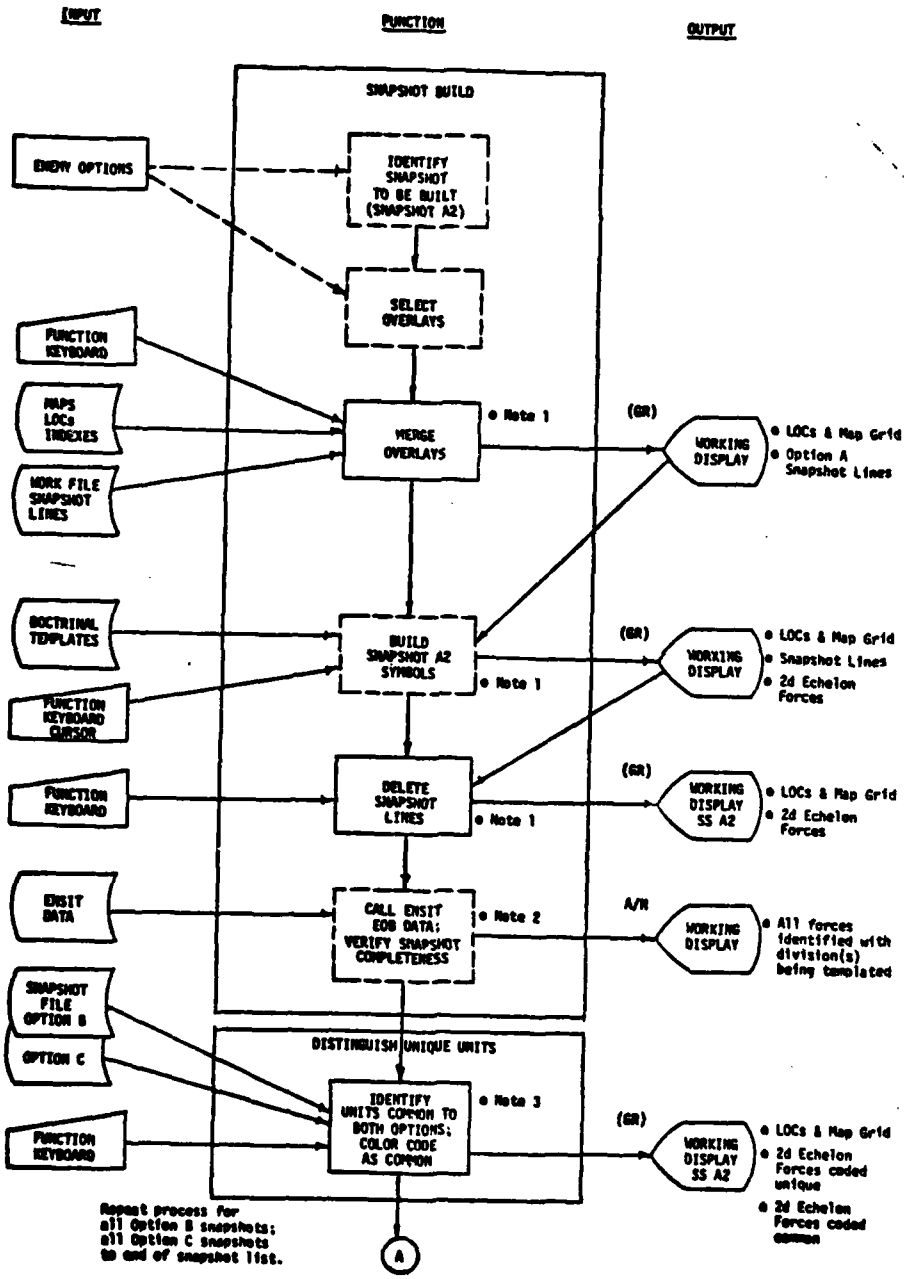


Figure 3.1.2-29. Snapshot Build Process (Sheet 1 of 2)

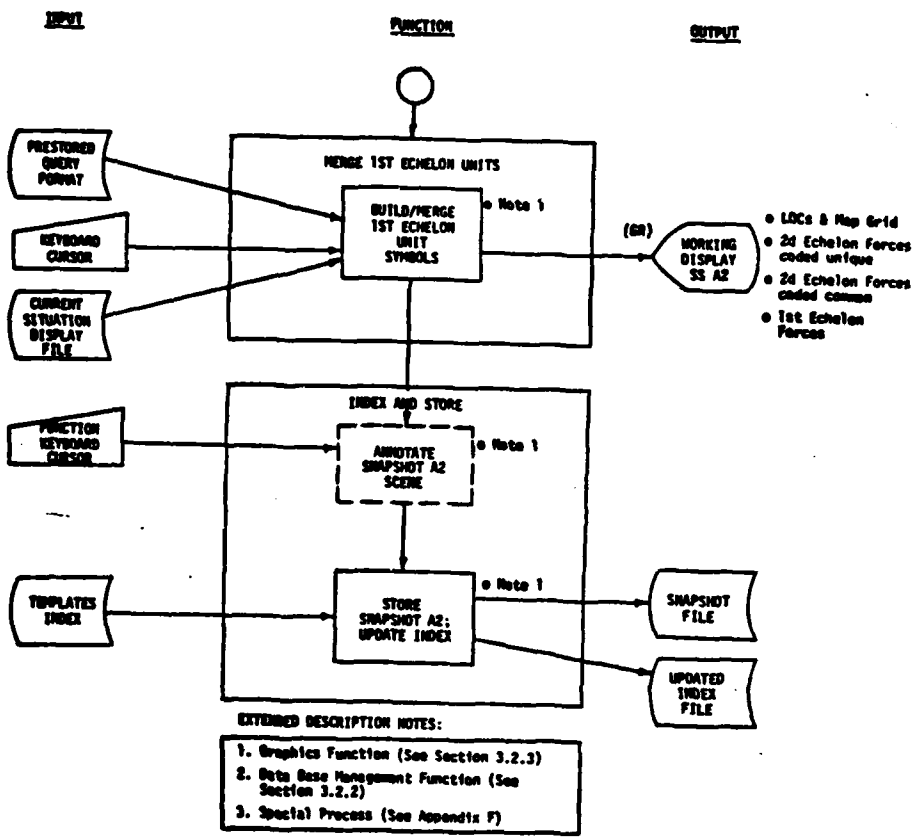


Figure 3.1.2-29. Snapshot Build Process (Sheet 2 of 2)

He can next call on the tabular screen sets of EOB data to assist in verifying that he has accounted for all units. If EOB units are missing from the working display, he adds them to the template picture, deriving their positions from division and regimental slice templates and/or from his knowledge of enemy fighting doctrine which may be supplemented by non-automated support files.

At the point when all snapshots are built for all options, the analyst next wants to identify units that are unique to this option and which therefore can be used as discriminators in separating options. Via input key control, he calls and merges, one at a time, every other snapshot, not of the same option, that has been built to deal with this enemy force as it attempts to achieve its major objective. As each comparison snapshot is merged the analyst uses the special function, Symbol Matching, which automatically finds common units (any unit on the Snapshot A2 template which is within 5 kilometers* of a unit of matching type and echelon on a different template). In this application the primary symbol(s) are those of Snapshot A2. The result is that matched A2 (primary) symbols will be re-coded (color coded) as common. When this step of the process is complete, the Snapshot A2 template shows a set of unique units in one color and a set of common units in a different color.

The analyst next wants to add to this template all current situation units reported to be in the same area. If what he has been templating is a new area of operations not previously under assault, there would be no existing units to be added. If he is templating a force such as a large reserve force which is moving into a previously

*A variable distance which can be reset by the operator.

contested area of operations, there would be existing units to be added. In the latter case, the analyst accesses the enemy portion of the current situation and merges it onto his IPB graphic screen to complete the snapshot. The analyst may now adjust individual symbols positions (but not origins) to declutter the screen.

When satisfied with the template picture, he will add pertinent military data including the line of contact, phase lines and military boundaries. He adds an identifying number and time stamp and stores the product in the system permanent file. The system automatically updates its indexes to reflect this item.

3.1.2.3.4 Situation Templates

Figures 3.1.2-30 and 3.1.2-31 are examples of situation templates at a 1:50,000 scale. Each situation template is a portion of a situation snapshot graphic highlighting those unit configurations unique to this option which enable the analyst to distinguish between this and other options. Several situation templates may be associated with one situation snapshot.

Figure 3.1.2-32 diagrams the steps in building a situation template. The analyst starts by displaying one snapshot (Snapshot A2 in this example) and determines which of the unique elements shown should be highlighted by a situation template. In response to an analyst input, the system automatically offsets and expands the selected field of view from the snapshot scale of 1:250,000 up to the 1:50,000 scale of the situation template. The system automatically transfers to the enlarged scale all LOC map details and unit symbols within that field of view.

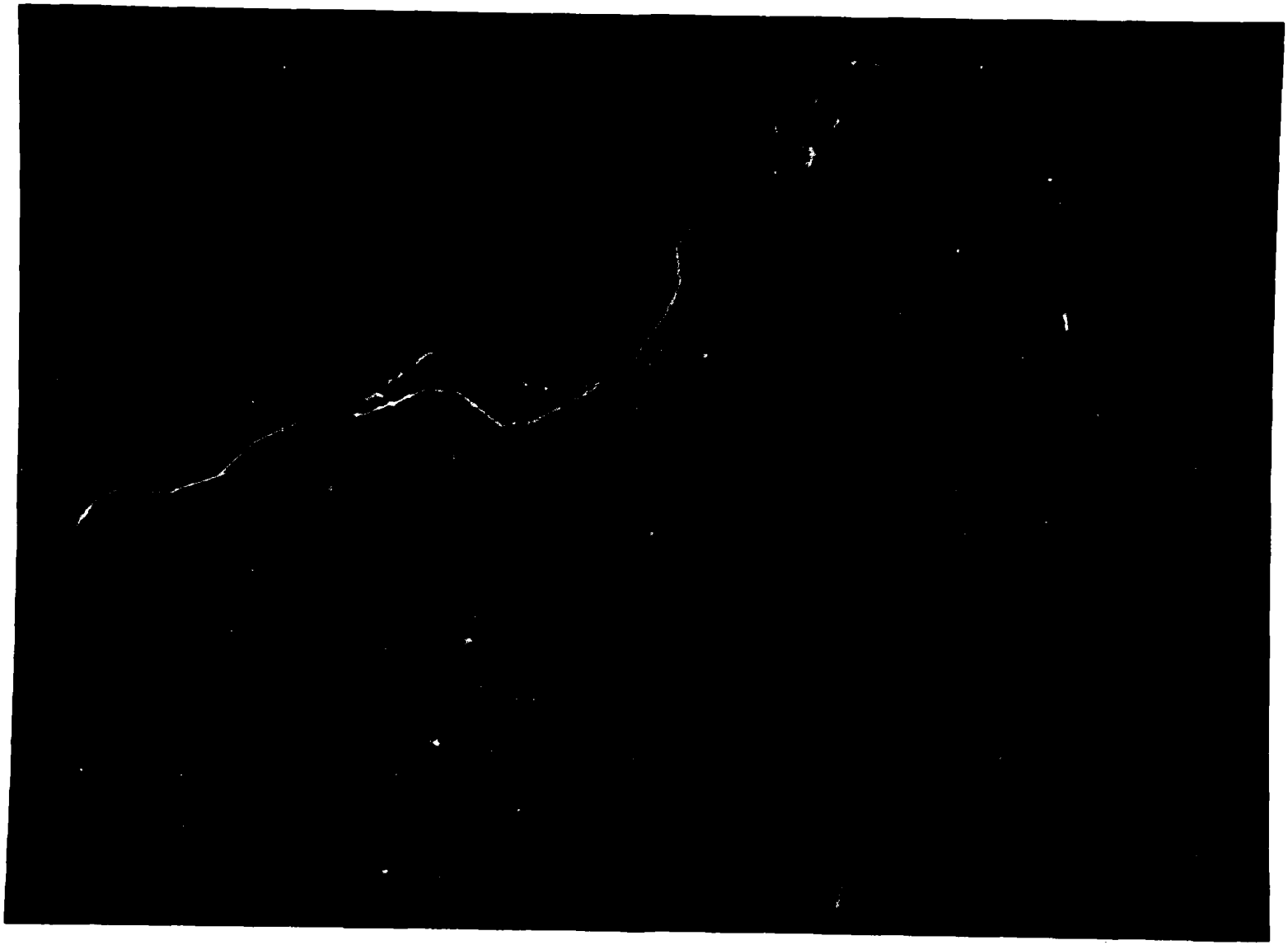


Figure 3.1.2-30 Situation Template Example Road March

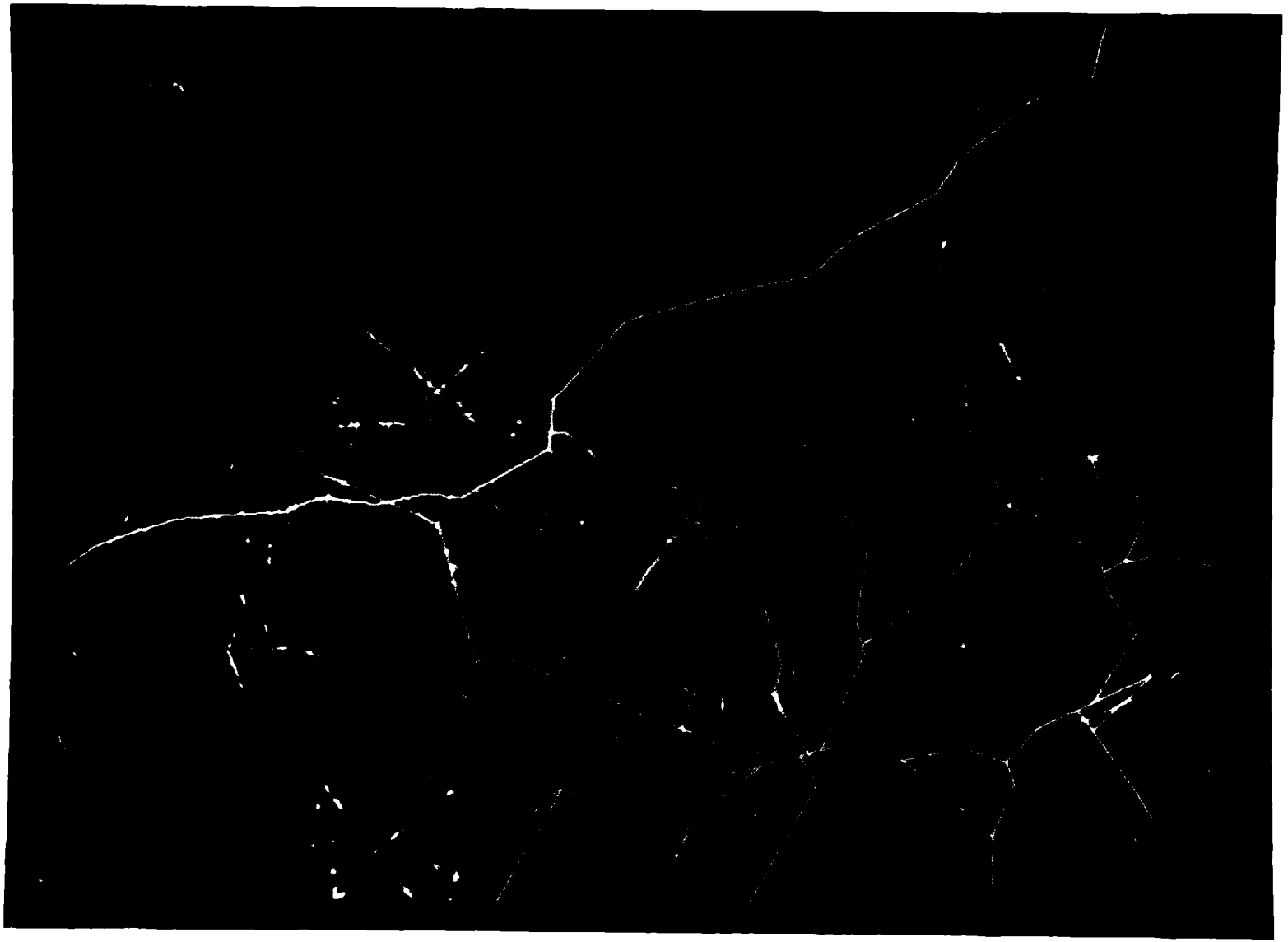


Figure 3.1.2-31 Situation Template Example — Attack Formation

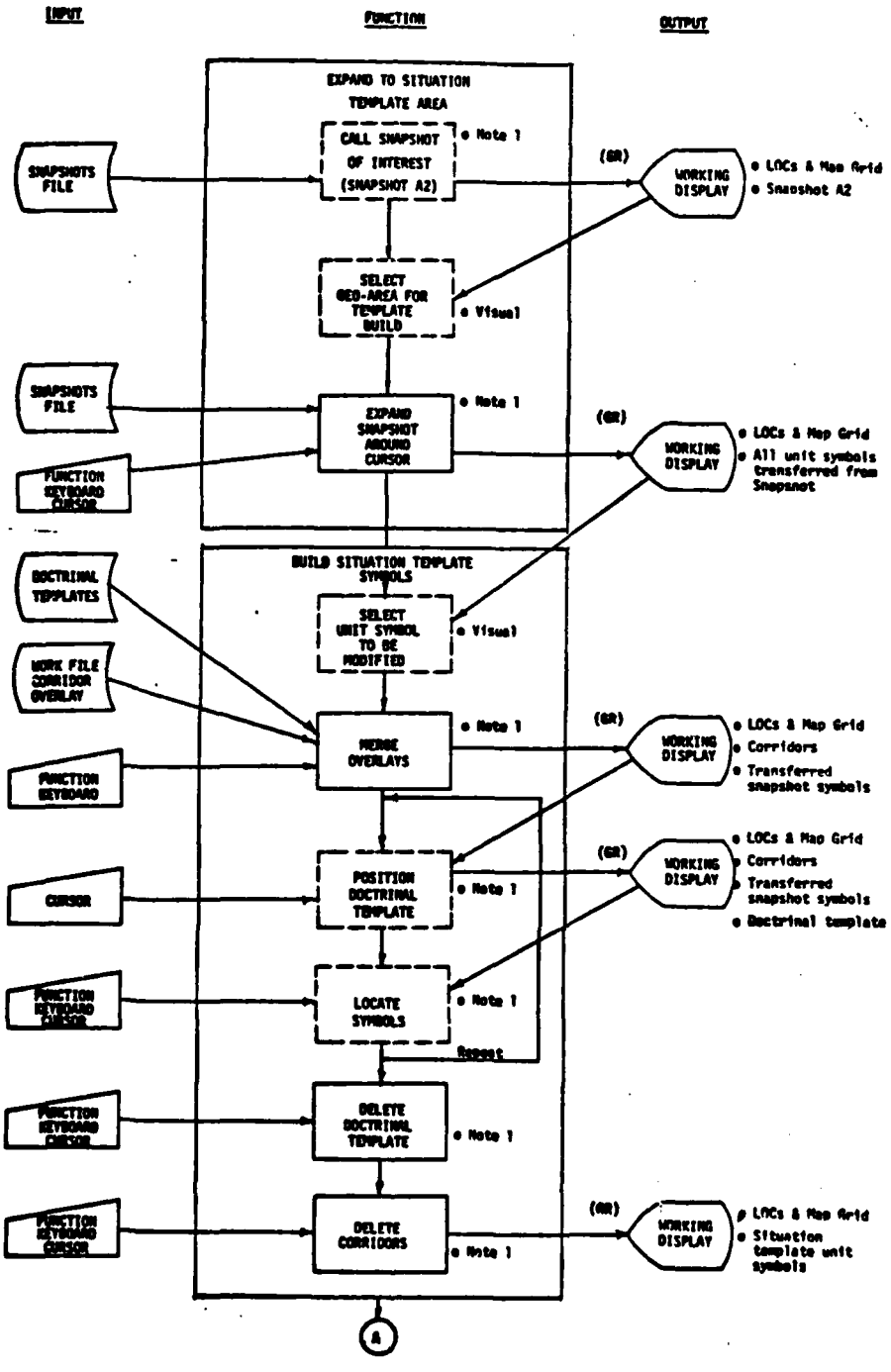


Figure 3.1.2-32. Situation Template Build Process (Sheet 1 of 2)

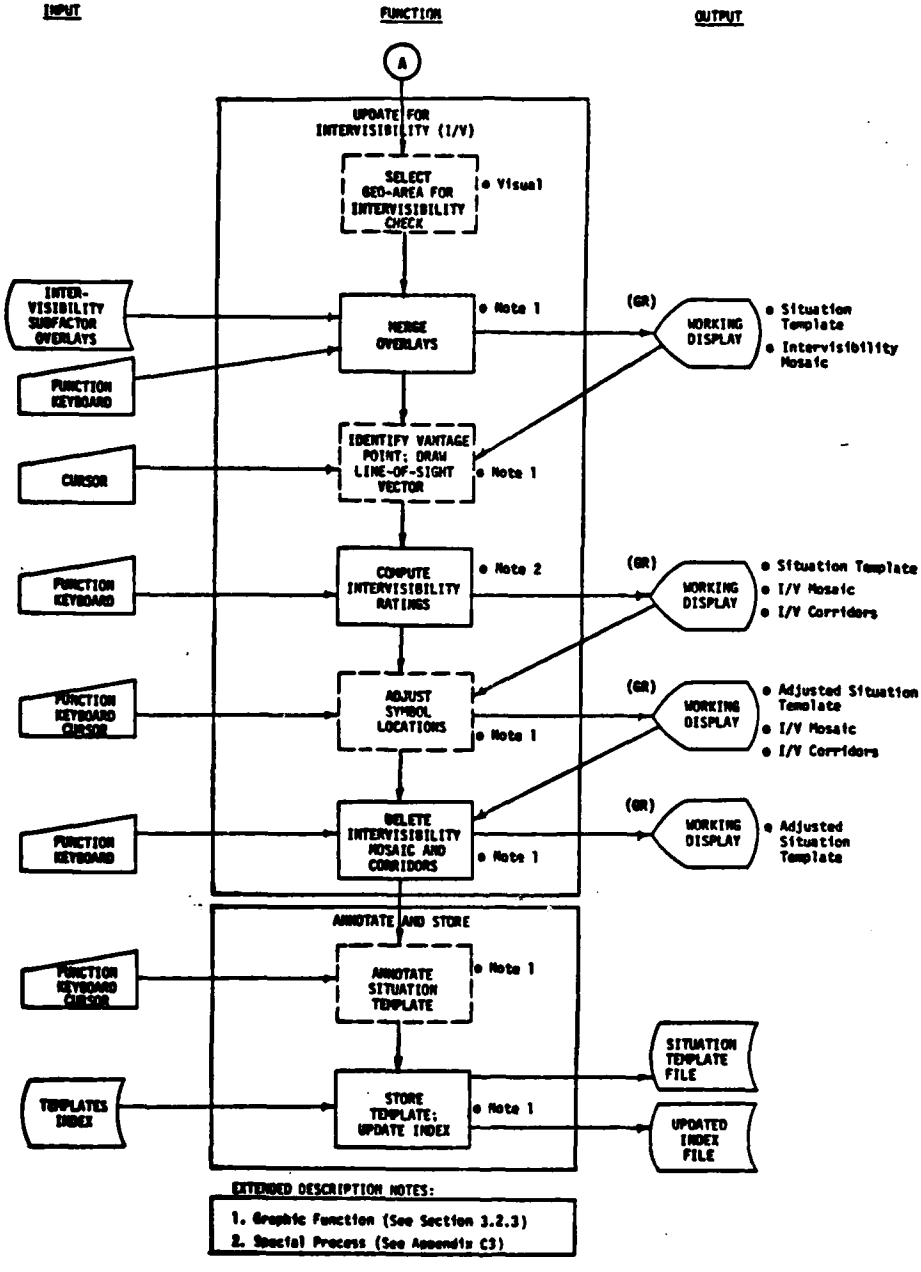


Figure 3.1.2-32. Situation Template Build Process (Sheet 2 of 2)

The analyst next will modify each symbol as required making it the desired unit and echelon representation for situation template use. He will call an appropriate doctrinal template at the 1:50,000 scale, align it with a transferred symbol and then build a new symbol to replace the regiment or battalion symbol transferred from the snapshot. In areas forward of the deployment line, he will utilize doctrinal templates depicting battalions in a regimental combat formation. On weather modified terrain, he will position battalion symbols to replace regiment symbols transferred from the snapshot. He will continue building symbol by symbol in this manner until he has an adequately detailed situation template.

He may further refine the unit positions by utilizing the ground intervisibility rating process. For any units in question, he calls and the system merges the intervisibility overlay for the area. He inputs an intervisibility rating request, indicating the desired vantage point and line-of-sight vector, and the system automatically computes and displays (in the form of color coded mosaic squares) what areas are visible from the selected vantage point. Depending upon the rating of the selected unit position, he may move the unit symbol to a better position. Upon completion of the intervisibility analysis the analyst will delete the last intervisibility corridor. The graphic CRT will now contain the fully adjusted situation template which consists of symbols which are scaled representations of maneuver forces in march route formation or deployed for combat. Unique units will be colored magenta; units which are common to more than this option will be colored red.

When satisfied with the template, he will add pertinent military data including the line of contact, phase lines and military boundaries. He adds an identifying number and time stamp and stores the product in the system permanent file. The system automatically updates its indexes to reflect this item.

3.1.2.3.5 Event Matrixes/Event Templates

An Event Matrix is a tabular list of events that immediately follow the time period represented by a Snapshot Template. It focuses on recognizable, near term activities in a time sequence. It relates each event to a geographic location by NAI (named area of interest). An Event Template graphic accompanies each Event Matrix. The graphic is a layout of event symbols on a scaled, gridded background map. Each event symbol is included within a numbered NAI circle or ploygon. The NAI number on the graphic also appears as n entry on the Event Matrix. An index is provided to cross-reference individual events, NAIs, event templates and snapshot templates.

Figures 3.1.2-33 and 3.1.2-34 are examples of an Event Matrix and an Event Template respectively.

Figure 3.1.2-35 diagrams the build process for constructing an Event Matrix and Event Template. Starting at the top of the diagram the analyst from knowledge of the option and working from the Snapshot Lines Template for that option, identifies the next Event Matrix/Event Template pair he will build. He selects overlays to be merged on the graphic screen. These will include background maps with lines of communication; snapshot templates whhich precede and follow in time sequence the Event Matrix time period; and corridor graphic overlays.

EVENT MATRIX A2

SEQ #	EVENT NAME	DESCRIPTION	HOURS	NAI	COORD
A2-1	VEH COLUMN	>25 VEH PASSING JUNCTION OF US22 & US35 (102TD/DAG)	XX	A2E1	PL475935
A2-2	VEH COLUMN	>100 VEH 25KM LONG MOVING N ON US19 TURNS NW S973 (MAIN BODY LEAD RGMT 102TD	XX	A2E4	PL720020
A2-3	VEH COLUMN	>100 VEH 25KM LONG MOVING N ON US31 TURNS NW ON S7 (MAIN BODY LEAD RGMT 203TD	XX	A2E3	PL640530
A2-4	TRACK LOSS	>25 VEH GRP MOVING NW ON RT222 (130MM RGMT DEPLYMT	XX	A2E1	PL335865
A2-5	PATROL ACTVTY	INTENSIFIED PATROL/RECCE RIVER BANKS VICINITY OF FEBA	XX	A2E2	PL325960 PL360580
A2-6	BRIDGE EQT	PONTON BRIDGE EQT ENTERS RGMT SPLY AREA W I20/US22	XX	A2E1	PL365940
A2-7	COMBAT ACTVTY	INCREASED PRESSURE TO SECURE FAR BANK OF RIVER VICINITY OF GRANBURY	XX	A2E1	PL290940
				A2E1	PL270910

Figure 3.1.2-33. Event Matrix Example

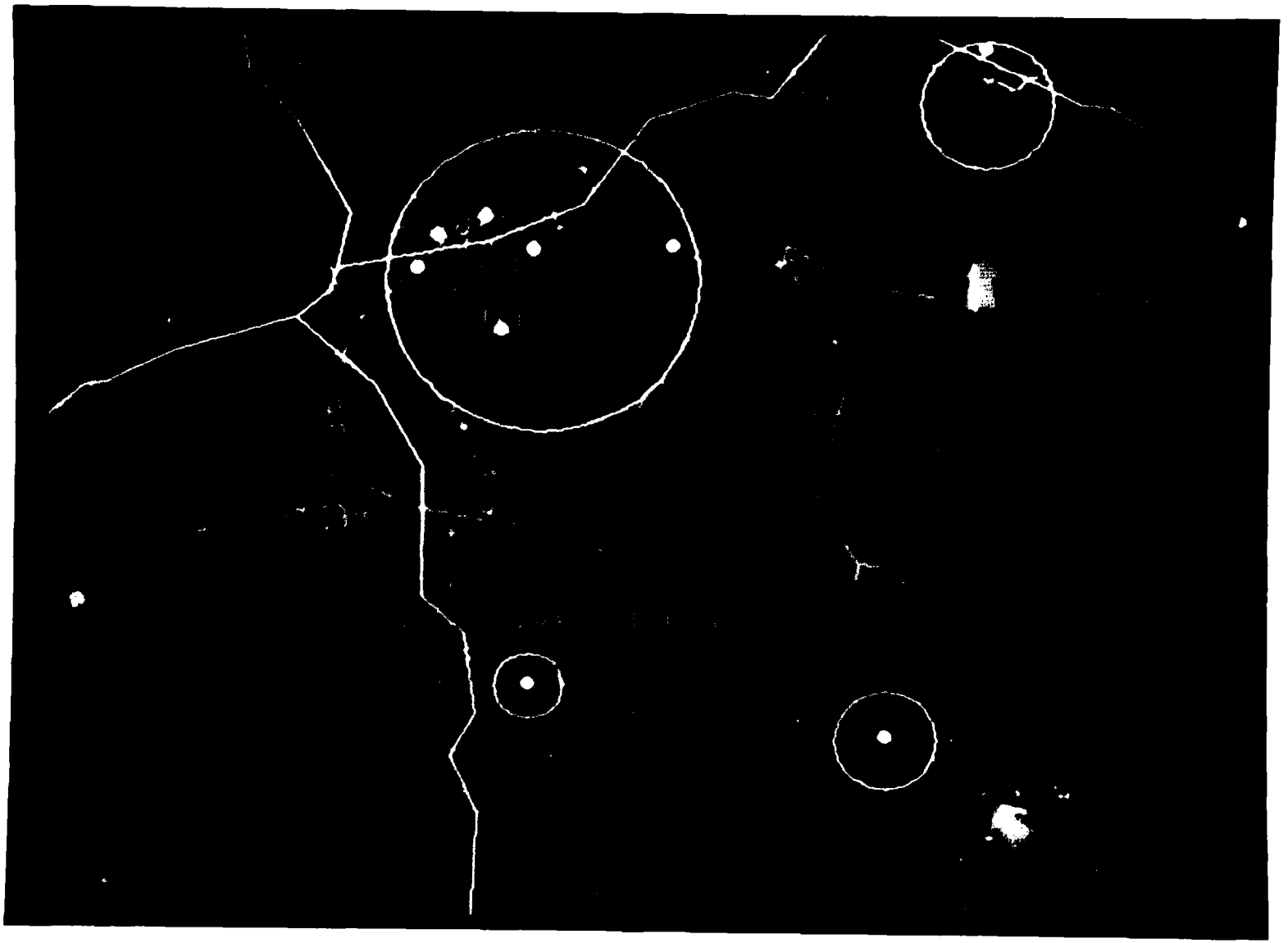


Figure 3.1.2-34 Event Template Example

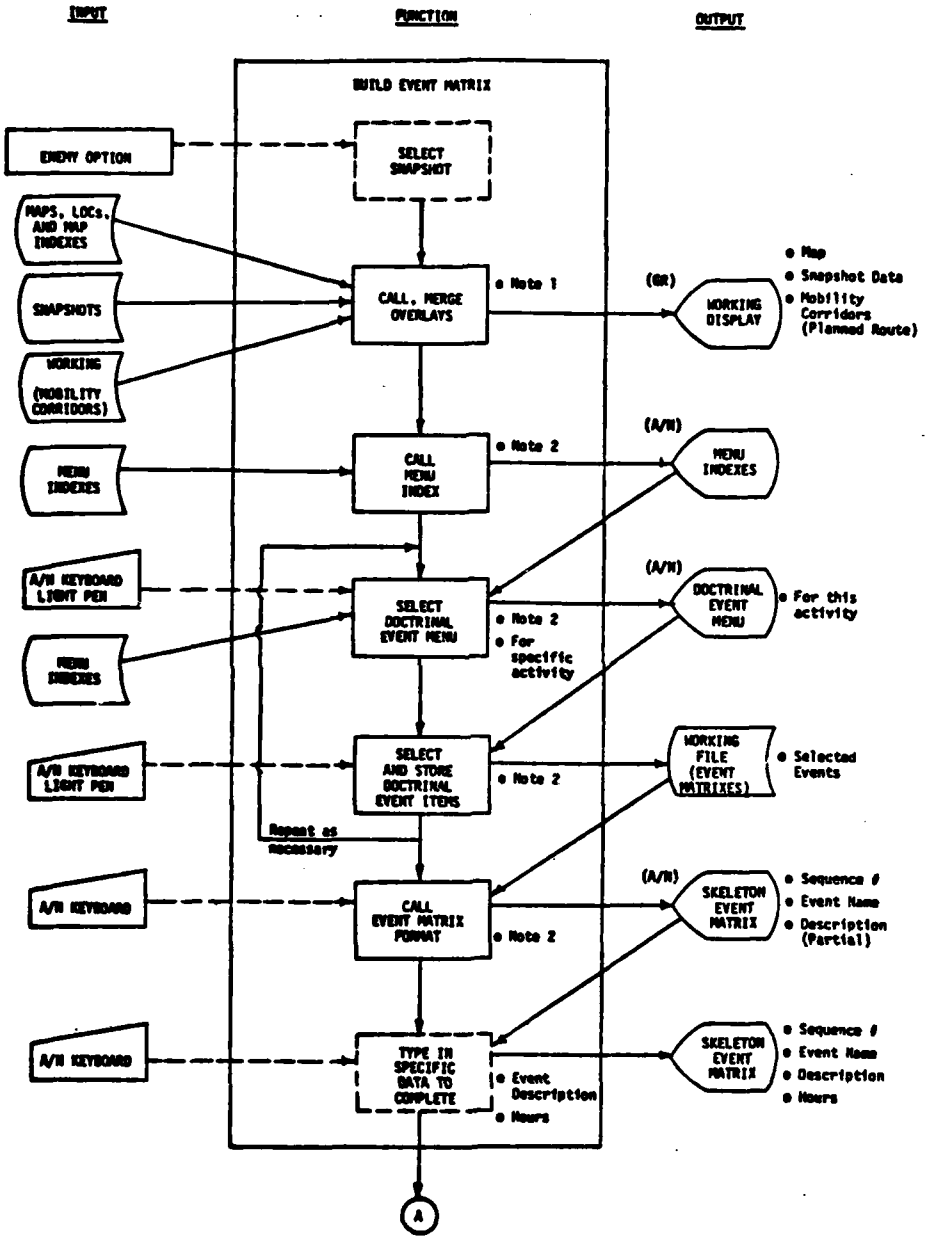


Figure 3.1.2-35. Function: Event Matrix/Event Template (Sheet 1 of 2)

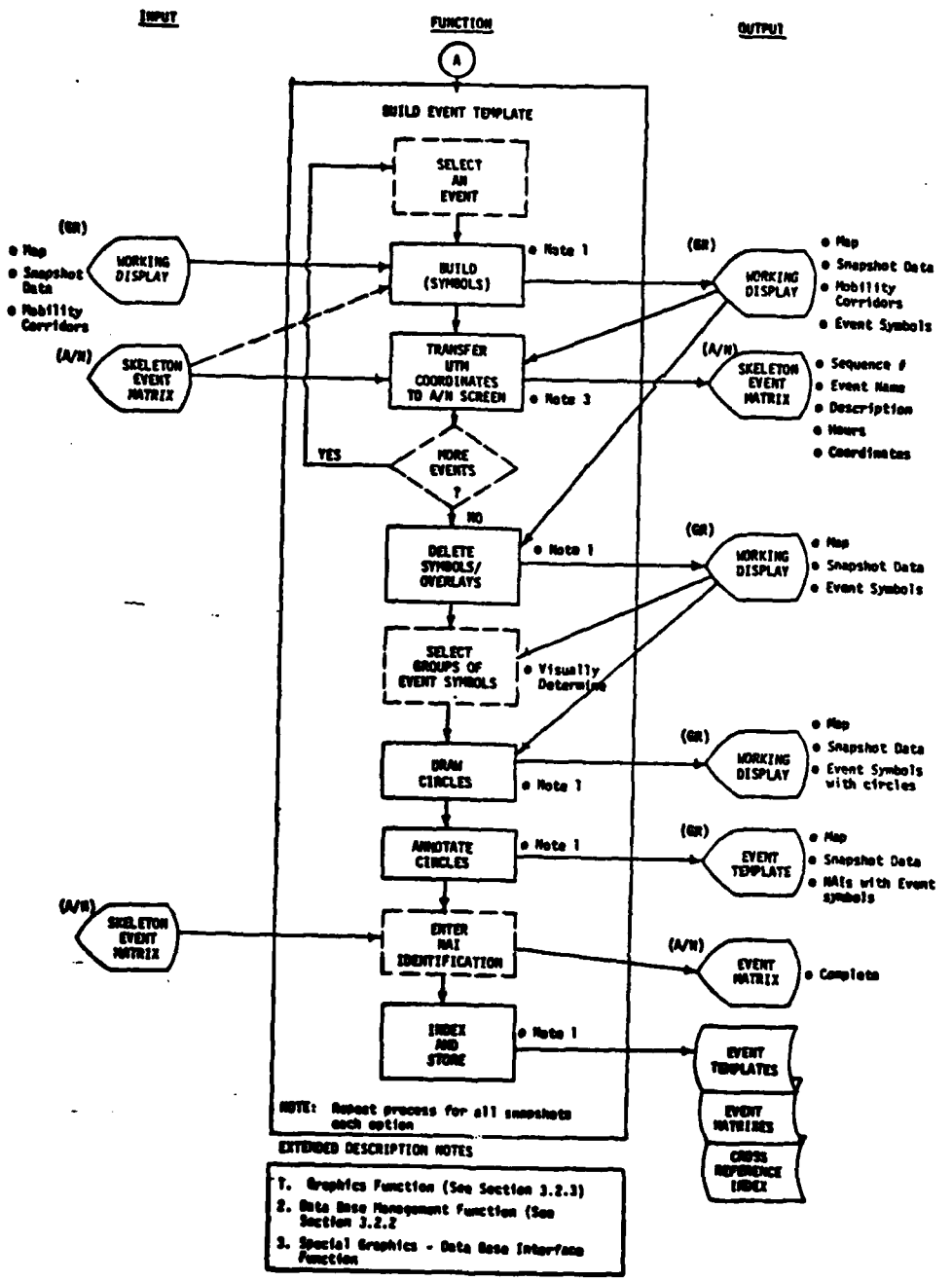


Figure 3.1.2-35. Function: Event Matrix/Event Template (Sheet 2 of 2)

He next selects from a tabular menu, a Doctrinal Event Menu. This is a prestored menu of events which are doctrinally associated with this option type/course of action. Having selected from this list a key event for inclusion in the Event Matrix, he calls to the tabular screen the preformatted Event Matrix List. He enters the description of the key event. If the description contained in the doctrinal menu is sufficient, he can transfer it by means of light pen or similar control device to save typing. He will complete the brief text description and time sequence but not the location coordinates and not the reference to the NAI number.

The analyst shifts his attention to the graphic screen. Examining the event description and time just entered on the tabular screen, and examining the composite overlay set on the graphic screen, he locates the symbol(s) for the new event. He queries the system for the symbol coordinates and then, returning to the tabular screen, he enters the coordinates for this event.

He continues this process until he has completed all desired entries on the Event Matrix and built the corresponding symbols on the Event Template. Inspecting the Event Template, he then groups event symbols into clusters constructs a circle on polygon around each cluster and assigns NAI numbers.

He next enters the NAI numbers opposite the appropriate event descriptions on the Event Matrix.

When satisfied with the matrix and template, he adds identifying numbers and time stamps and stores the products in the system permanent files. The system automatically updates its indexes to reflect these products. The system automatically updates a Cross Reference Index which relates individual events and their NAIs and relates the NAIs to Event Templates and Snapshot Templates.

3.1.2.3.6 Target Analysis Matrixes

For improved efficiency overall the IPB analyst builds the initial target analysis matrixes with a minimum degree of detail. More detailed modification of specific matrixes is performed after the enemy intentions have been perceived and the Intelligence Estimate is made. Figure 3.1.2-36 diagrams the IPB target analysis matrix build process. Each matrix is associated with a specific event template/matrix and, in turn, a specific snapshot. Therefore, the process is repeated for each snapshot/event template within each option.

Since targets are associated by location and time with events, the first step in the build process is to view a specific event template. The IPB analyst selects the desired event template from the file and reviews it on the graphics CRT. Working within each NAI the analyst notes the type of enemy unit and the activity of that unit portrayed on the event template. For more details he could display the appropriate situation templates and/or event matrix.

The analyst retrieves the doctrinal target menu identified with the specific type of unit or activity. He selects those targets which in his judgment are applicable to this option and event. The selection action (light pen or keyboard entry) causes the system to transfer that item to a working file used to build the target analysis matrix. The TAI identification is entered by the analyst. This process is repeated for each type of unit in each NAI that the analyst elects to consider.

At this point the working file has a set of potential targets with their doctrinal descriptions and the TAIs with which they belong. The analyst can review the list in a skeletonized target analysis matrix format on the A/N CRT.

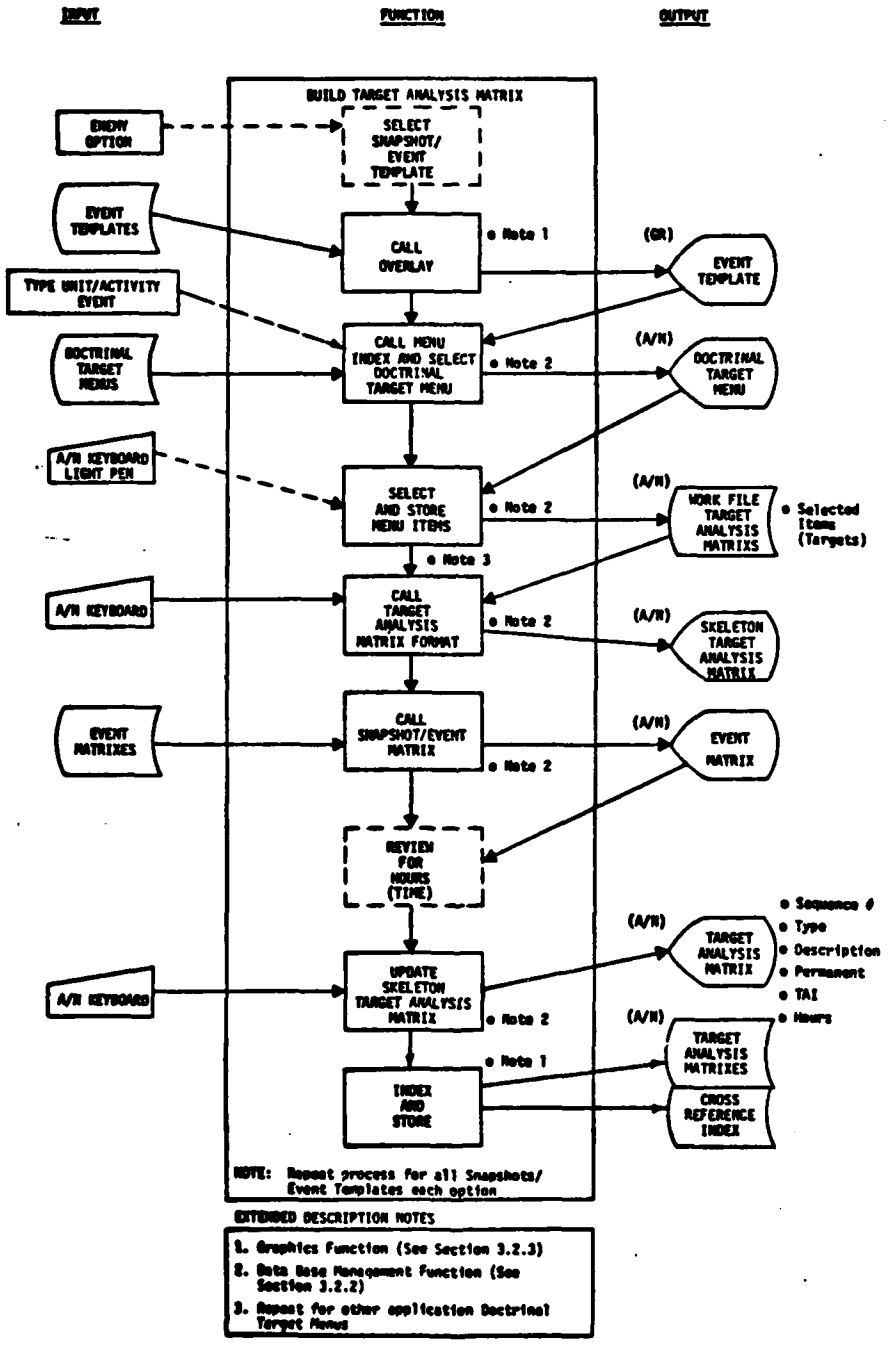


Figure 3.1.2-36. Function: Target Analysis Matrix

To relate the potential targets to time the analyst next displays the related event matrix on the A/N CRT. Time ranges based upon snapshot time were assigned to each event listed. These same events correspond with potential targets and the analyst transfers the time estimates to the potential targets in the target analysis matrix working file. The updated file can then be viewed in matrix format on the A/N CRT. Figure 3.1.2-37 is an example of a target analysis matrix. Entries in the columns vicinity, worth and weapons system assignment are intentionally not made at this time. See Section 3.1.3.3 for completion of these elements of information.

3.1.2.3.7 Target Templates

Target templates are built initially in a generalized manner for the same reasons cited for target analysis matrixes. Figure 3.1.2-38 diagrams the building of one target template. Each template is associated with a specific event template and target analysis matrix which in turn is associated with a specific snapshot. Therefore, the process is repeated for each snapshot/event template within each option.

For an enemy option the IPB analyst selects the event template for the time/area under consideration and reviews it on the graphic CRT. He also queries, retrieves and displays on the A/N terminal the target analysis matrix which corresponds to that event template. The remainder of the build function is supported by the subfunctions of the system graphics capabilities by which interactively the analyst changes the display (event template) on the graphic CRT. Within each NAI circle the analyst selects a military unit (flag symbol), notes on the A/N CRT what targets that represents, deletes the flag symbol and builds the appropriate target symbols in its place. Repeating this process, the analyst "plots" the targets listed on the target analysis matrix within NAI circles on a map background. Upon completion of the

TARGET ANALYSIS MATRIX - A5

PG 1 OF 2PGS

TGT SEQ #	TARGET TYPE	TARGET DESCRIPTION	PERM	HOURS 1	2	3	VICIN	TAI	WRTH	WPNSYS ASSIGN
A5A1	EMIT	ARTY BTRYS	STA	X			PL350940	A5A	20	FA
A5A2	SHOOT	ARTY BTRYS	STA	X			PL350930	A5A	20	FA
A5A3	MOVE	TRP/VEH CON CENTRATION	CONT MOVE		X		PL365910	A5A	30	
A5A4	MOVE	TRP CONCEN-TRATION	EXP STOP		X		PL340980	A5A	10	AIR
A5A5	EMIT	MET RADAR/ ROCKET MSL POSITION	STA	X			PL380835	A5A	30	JAM
A5B1	EMIT	ARTY BTRYS	STA	X			PL310690	A5B	10	JAM
A5B2	MOVE	TANK CONCEN TRATION	EXP STOP		X		PL390580	A5B	10	FA
A5B3	EMIT	RGT CP	EXP MOVE	X			PL380920	A5B	10	INTCPT

Figure 3.1.2-37. Target Analysis Matrix Example

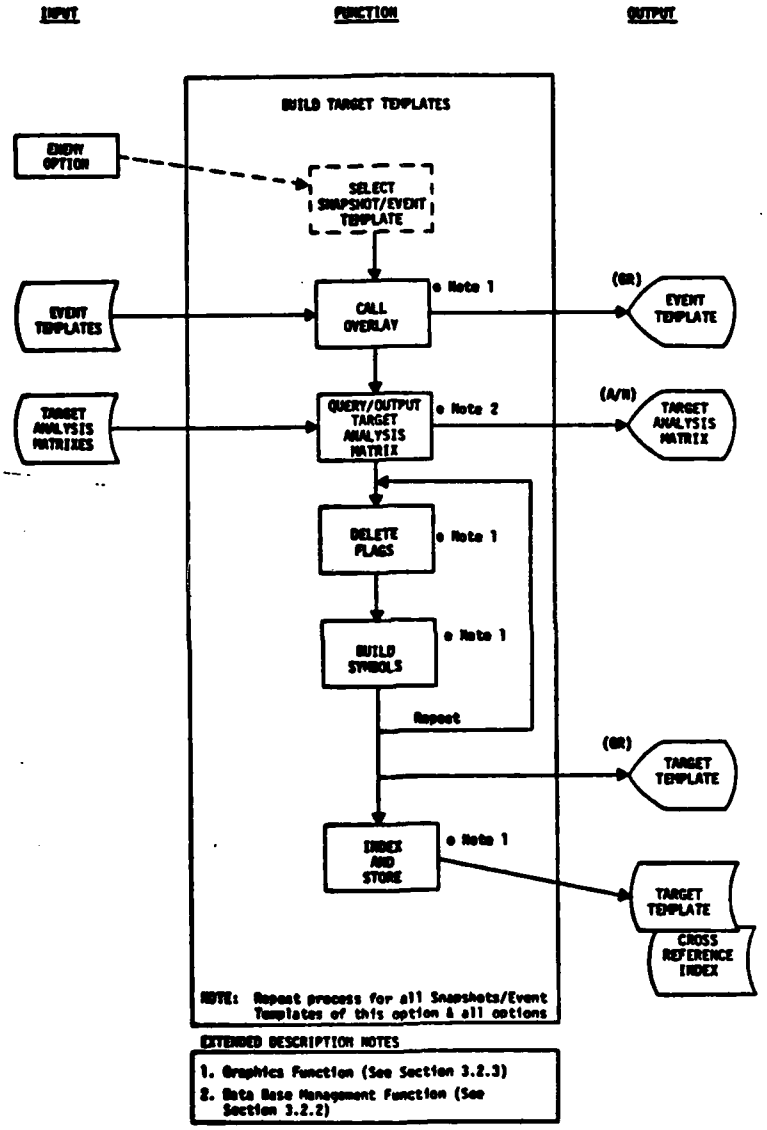


Figure 3.1.2-38. Function: Target Template

process the circles are TAIs and the scene on the graphics CRT is the target template. The analyst annotates it as desired, indexes and stores it on a working file for later use. Figure 3.1.2-39 shows the completed target template.

A representative set of symbols to use for targets is as follows:

TITLE/TARGET TYPE	SYMBOL	NOTES
Radar Emitter Communications Emitter		Each symbol displayed represents one or a prescribed number of emitters
Shooter-Artillery Shooter-Missile/Rocket		Each symbol represents one or a prescribed number of shooters (a battery)
Mover		Each symbol represents 1 to 10 movers

3.1.2.3.8 Decision Alternative Templates

For each predicted enemy course of action (option) one or more friendly alternative reactions are planned for the commander's consideration. The graphic summarization of the enemy-friendly actions is the commander's decision support template. This template could be developed during this IPB phase, i.e., before the battle, but the process is described in Section 3.1.3.3 of the IPB Product Use section.

Figure 3.1.2-39 Target Template Example

One of the essential elements to be included on that template is time available. That figure is not determinable until the IPB Intelligence Estimate has predicted in which option and where in that option the enemy has been detected.

Various elements supporting the commander's decision support template, called decision alternatives, can be developed in this IPB phase however depending upon the specifics of the situation. Two examples, maneuver and fires, are included as representative of the decision alternative process and graphics. Early preparation facilitates a more rapid update during the battle.

The decision alternative templates resemble snapshots very closely, hence the first step of the function diagrammed in Figure 3.1.2-40 is for the IPB analyst to select a snapshot based upon command guidance. The analyst merges the snapshot with the appropriate map background and the military boundaries of both enemy and friendly forces. The friendly boundaries used initially are as in the current situation. Flag symbols representing enemy forces other than combat units are deleted by the analyst to reduce clutter.

The amount of IPB support to the development of the maneuver decision alternative template is variable. For snapshots which occur very early in the enemy option, perhaps well prior to the enemy reaching the line of contact or main battle area, there may not be any maneuver action needed. Hence, the friendly portion of the decision alternative template would consist of the current maneuver situation. For other snapshots schemes of maneuver may be planned. Flag symbols representing combat units are depicted at the battalion level. The combat power ratio algorithm is employed by the IPB analyst to determine the size of the enemy force in the selected geographic area expressed in equivalent U.S. maneuver battalions. Application of command guidance as to the

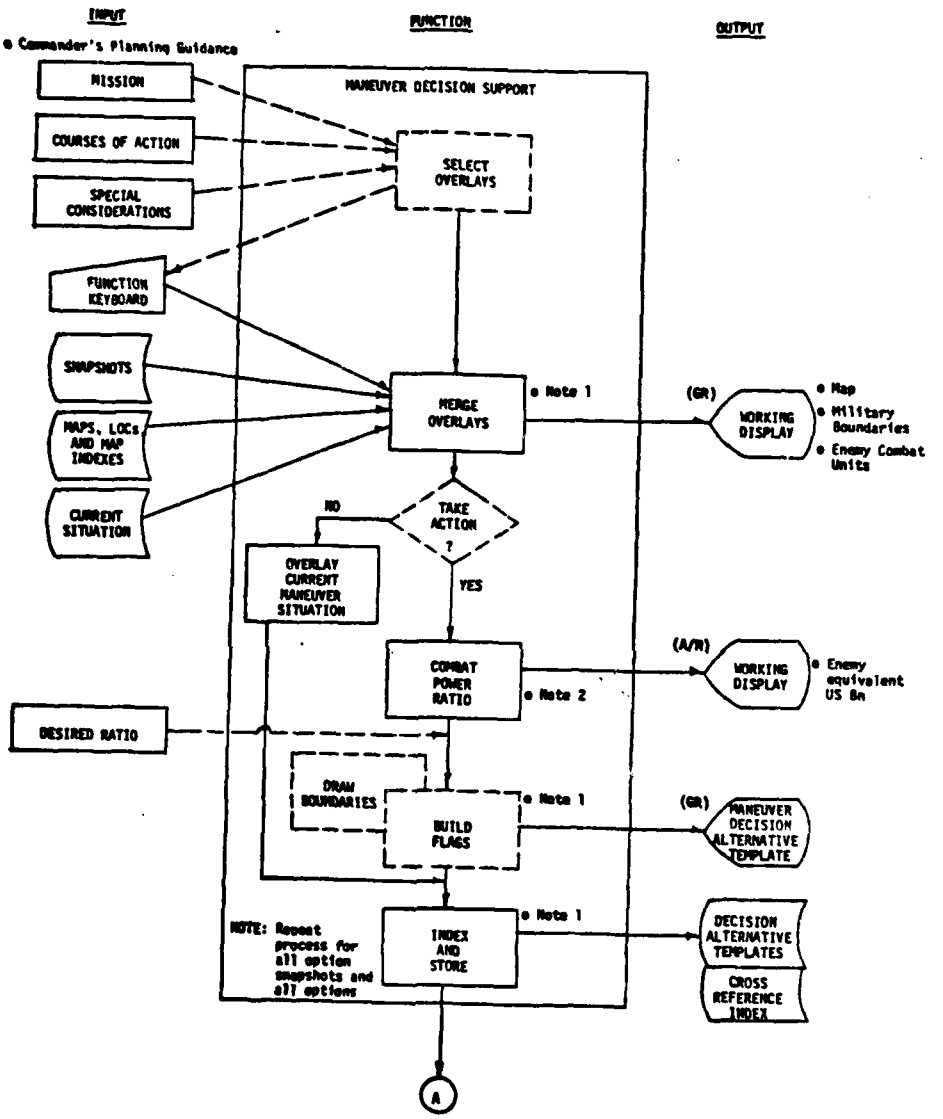


Figure 3.1.2-40. Function: Decision Alternative Template (Sheet 1 of 2)

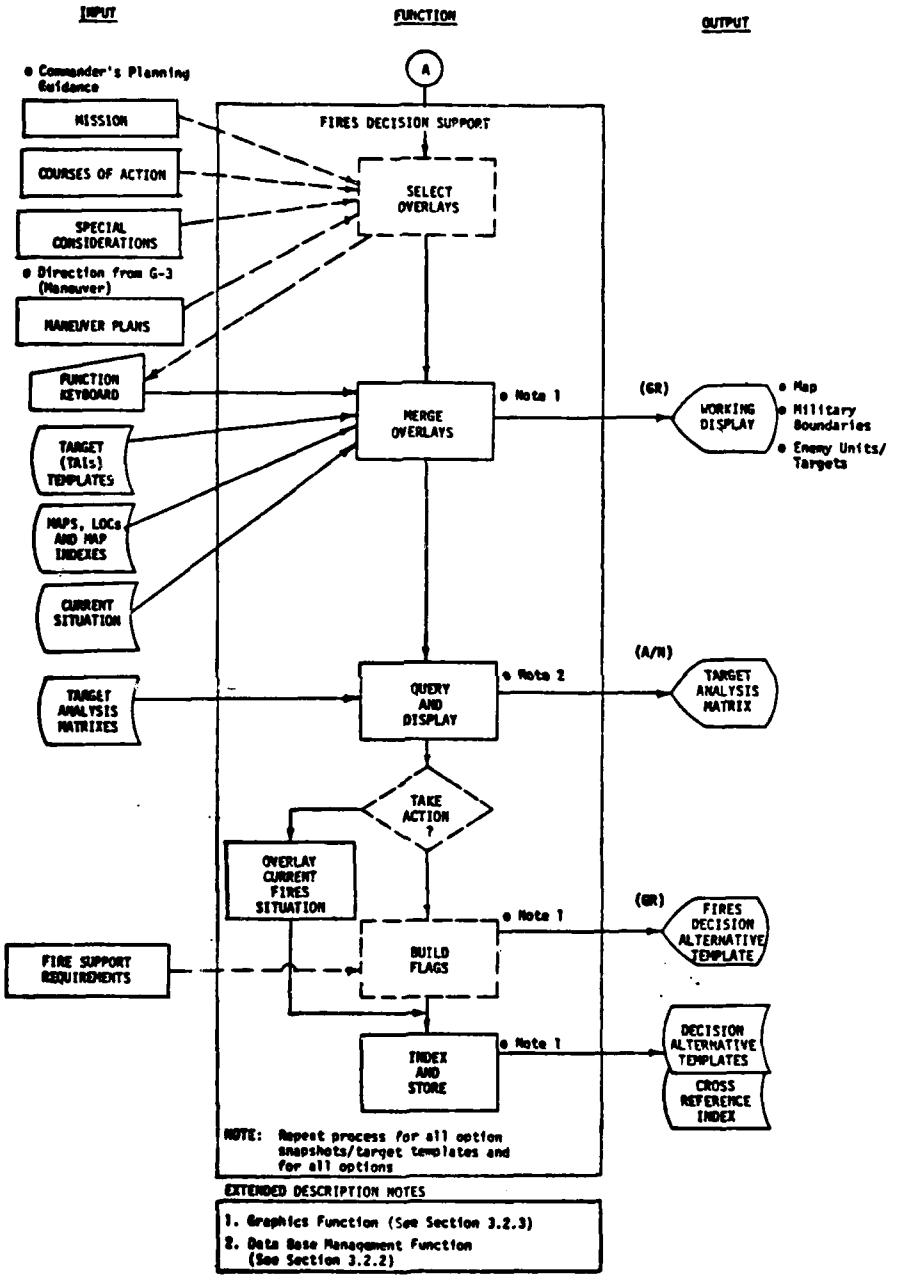


Figure 3.1.2-40. Function: Decision Alternative Template (Sheet 2 of 2)

desirable force ratio readily translates the enemy size into the friendly force size which should be used in the particular alternative envisioned. The IPB analyst uses the system capabilities of drawing military boundaries and building flags to outline the areas of responsibility and build the desired number of friendly maneuver units on the graphics display.

Questions of maneuver feasibility and careful determination of friendly force locations is purposely postponed for consideration during the real time battle situation. Hence, this subfunction ends with having developed a planned maneuver decision alternative template for the selected snapshot in which the friendly units have been "sized" to meet the planned enemy force, but have not been carefully located on the terrain and have not been tested for feasibility of getting into position. Figure 3.1.2-41 is an example of a maneuver decision alternative template. This template is indexed and stored in a work file for later retrieval and use. The process is repeated for each snapshot, each option as desired.

The other decision alternative diagrammed in the functional flow chart is the preparation of the fire support portion of the decision alternative template. In the case of early snapshots where no specific scheme of maneuver is involved, interdiction of the enemy may be the primary action to be taken. Hence, the fire support portion may be the most significant. In any case, the fires function also uses command guidance as input parameters in addition to the G-3 maneuver plan(s). The same snapshot(s) selected in the previous subfunction is used as a basis for selecting the corresponding target template from the files, merging it with the appropriate map backgrounds and military boundaries from the current situation. Concurrently, the analyst queries the A/N data base to display the corresponding target analysis matrix.

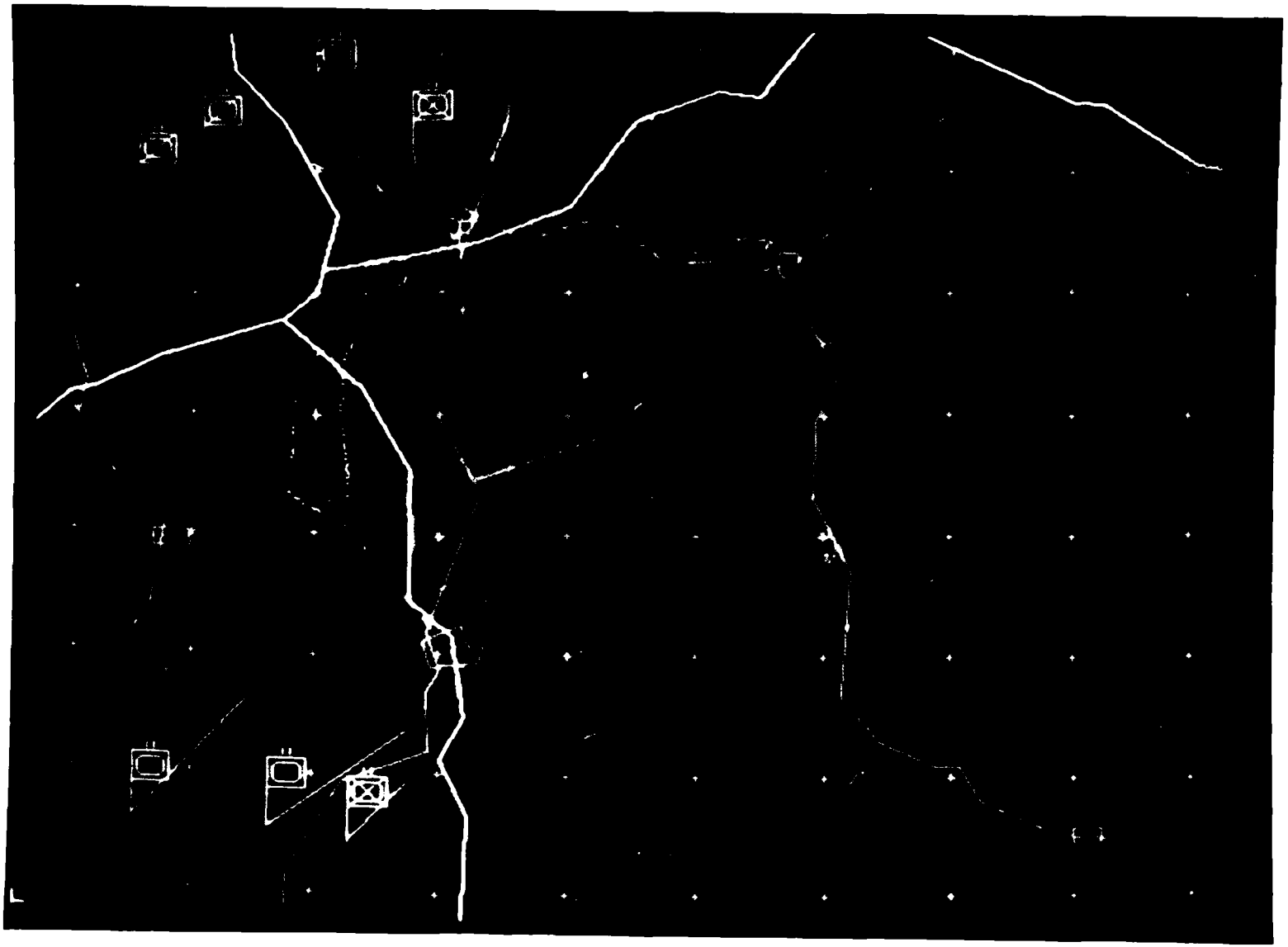


Figure 3.1.2-41 Maneuver Decision Alternative Template Example

The remainder of the subfunction is similar to that of the maneuver portion, i.e., contingent upon a decision to retain the current allocation/assignment of FA units or to change it. If the former, the current plot of FA battalions is merged on the graphic display. If the latter, the build flag capability is used to build a planned fires decision alternative template based upon definition of the optimum number of FA battalions required to service the number of targets. This template is also indexed and stored for possible later retrieval and update in more detailed fashion. Again, the process is repeated for each snapshot within each option as required.

3.1.3 IPB Product Use Functions

This section describes the use of IPB products in the course of hostilities. HIPO diagrams are used to describe the IPB support provided to the following command and control functions:

- Intelligence Functions including Intelligence Estimates
- Maneuver and Fires Operations Planning
- Commander's Decision Support

3.1.3.1 Intelligence Functions Support

Figure 3.1.3-1 is a diagram showing the way the IPB analyst uses pre-built IPB products in performing his realtime intelligence estimating function and to focus collection resources on higher yield areas of interest.

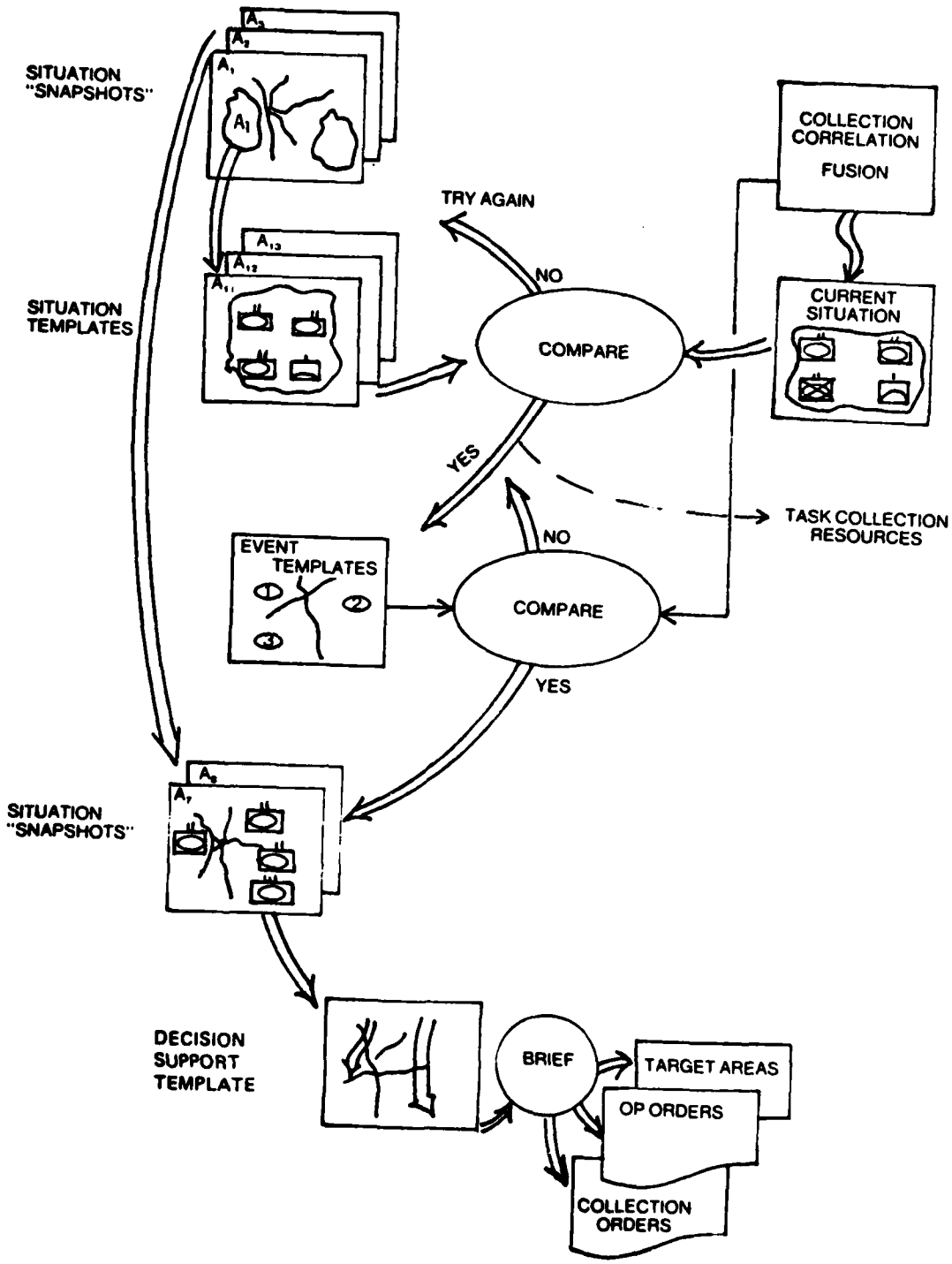


Figure 3.1.3-1. Operational Concept

In the upper right corner of the diagram are a group of 2 blocks indicating that the IPB analyst receives frequent updates to the current military situation picture. This picture shows enemy locations and movements at the unit level and is displayed at the IPB station on a separate monitor. The IPB analyst can cause a situation update to appear on his current situation monitor, and can cause it to be scaled to match his IPB products. Generation of this display through correlation and fusion processes is assumed to be a continuous process performed by an ASAS function external to the IPB function.

When he receives a current situation update, he will normally position the cursor (on the IPB graphic monitor) close to a newly reported activity of interest and ask the system to display on the alphanumeric screen, a list of all prestored situation templates which contain the identified point. He compares prestored situation templates with similarly scaled areas on the current situation screen. He looks for approximate matches, relying on his experience and familiarity with templates and parent snapshots previously built. He will frequently draw on his other IPB files (doctrinal templates, terrain overlays, technical data, etc.) to try to rationalize differences in the situation displays. He repeats this process as further updates are received. He is continuously attempting to isolate the enemy option and snapshot point. When he believes he has identified an option and snapshot he attempts to confirm his hypothesis. He does this by requesting intelligence collections against the pre-planned event matrix and event template following the selected snapshot point. He cues the input processing system to immediately route alert messages to his alphanumeric screen when sensor returns for specific collection requests are received.

The input process system also signals the analyst after a prescribed time if none of the event matrix events are detected. This allows him to terminate collection and front end conditioning if he chooses.

At a point when, in his judgment, a sufficient number of events have been identified as fitting the event matrix, the analyst may choose to declare the option and snapshot point confirmed. He then analyzes additional snapshots that occur far enough in the future in the option so that friendly actions can be taken to adequately defend the attack. He may need to update the snapshots to reflect current situation, e.g., different unit locations or force composition. Once satisfied that the snapshot reflects the bee st portrayal of enemy intentions, the analyst uses it as his "intelligence estimate." He prepares data on two or more future snapshots as a briefing tool for the G-3 staff and commander.

In concert with the G3 operations staff, he prepares alternative decision support templates. These show required and achievable friendly force movements and timings to defend at successive phase lines. These will reflect the results of analysis which trades off achievable combat power ratios against such considerations as best terrain for defense.

In addition, event templates can be exploited to notify the Fire Support Element (FSE) of what targets can be expected at which locations over the next several hours. Preplanned operations orders can be finalized for deployment of friendly forces to meet the enemy. The terrain analyses completed in advance by the G2 staff would be useful to the FSE and maneuver sections in planning fires allocation and friendly force movements to interdict.

3.1.3.1.1 IPB Template/Current Situation Comparison Process

Figure 3.1.3-2 indicates the inputs, processes and outputs of the IPB Template/Current Situation Comparison processing subfunction. This subfunction shall provide automation support to the IPB analyst as he performs his IPB analysis during hostilities to arrive at the intelligence estimate of the situation.

The IPB analyst controls the call-up and display of new scenes on his current situation screen. He closely monitors enemy forces and areas of interest. He continuously looks for significant indicators of new enemy options and courses of action. When a new situation report(s) comes to his attention, he positions the graphic cursor to a central point in the interest area and queries the system to provide him a Situation Template List. Search shall be against an index of all stored situation templates; it retrieves all situation templates which contain the cursor indicated point. The list is displayed on his alphameric screen.

The analyst selects one situation template for call-up and display on his IPB screen. The scale is selected by the analyst and will normally be 1:50,000. As he calls this situation template, the system will read the template's centerpoint (included in the record). Using this and the template scale value, the system will cause the corresponding field of view and scale of the current situation screen to be displayed.

The analyst visually compares the content of the two screens, attempting to identify close matches. He augments this step by calling other IPB products--snapshots, doctrinal templates, planned routes, mobility corridors, terrain subfactors and composites--to his IPB screen to help rationalize differences between the template and current situation graphic.

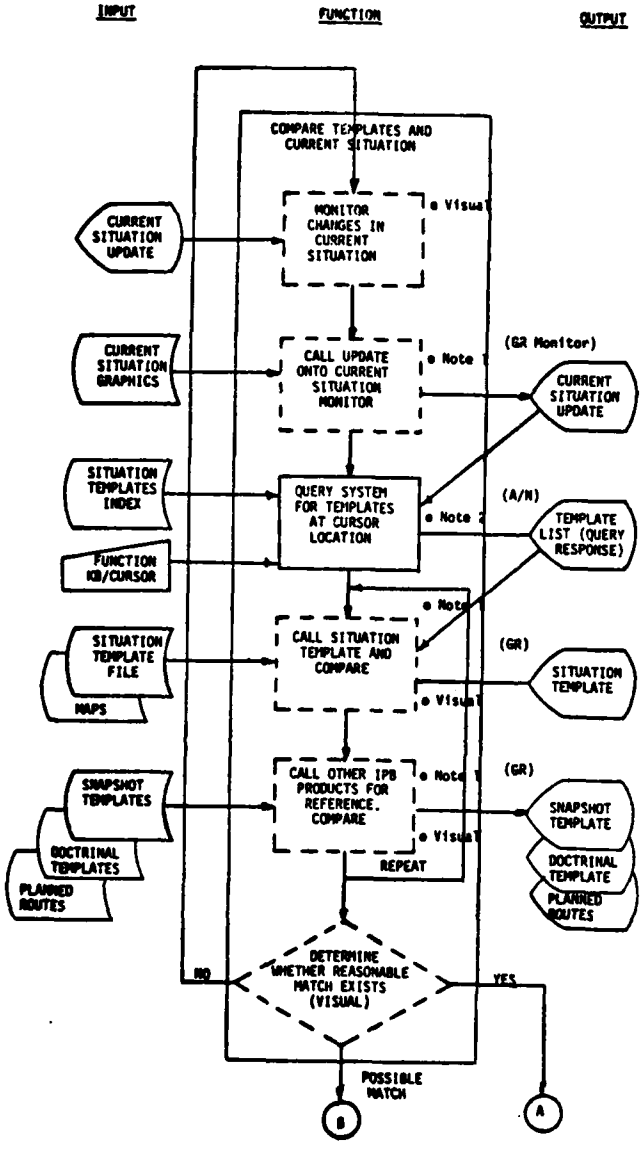


Figure 3.1.3-2. Current Situation Compare Function
(Sheet 1 of 2)

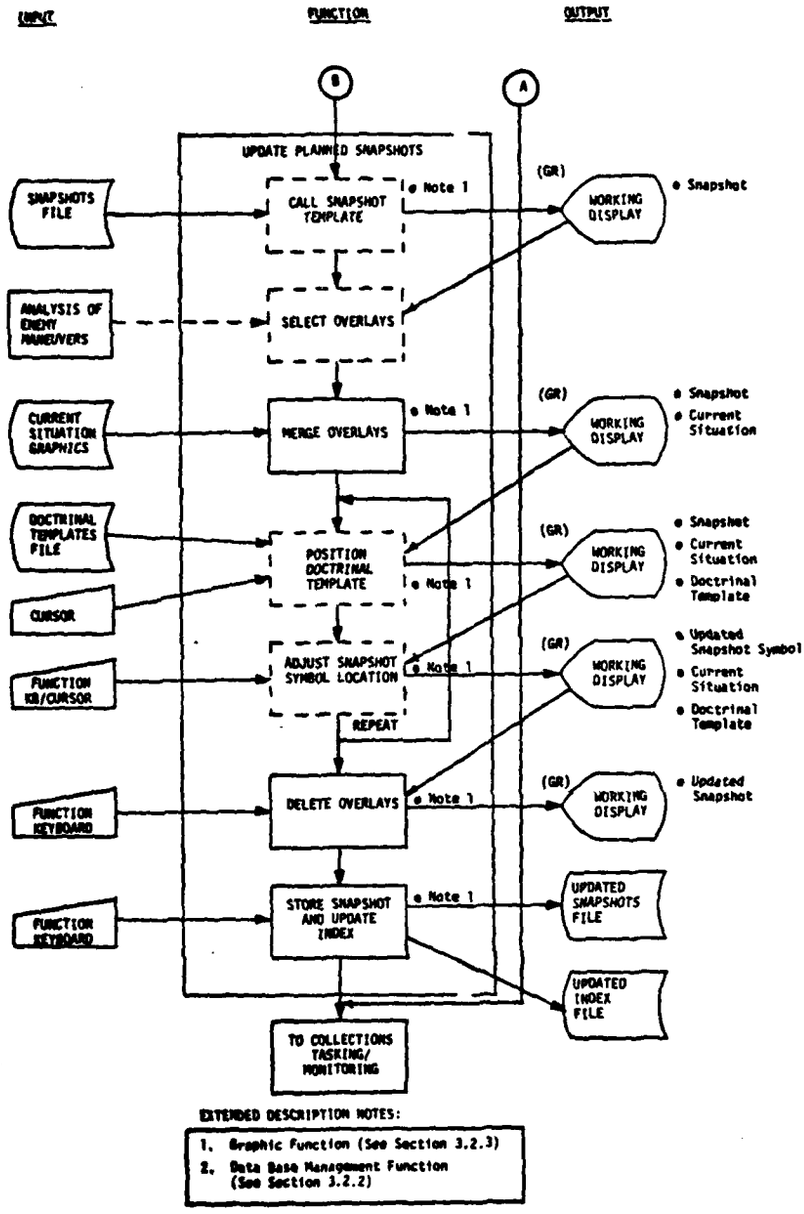


Figure 3.1.3-2. Current Situation Compare Function
(Sheet 2 of 2)

He proceeds to the next situation template on the list. This is called up on the graphic; the current situation screen field of view and scale are adjusted and the comparison process using augmenting IPB products is repeated. If a strong match is found between one situation template and a unit activity on the current situation screen and the analyst has progressed far enough in his investigation of options, he may elect to move on to the next phases of the IPB process. In some cases the analyst may become convinced that there is good correspondence between a situation template/snapshot and a current situation activity although the match he finds is a partial rather a strong match. In this case he will update the parent snapshot as diagrammed on page 2 of the Figure 3.1.3-2. He merges overlays including the current situation and doctrinal templates on top of the planned snapshot (he may also work with situation templates if expanded detail is required). He adjusts unit locations to better fit the current situation activity; he deletes overlays, adds annotation and stores the updated snapshot. The updated version shall be stored as an additional snapshot and not cause deletion of the original snapshot. By maintaining a record of changes in this manner, the analyst will have valid, updated snapshots for quick reference when he subsequently develops the intelligence estimate.

If no strong matches are found between templates on the situation template list and the unit activity/area of interest on the current situation screen, the analyst has several choices. He may return to the master large area current situation graphic and select another activity/area for focusing his attention. Or, if he has thoroughly analyzed all the latest units/activities on the current situation graphic without resolving between options, he may elect to await the next update to be routed to him by the current situation analyst.

While engaged in this search/template match process, he may elect to call particular snapshots that will be helpful in checking overall timing of perceived enemy movements. By referencing particular snapshots, he may gain confidence that an enemy force has not progressed beyond a certain phase, even though he may not have high confidence of what option/course of action the enemy is embarked on.

Control of Slaved Current Situation Graphic Monitor

This monitor, located at the IPB analyst position, is slaved to a master current situation terminal which is operated external to the IPB process. These paragraphs describe the software functions and controls relevant to the IPB analyst's use of the slaved monitor in the comparison process.

In its standby mode, a copy of the last declared current situation graphic shall be displayed on the slaved monitor for viewing by the IPB analyst.

At the time of a new update to the master current situation graphic, a prominently blinking message "UPDATE" shall be displayed in the upper left corner of the slaved monitor. This message will overlay whatever scene is then displayed and not cause deletion of that scene.

Upon IPB analyst action, the newly declared current situation graphic from the master terminal shall be displayed in its entirety on the slaved screen, automatically causing deletion of the previously displayed scene.

Upon IPB analyst action, a center point for a new, expanded field of view shall be identified and the new, expanded scale view shall be displayed on the slaved monitor. Center point identification shall be by graphic cursor control on the IPB template graphic screen (not on the slaved current situation screen). Scale of the expanded view shall be selected by function key input at the IPB analyst console. The expanded scene shall contain all symbols, vectors and notation from the portion of the parent current situation graphic presented in the new view.

Other controls required by the IPB analyst include the ability to selectively display part or all of the current situation directly on the IPB graphic screen. This capability is required to support the IPB product build functions and is further discussed in Section 3.1.2.

3.1.3.1.2 Collections Tasking/Monitoring

Figure 3.1.3-3 indicates the inputs, processes and outputs of the IPB Collections Tasking/Monitoring processing subfunction. This subfunction shall provide automation support to the IPB analyst as he makes sensor tasking requests and processes returns from sensor collections.

The IPB analyst controls the flow of the collections tasking request/monitoring activity. As part of the IPB planning process prior to hostilities he has planned a series of Event Templates and Event Matrixes and provided copies of these to the Collections Management function. During hostilities, he uses Event Templates and Event Matrix Lists, updated to reflect real time projections of enemy courses of action, as a means of focusing sensor collection assets to acquire critical indicator information and thereby to help confirm what option/course of action the enemy is following. The analyst receives

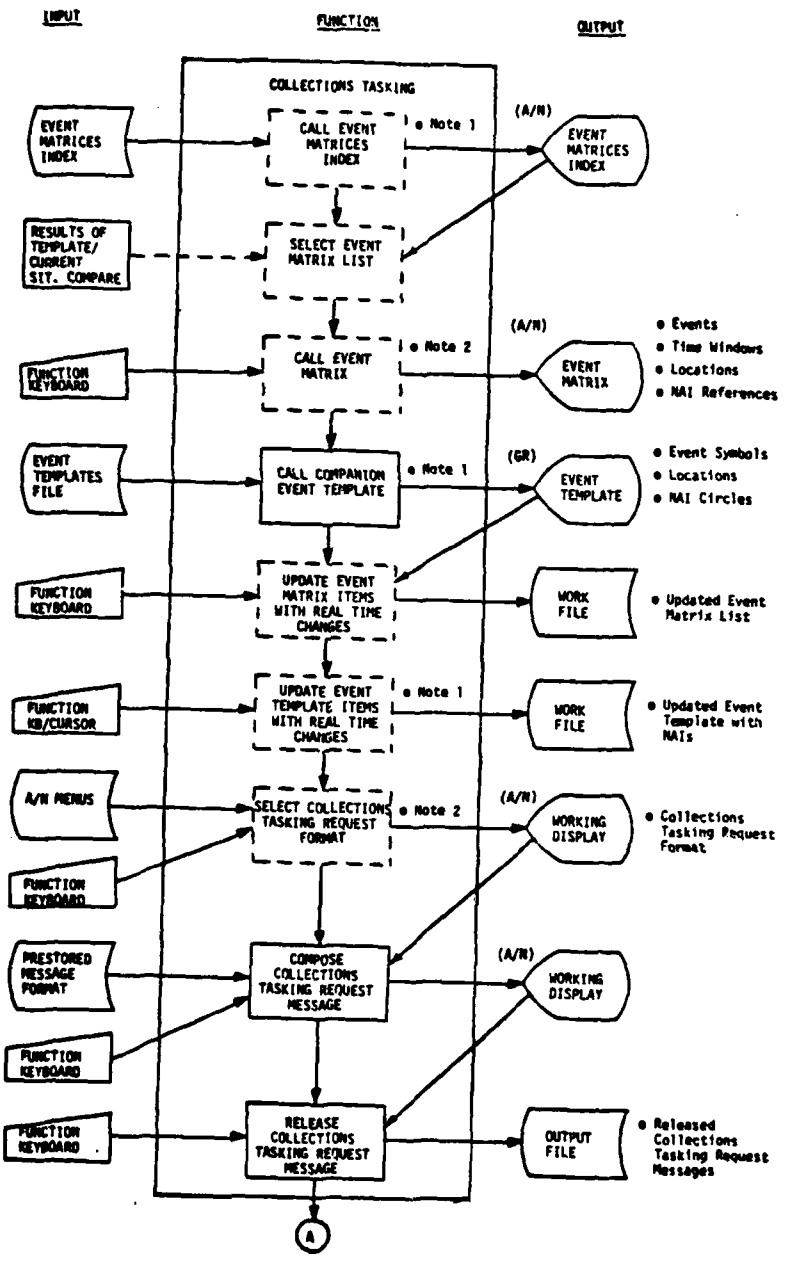


Figure 3.1.3-3. Collections Tasking/Monitoring Function (Sheet 1 of 2)

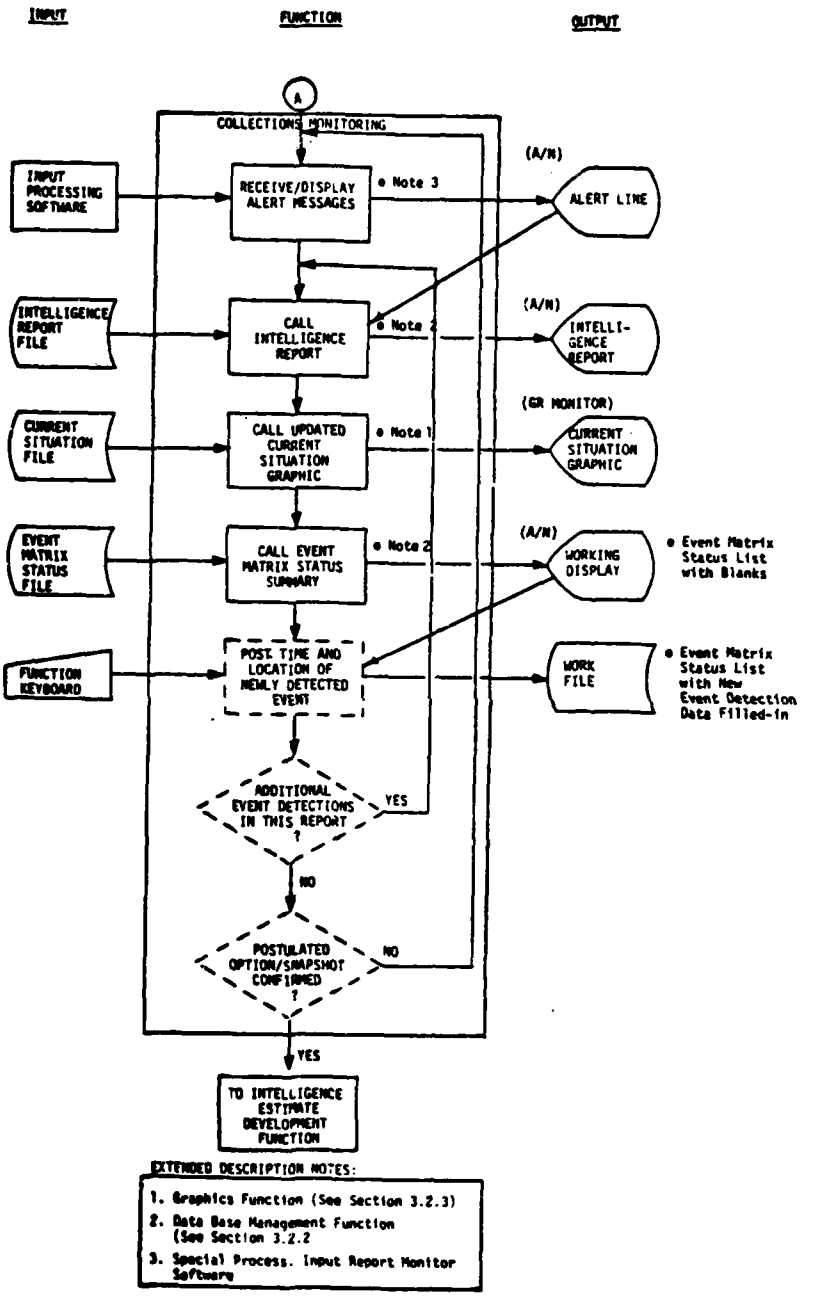


Figure 3.1.3-3. Collections Tasking/Monitoring Function (Sheet 2 of 2)

intelligence reports that are in response to his requests. He and/or the system post analyzed results to an Event Matrix Status Summary. When, in his judgment, a sufficient number of events closely matching a preplanned set have been detected he declares an option/course of action as confirmed and proceeds to the next IPB phase which is development of the Intelligence Estimate.

Collections Tasking

Referring to Figure 3.1.3-3, the analyst first calls the Event Matrix Index to his tabular screen; he selects the planned Event Matrix for which he has decided to invoke a collections tasking request. The corresponding Event Template shall be automatically displayed on the graphic screen. This combination of graphic and tabular data provides the analyst with critical events/indicators that doctrinally should follow closely after the related snapshot point.

The analyst updates the Event Template and Event Matrix to reflect real time changes to planned events as a result of comparisons and analysis. Changes to graphic symbols shall be via function keyboard and graphic cursor. Changes to tabular entries shall be via the typewriter keyboard.

The analyst then calls the Collections Tasking Request Message Format which shall be displayed on the tabular screen. Selection of this message format shall be via a tabular menu and lightpen or similar data entry device. Upon analyst action the desired content of the Collections Tasking Request message shall be completed by a fill-in-the-blanks technique. He may elect to include all or part of the planned matrix in the collection message. If no changes are required to the planned event set, he may prepare an abbreviated

message simply referencing the planned Event Matrix/Event Template pair that was provided to the Collections Management function prior to hostilities. The completed message is transmitted to the Collections Management function.

Collections Monitoring

Referring to page 2 of Figure 3.1.3-3, an IPB input processing function automatically monitors intelligence reports incoming to the IPB system. When an event number requested by the IPB analyst is detected, the system generates an alert message which is automatically displayed on the tabular screen. The alert message shall be superimposed on whatever tabular message is then displayed on the tabular screen; it shall not cause automatic deletion of the existing screen contents.

Upon analyst action the intelligence report containing the requested information shall be automatically composed and displayed on the tabular screen. The updated current situation shall be simultaneously displayed on the graphic monitor.

The analyst then calls the Event Matrix Status Summary corresponding to the appropriate Event Matrix for display on the tabular screen. Location and time of the event shall be entered. Upon analyst action the updated Event Matrix Status Summary shall be stored with the new event detection data filled in.

3.1.3.1.3 Intelligence Estimate Development

Figure 3.1.3-4 indicates the inputs, processes and outputs of the IPB Intelligence Estimate Development processing subfunction. This subfunction shall provide automation support to the IPB analyst as he prepares the G-2 intelligence estimate of the situation which he will use to brief the commander and G-3 staff.

The IPB analyst having gained sufficient confidence that he knows the option and snapshot that the enemy is in, next prepares the intelligence estimate of the situation. The analyst begins by assessing the validity of his pre-hostility IPB products for the confirmed option. He does this by examining the snapshots and situation templates which reflect the early stages in the option. He decides whether the differences between pre-built template data and current situation data that he noted and recorded on these templates during the comparison process signify an impact due to force size/composition changes and/or weather changes. If not, the analyst bypasses the next few steps on the diagram and proceeds to the pre-built Snapshot Lines Template. If yes, the analyst calls the Planned Routes Template for the option. He determines which map areas/pre-built corridors are affected and therefore will require re-examination.

He now re-evaluates the enemy's choice of routes, corridors, attack formations and overall route timings. He does this by calling to the graphic screen one at a time, the pre-built crosscountry and road corridors. Using algorithmic techniques described elsewhere in this document, he causes corridor rating and transit time for each corridor to be recomputed. He transfers the accumulated times to the Snapshot Lines Template thus arriving at a revised total time between the snapshot point at which the option is confirmed and the attack line snapshot point.

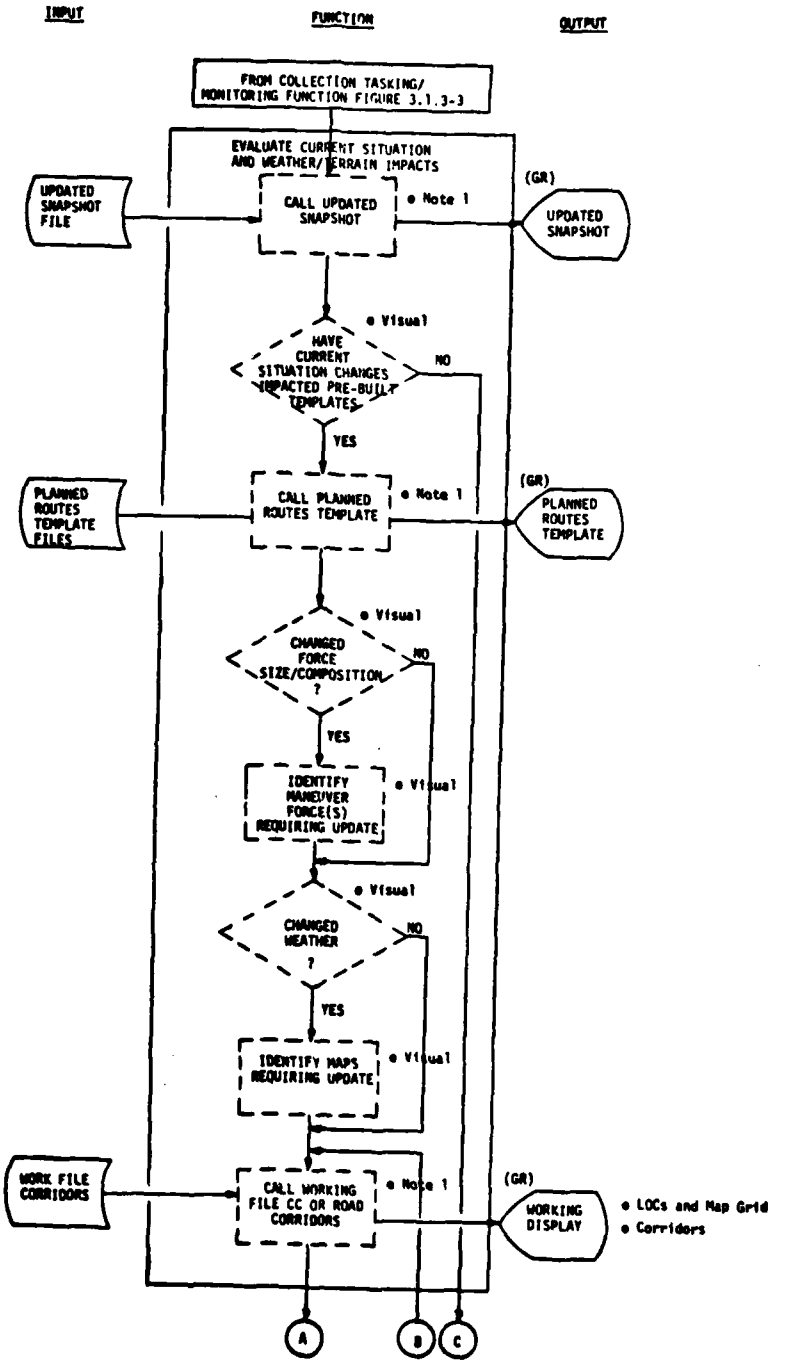


Figure 3.1.3-4. Intelligence Estimate Development Function (Sheet 1 of 3)

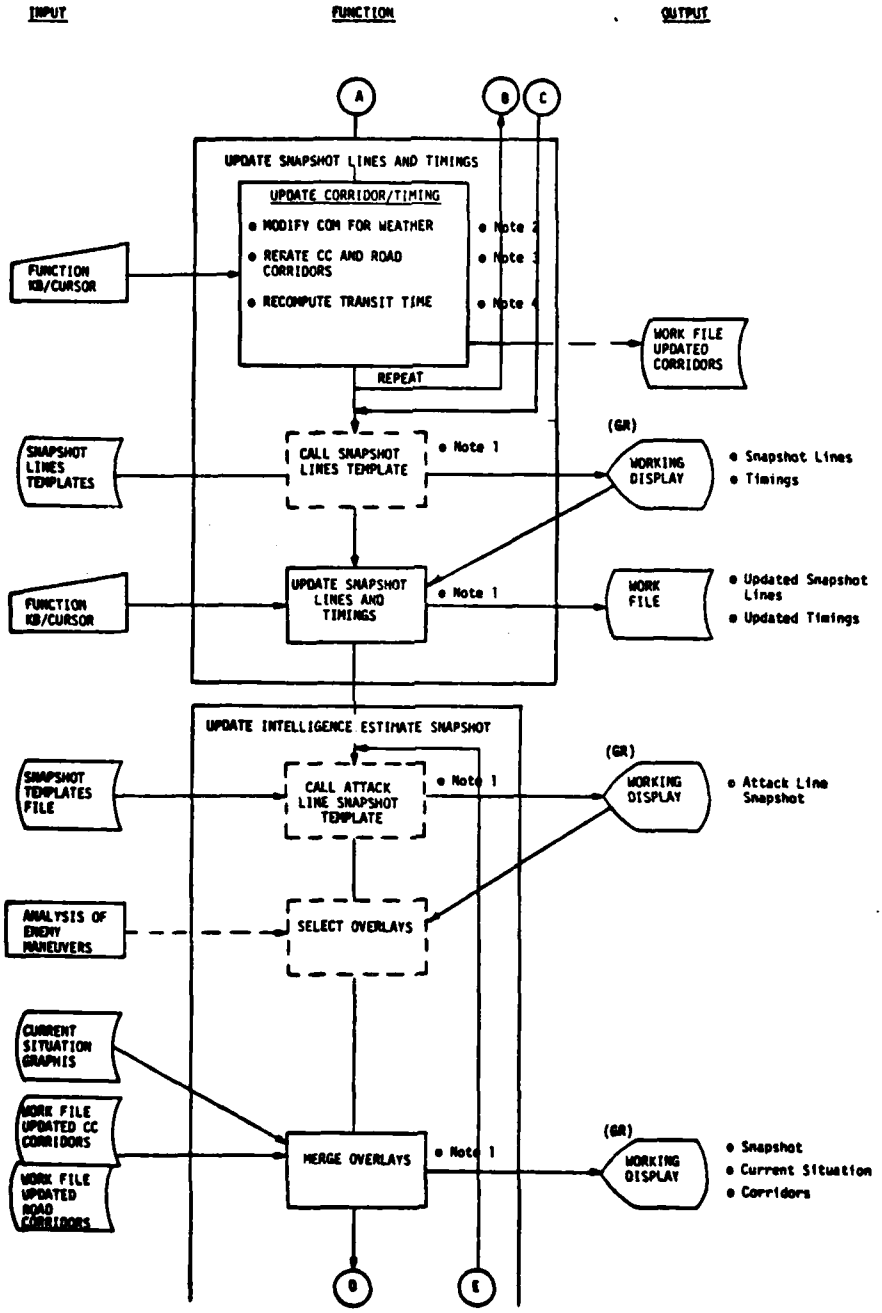


Figure 3.1.3-4. Intelligence Estimate Development Function (Sheet 2 of 3)

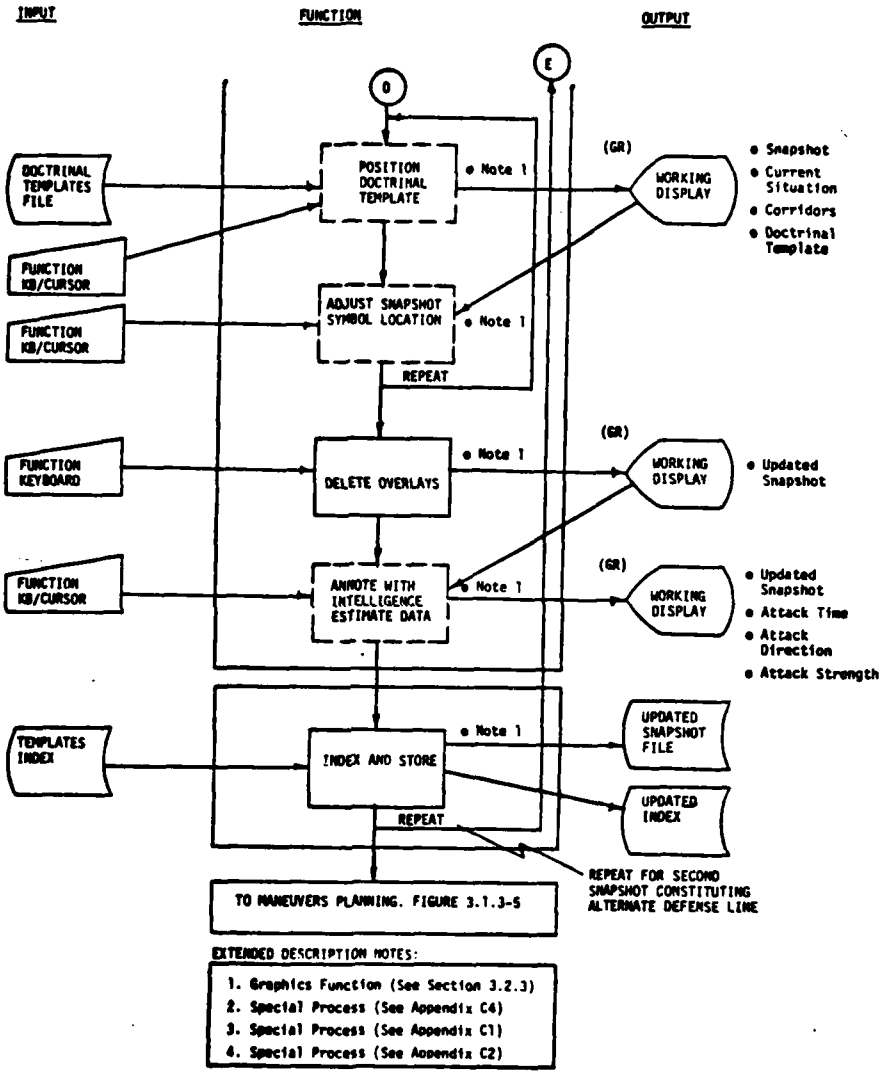


Figure 3.1.3-4. Intelligence Estimate Development Function (Sheet 3 of 3)

He next updates the pre-built Attack Line Snapshot Template which together with the Snapshot Lines Template will constitute the basis of the intelligence estimate. To update this template, he may use a variety of merged overlays as indicated by the diagram. He may superimpose on the graphic screen at one time, the pre-built snapshot, the mobility corridors overlay, and groups of symbols that are cursor designated to be transferred from the current situation monitor. Superimposed on this working display, he locates and orients a doctrinal template. He then adjusts the positions of individual symbols making up the snapshot. If a difference in force size/composition is indicated, he adds or deletes or modifies symbols. If a difference in corridors is indicated, he relocates individual symbols or groups of symbols to suit his interpretation of enemy doctrine fitted to the terrain and weather.

The analyst adjusts pertinent military data including attack line, line of contact, phase lines and military boundaries. He causes the corridor, doctrinal template and current situation overlays to be deleted, leaving the updated snapshot information on the working display.

When satisfied with the template picture including the second echelon projected and first echelon existing forces, the analyst annotates the graphic to include expected attack time, total force size and direction of attack. He adds an identifying number and time stamp and stores the product in the system permanent file. The system automatically updates its indexes to reflect this item.

The analyst may repeat this process for another snapshot of this same option. The purpose would be to provide the G-3 maneuvers analyst with an alternate line at which to plan a main defense.

3.1.3.2 Operations Functions Support

IPB products are also useful in supporting some of the functions which are the responsibility of the G-3 staff. G-3 product use during hostilities generally begins with the G-2's prediction of the enemy's probable corridors of advance, attack locations, force sizes, and time of attack. The G-3 support functions are oriented toward using IPB data to determine feasibility of maneuver actions in response to the predicted enemy movement. Such functions may well be incorporated into systems other than the ASAS. However, the use of basic IPB data (provided by the ASAS) would be of value in several G-3 activities.

The IPB products which may be used by the G-3 staff include:

- Terrain composite overlays
  - CCM
  - COM
  - Mobility corridors
  - Intervisibility corridors
- Weather Overlays
- IPB Template Products
  - Snapshots
  - Situation Templates
  - Target Analysis Matrixes
  - Target Templates
  - "Best" Decision Alternative Templates
- Special Processes
  - Corridor Rating/Painting
  - Route Timing
  - Combat Power Ratio
  - Symbol Matching

Extracts from the Current Situation (both ENSIT and FRENSIT) graphics as well as A/N data base are essential in supporting G-3.

The objective of the use of IPB products is to facilitate the efforts of the Maneuvers Section and the Fire Support Element of the TOC to develop feasible, alternative courses of action which can be presented to the commander for decision and then implementation. Section 3.1.3.2.1 explains IPB support to the maneuver planning and Section 3.1.3.2.2 support to fires planning.

3.1.3.2.1 Maneuver Planning

The IPB products used in this function are:

- Templates
  - Snapshots
  - Decision Alternative
  - Terrain and Intervisibility
- Special Algorithms
  - Route Timing
  - Symbol Matching
  - Combat Power Ratio
  - Symbol Replot
  - Intervisibility Corridor Paint and Rate

A detailed presentation of how IPB products are used to support maneuver planning is contained in Figure 3.1.3-5. Feasible (or achievable) alternatives can be developed rapidly by analyst interaction with IPB. Once the Intelligence Estimate is made and the enemy option (course of action) identified, the major factor governing friendly force reaction is time available. The analyst can select the predicted enemy disposition using the snapshot line display which identifies snapshots and time intervals. The analyst selects the pre-prepared "best" or "optimum"

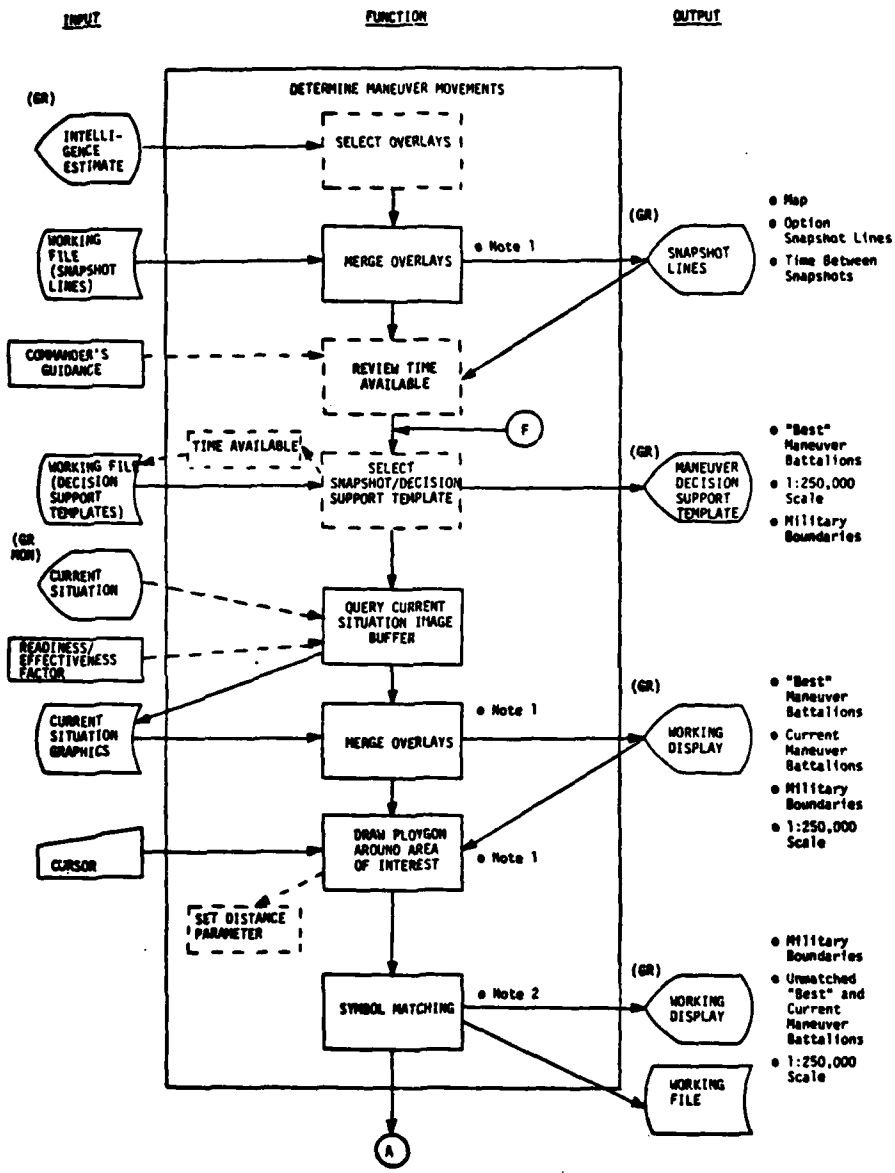


Figure 3.1.3-5. Maneuver Planning Function (Sheet 1 of 5)

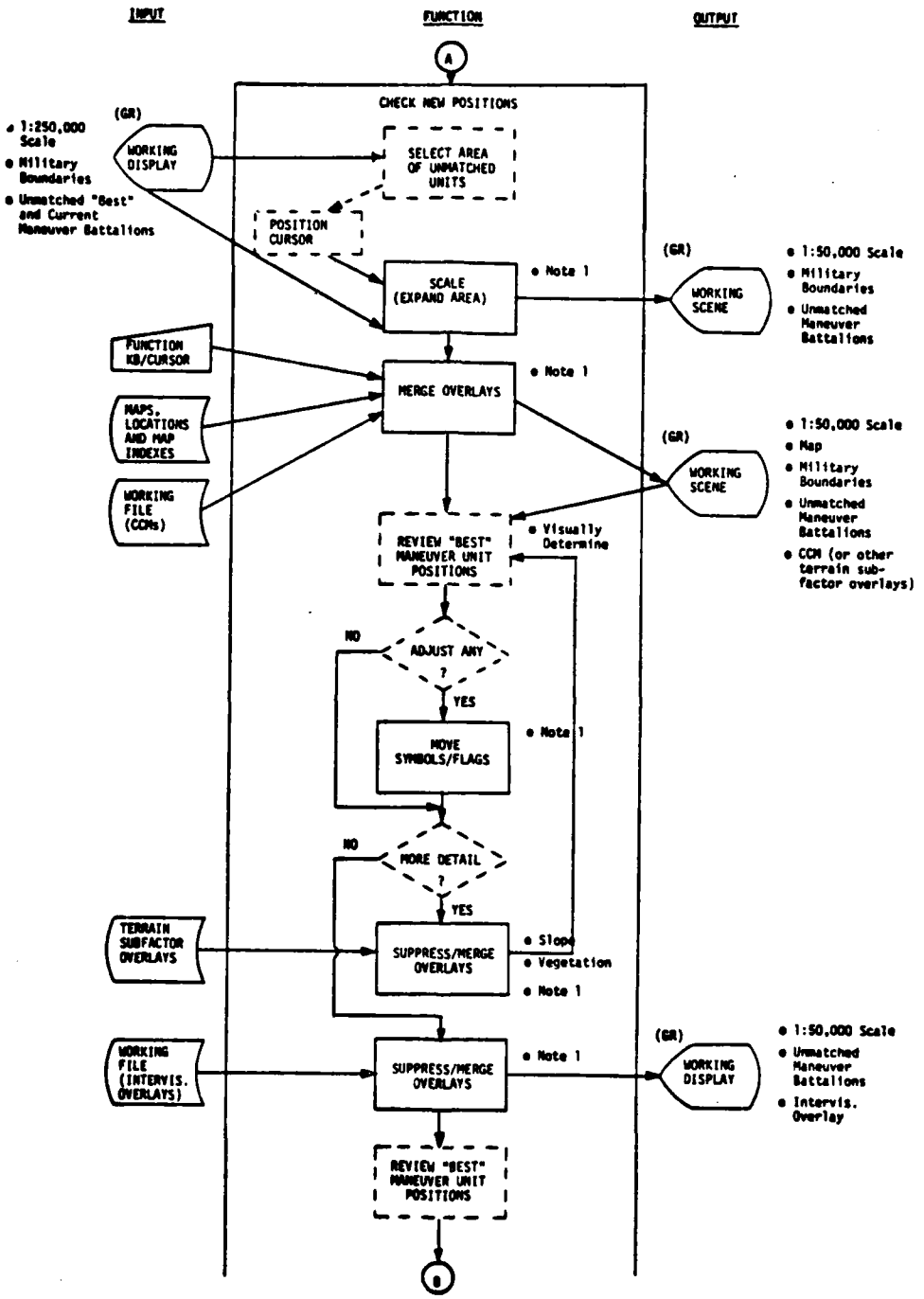


Figure 3.1.3-5. Maneuver Planning Function (Sheet 2 of 5)

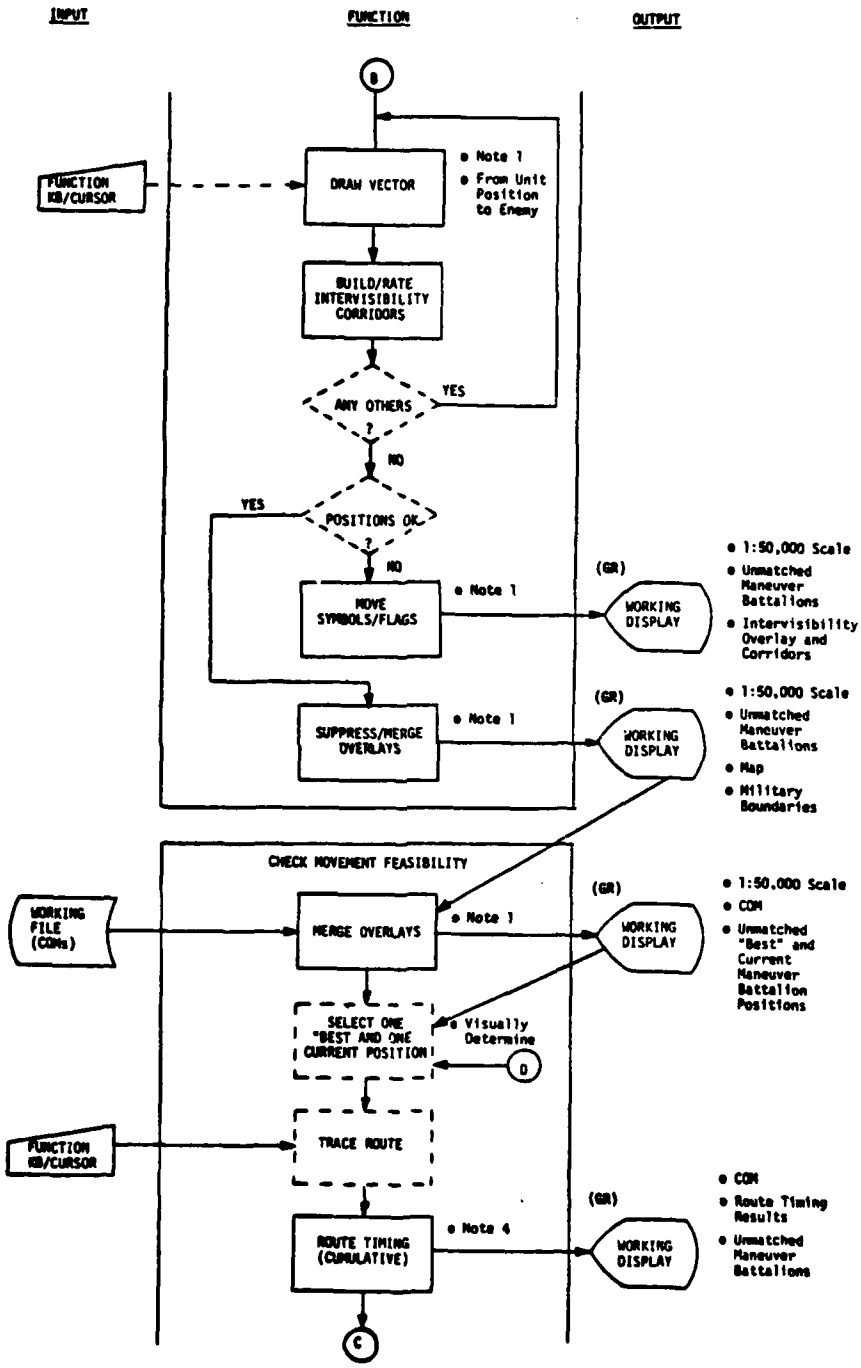


Figure 3.1.3-5. Maneuver Planning Function (Sheet 3 of 5)

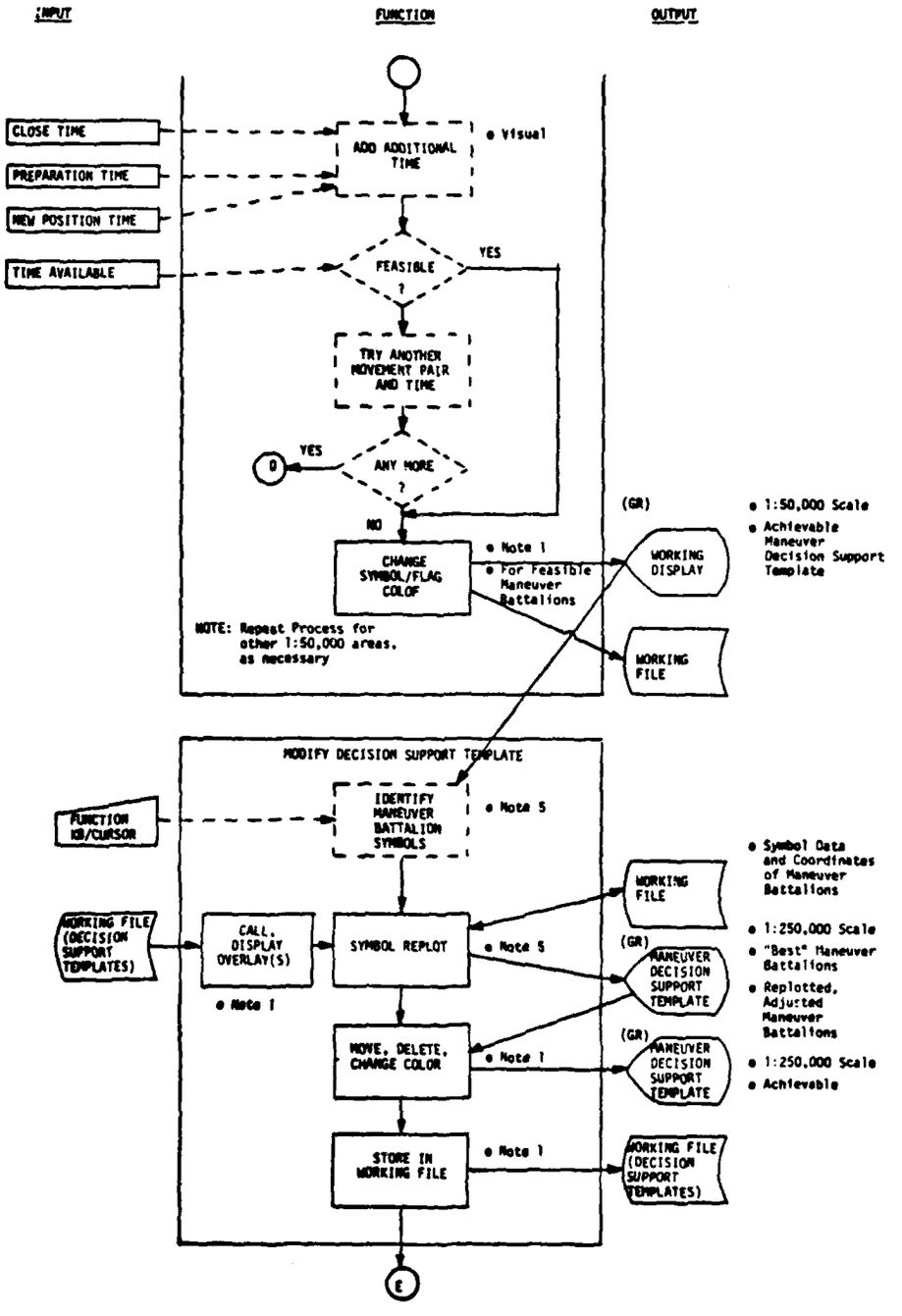


Figure 3.1.3-5. Maneuver Planning Function (Sheet 4 of 5)

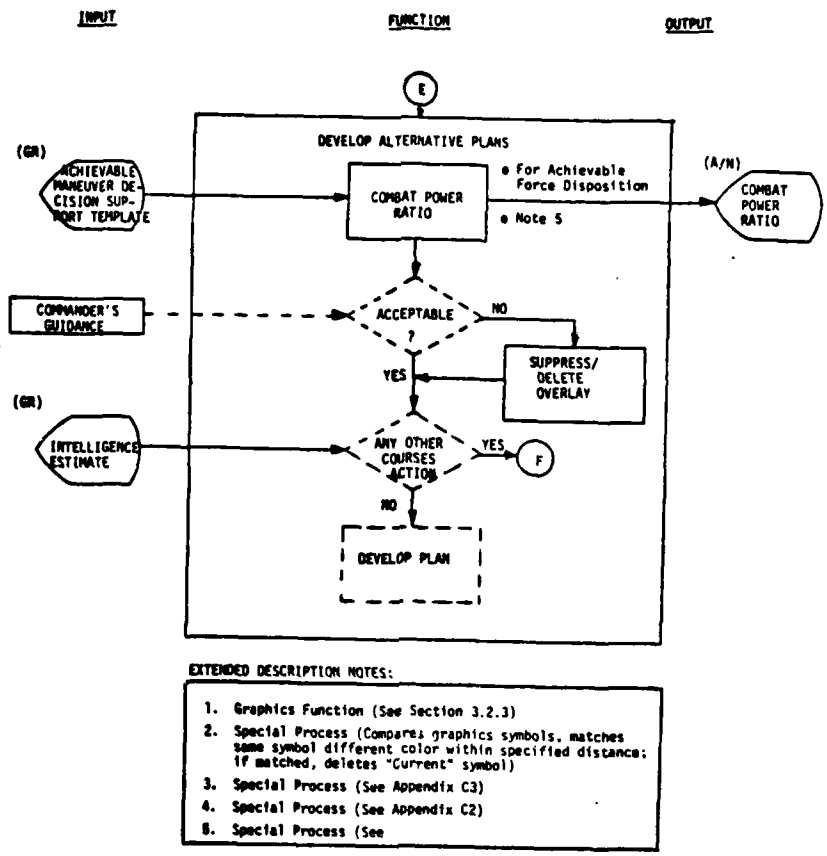


Figure 3.1.3-5. Maneuver Planning Function (Sheet 5 of 5)

maneuver decision alternative template (Section 3.1.2.3.8). By using the symbol matching algorithm the analyst tests the general location of the desired number of maneuver battalions with the current FRENSIT to determine which desired positions are already fulfilled by existing maneuver battalions, which desired positions can be fulfilled only by moving a battalion from its present location and which battalions are "available" to be relocated. Note, that the two displays use different colors for friendly unit symbols, e.g., blue for current, cyan for "best" to facilitate visual comparison. This technique rapidly establishes the movement feasibility issue: Can we get from here to there in the time available?.

Prior to testing that feasibility, the analyst verifies the suitability of the desired position. IPB CCM, Slope and Vegetation as well as LOC overlays are used to make this check. Adjustments to positions, if desired, can be readily accomplished using IPB graphics functions. Suitability of proposed positions is also checked with regard to intervisibility.

Movement feasibility is then ascertained by using the IPB Route Timing algorithm. The route from the current location of a maneuver battalion to one (or more) proposed locations is traced and the cumulative movement time is automatically computed and displayed. The analyst must add other (non-travel) times to this figure and compare the total to the time available. Depending upon his judgement that a unit can be moved to its new location in time, the analyst continues to seek to accomplish the planned friendly maneuver force disposition to meet the expected enemy action. Each of the detailed 1:50,000 scale resulting graphics are stored for later use.

Next, the analyst reconstructs the 1:250,000 scale maneuver decision alternative templates, changing from a planned to an achievable display. To do this the special graphics function "Symbol Replot" is required.

On each of the 1:50,000 scale displays on which the analyst worked out achievable future/probable locations for maneuver units he identifies those locations and types of units by invoking Symbol Replot and positioning the cursor at each location to be saved. The symbol display data and UTM coordinates are automatically stored. After doing this operation for each 1:50,000 scene the analyst completes the symbol replot by first calling the "best" planned maneuver alternative and merging the achievable maneuver locations on the 1:250,000 scale display. He then adjusts the graphics display by eliminating planned positions which have been modified to be achievable and/or changing color/blinking planned position symbols which cannot be achieved. The completed scene is re-titled "achievable" and stored for later reference.

The analyst then checks the maneuver plan--the achievable template--for suitability, i.e., Does it provide for an acceptable combat power ratio? The analyst invokes the Combat Power Ratio algorithm by defining the area of interest. The ratio appears on the A/N CRT. The analyst then is either satisfied that he would present this plan to the commander as a viable alternative course of action or he discards it. Other alternatives can be prepared in like manner by repeating the process with a different decision alternative template.

3.1.3.2.2 Fires Planning

IPB products used in conjunction with the current situation display to support this function include:

- Target Analysis Matrixes
- Fires Decision Alternative Templates
- Target Templates
- Terrain and Intervisibility Overlays

- Special Algorithms
  - Route Timing
  - Intervisibility Corridor Paint and Rate

A detailed presentation of how IPB products are used in fires support planning is contained in Figure 3.1.3-6. Feasible fires planning in support of the alternative maneuver courses of action can be accomplished rapidly by the analyst using IPB products. The starting point depends upon Commander/G-3 guidance. If the analysis performed in Section 3.1.3.2.1, Maneuver Planning, indicates that insufficient time is available for friendly reaction, and diversion of enemy operation is advisable, fires planning may begin at an earlier snapshot point than the maneuver plan. For example, G-3 may want to interdict the enemy to slow the advance or cause a change to the enemy route. Based upon guidance the analyst selects a specific maneuver decision alternative template and the corresponding target analysis matrix to update. The analyst calls and displays the corresponding target template which provides a display of probable targets and is used in conjunction with the matrix. The analyst selects a value for the "worth" of each target using guidance received and his professional judgement. Suggested values of target worth are:

10 = vital (Analogous to Priority I per FM 6-20)
20 = important (Analogous to Priority II per FM 6-20)
30 = supporting (Analogous to Priorities III and IV per FM 6-20)
40 = not part of the operation
50 = unimportant

Each definition refers to the relative importance to the enemy in terms of the success of his operation. The target analysis matrix is updated via the alphanumeric keyboard.

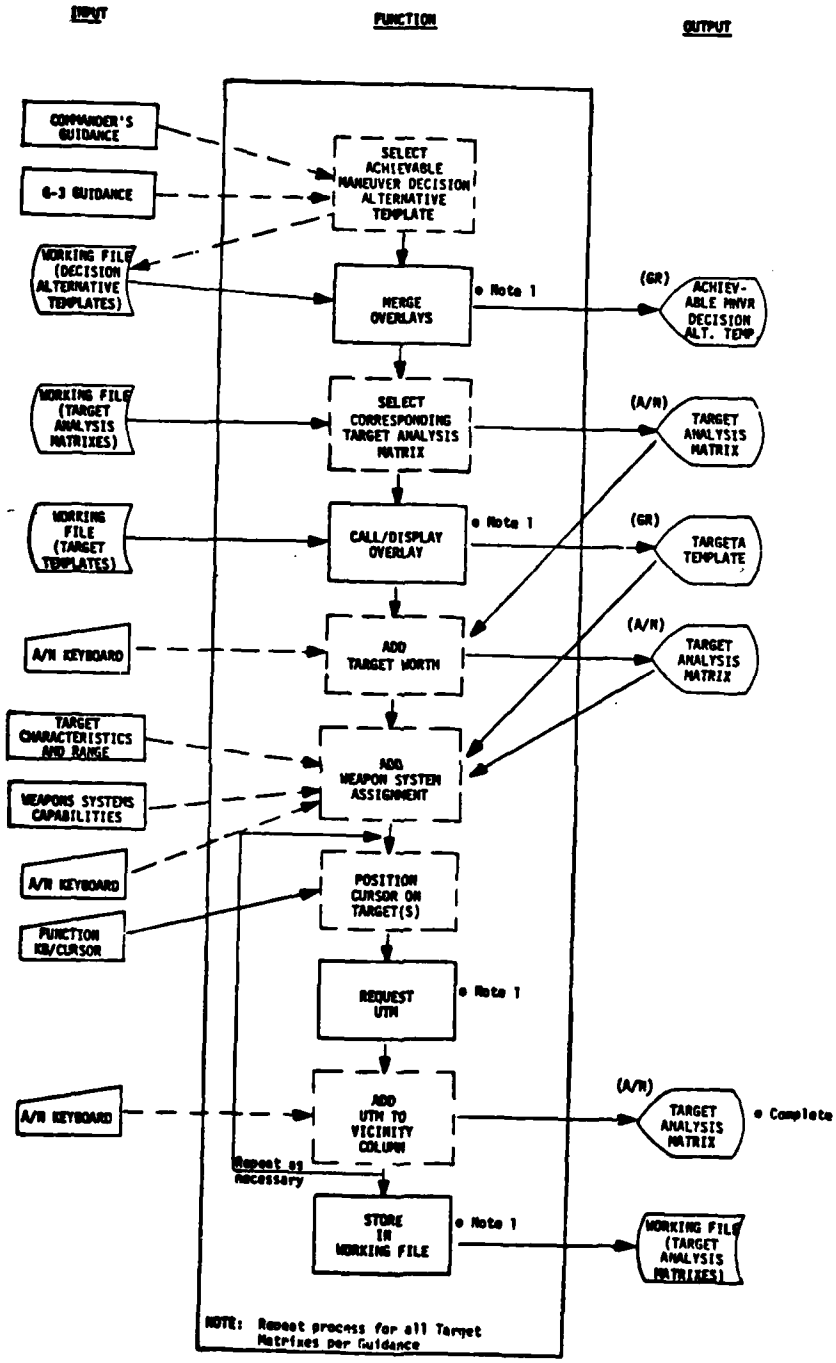


Figure 3.1.3-6. Fires Planning Function (Sheet 1 of 3)

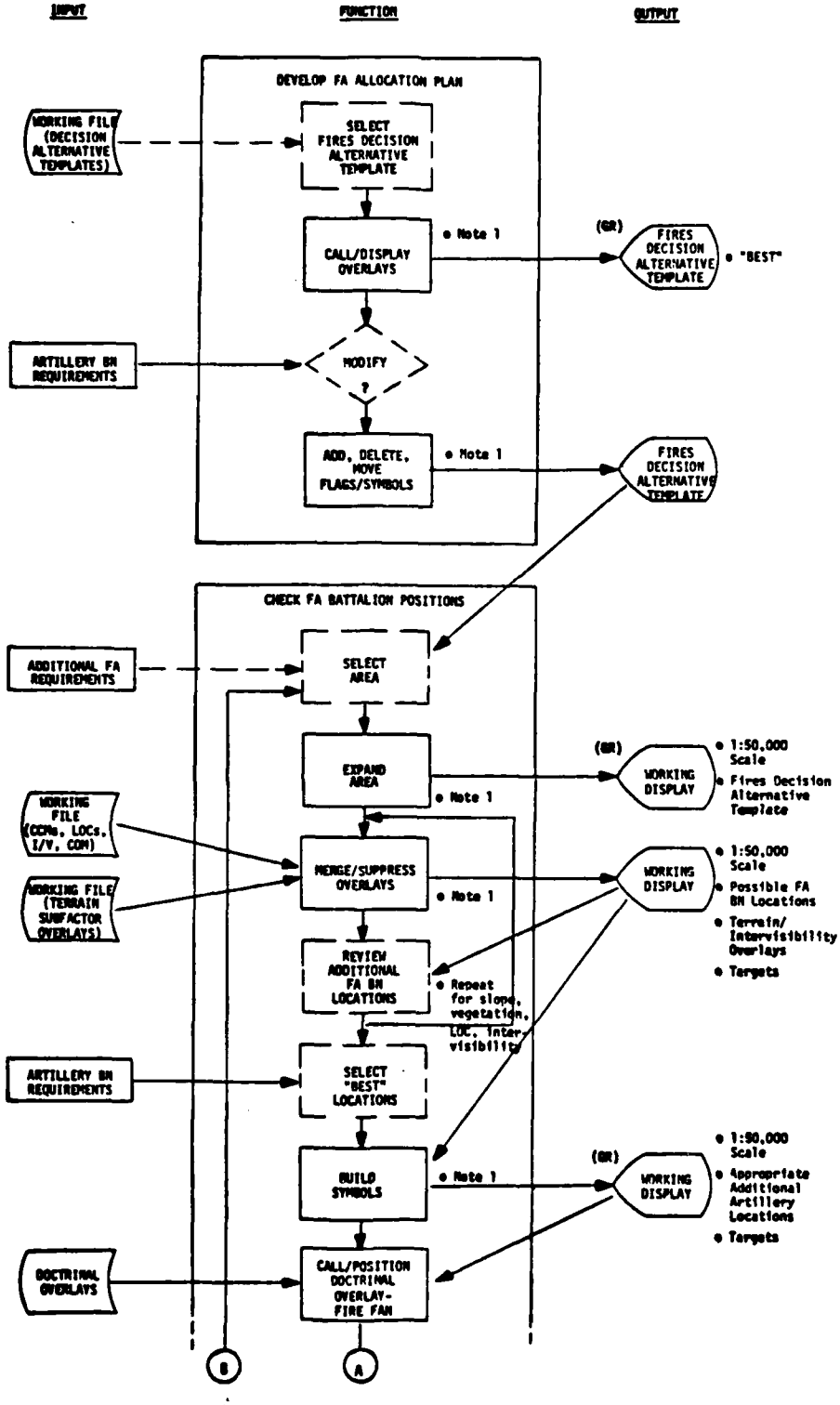


Figure 3.1.3-6. Fires Planning Function (Sheet 2 of 3)

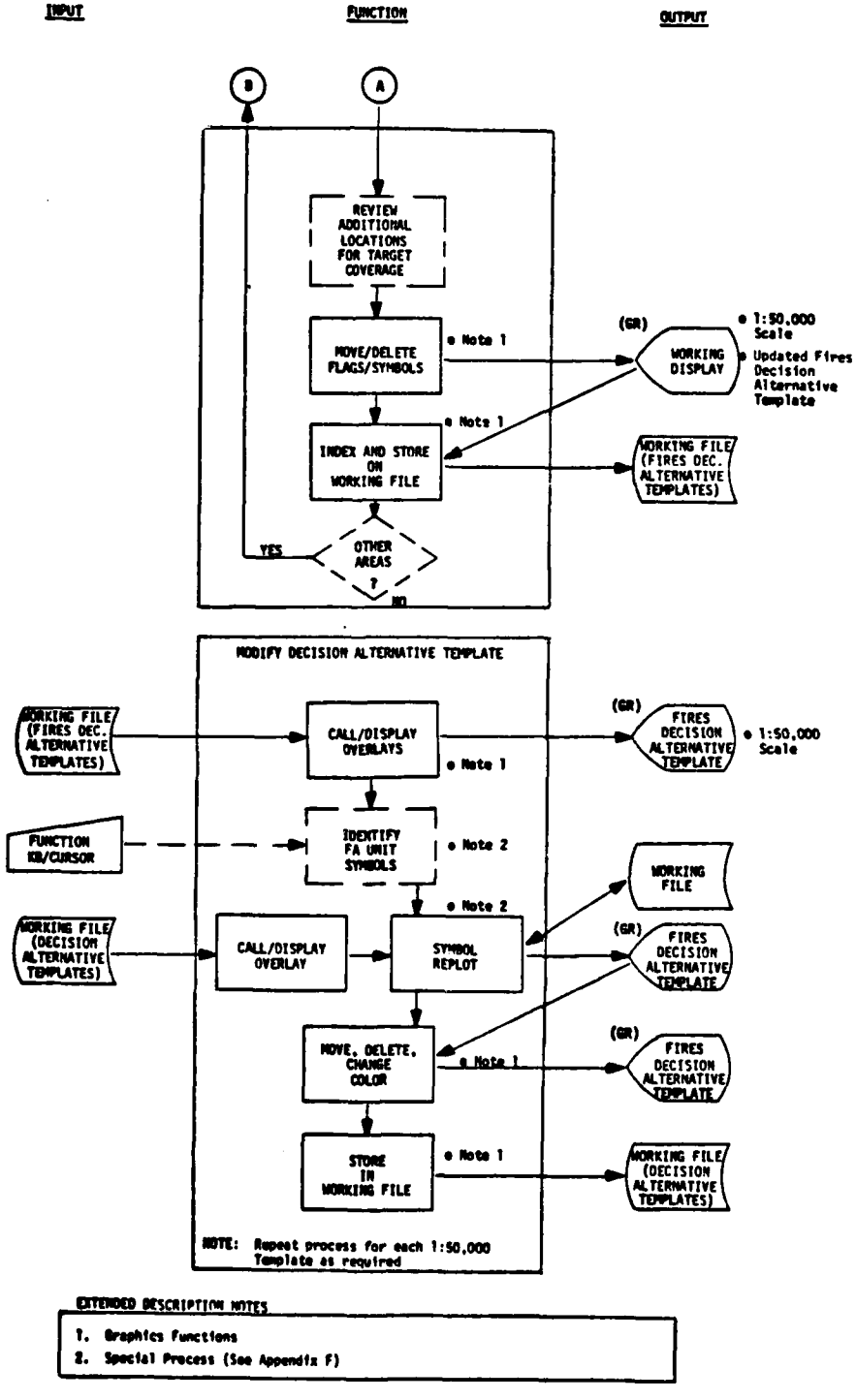


Figure 3.1.3-6. Fires Planning Function (Sheet 3 of 3)

Using knowledge of the characteristics of the targets listed and their range as viewed on the target template the analyst makes a decision as to weapons systems to assign, i.e., close air support or field artillery. He may also apply commander's guidance to indicate, for example, that an emitter target is to be jammed rather than destroyed. Again, using the A/N keyboard the analyst completes this column of the target analysis matrix. The analyst also completes the vicinity column of the target analysis matrix by employing the graphics function "UTM"--the UTM coordinates of the cursor appear in the lower left corner of the graphics CRT. By successive cursor positioning on any of the targets applicable and typing the corresponding coordinates on the A/N keyboard the vicinity of each target is entered in the matrix. Figure 3.1.3-7 is an example of a completed target analysis matrix. A copy of the matrix would be transmitted to the collection resources manager, and other sections of G-2 and G-3.

With the updated matrix still on the A/N CRT, the analyst calls up the "best" or optimum fires decision alternative template previously prepared. Since specific judgements have now been made regarding weapons systems assignments and maneuver planning, more specific fire support planning may be accomplished. A new determination as to FA support required to service the target array to be assigned to FA attack is used to modify the allocation of FA battalions. The IPB capability to move, add, delete flags and symbols enables the analyst to quickly update the template.

Once a quantitative decision has been reflected on the graphics CRT, the analyst is ready to review possible, suitable artillery battalion locations. IPB products such as terrain subfactor overlays, intervisibility overlays and corridors facilitate this process. It must be emphasized that the analyst is not attempting to perform a responsibility normally the prerogative of the unit commander in the

TARGET ANALYSIS MATRIX - A5

PG 1 OF 2PGS

TGT SEQ #	TARGET TYPE	TARGET DESCRIPTION	PERM	HOURS 1	2	3	VICIN	TAI	WRTH	WPNSYS ASSIGN
A5A1	EMIT	ARTY BTRYS	STA	X			PL350940	A5A	20	FA
A5A2	SHOOT	ARTY BTRYS	STA	X			PL350930	A5A	20	FA
A5A3	MOVE	TRP/VEH CON CENTRATION	CONT MOVE		X		PL365910	A5A	30	
A5A4	MOVE	TRP CONCEN-TRATION	EXP STOP		X		PL340980	A5A	10	AIR
A5A5	EMIT	MET RADAR/ ROCKET MSL POSITION	STA	X			PL380835	A5A	30	JAM
A5B1	EMIT	ARTY BTRYS	STA	X			PL310690	A5B	10	JAM
A5B2	MOVE	TANK CONCEN TRATION	EXP STOP		X		PL390580	A5B	10	FA
A5B3	EMIT	RGT CP	EXP MOVE	X			PL380920	A5B	10	INTCPT

Figure 3.1.3-7. Completed Target Analysis Matrix

field. A gross feasibility check is advantageous, however. Time may be saved by general indication of suitable areas for the FA unit commander to do a more detailed survey. As shown in the subfunction "Check FA Bn Positioning" the analyst uses IPB to perform a gross search with respect to slope, vegetation, accessibility by suitable LOC and intervisibility. The graphics plot is modified as necessary until each area of concern has been reviewed.

The last step is similar to that used in maneuver planning wherein the 1:50,000 scale detailed plots of appropriate locations for FA battalions are replotted on a 1:250,000 scale display. The special graphics function Symbol Replot is used to support this step. The result is an achievable fires decision alternative template. Other alternatives can be prepared in like manner by repeating the process with a different achievable maneuver decision alternative template.

3.1.3.3 Commander's Decision Support

The decision support template is a graphic portrayal of probable enemy courses of action and corresponding friendly courses of action. The purpose of decision support templates is to present alternatives to the commander in a manner which facilitates comparison of advantages and disadvantages such as risk, time available and combat power ratios. Decision support templates are more flexible in their content than most of the other IPB templates and the interactive features of the system are necessary to support this ad hoc process. The system graphics function DRAW (free form figures, shading, variation of color intensity) is essential to enable the IPB analyst to rapidly augment other templates/ working displays in building the decision support templates and to make modifications as directedd by the commander.

Figure 3.1.3-8 depicts the process by which a decision support template is prepared and presented to the commander for his consideration. A defensive plan has been used as the example, but friendly offensive operations may be portrayed on the IPB decision support template also. Not shown in Figure 3.1.3-8, but also available in the IPB system are more detailed 1:50,000 scale displays of terrain features which may be used to show significant areas of operation.

Should a preliminary decision support template have been prepared during the G-3 build phase (see Section 3.1.2.3.8) it would be used to initiate the process. Otherwise, the initial display is constructed by merging the planned routes (for the appropriate enemy options), the line of contact and military boundaries from the current situation graphics data base on a map of the area. The analyst uses system graphics features such as changing color or intensity or pattern of the planned routes to highlight the option which the enemy is thought to be executing.

Using one of the maneuver courses of action as represented by a maneuver decision alternative template, the analyst adds to the graphics display:

- Line(s) of defense and/or phase lines
- Time available (to execute this course of action)
- Symbols generally depicting key elements of the operation, i.e., attack positions, defended areas, landing zones or drop zones.

The system capability required to facilitate this process consists of building a new overlay from an existing display. Once the "new overlay" graphics function is initiated, the analyst indicates on the CRT those

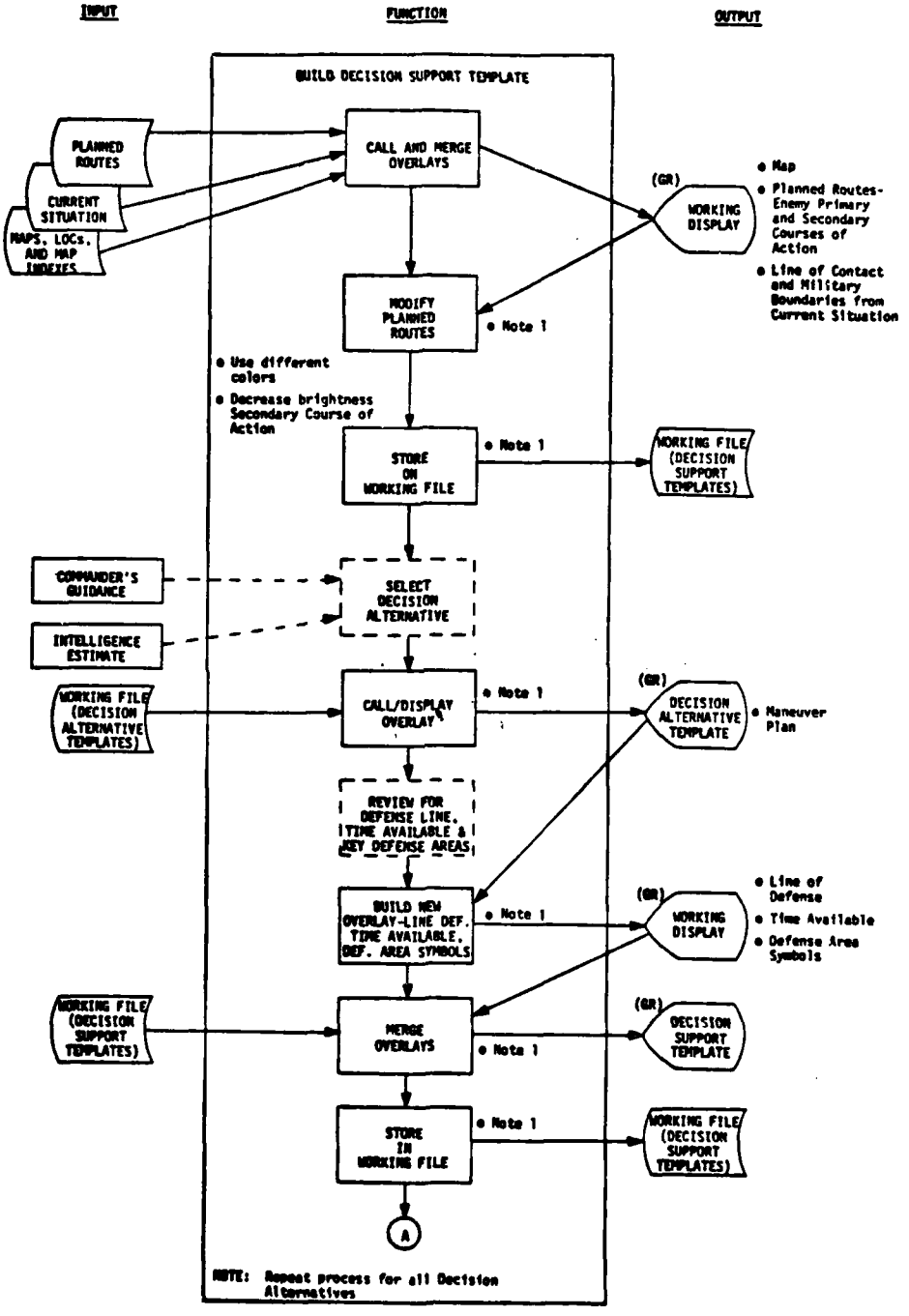


Figure 3.1.3-8. Commander's Decision Support Function (Sheet 1 of 2)

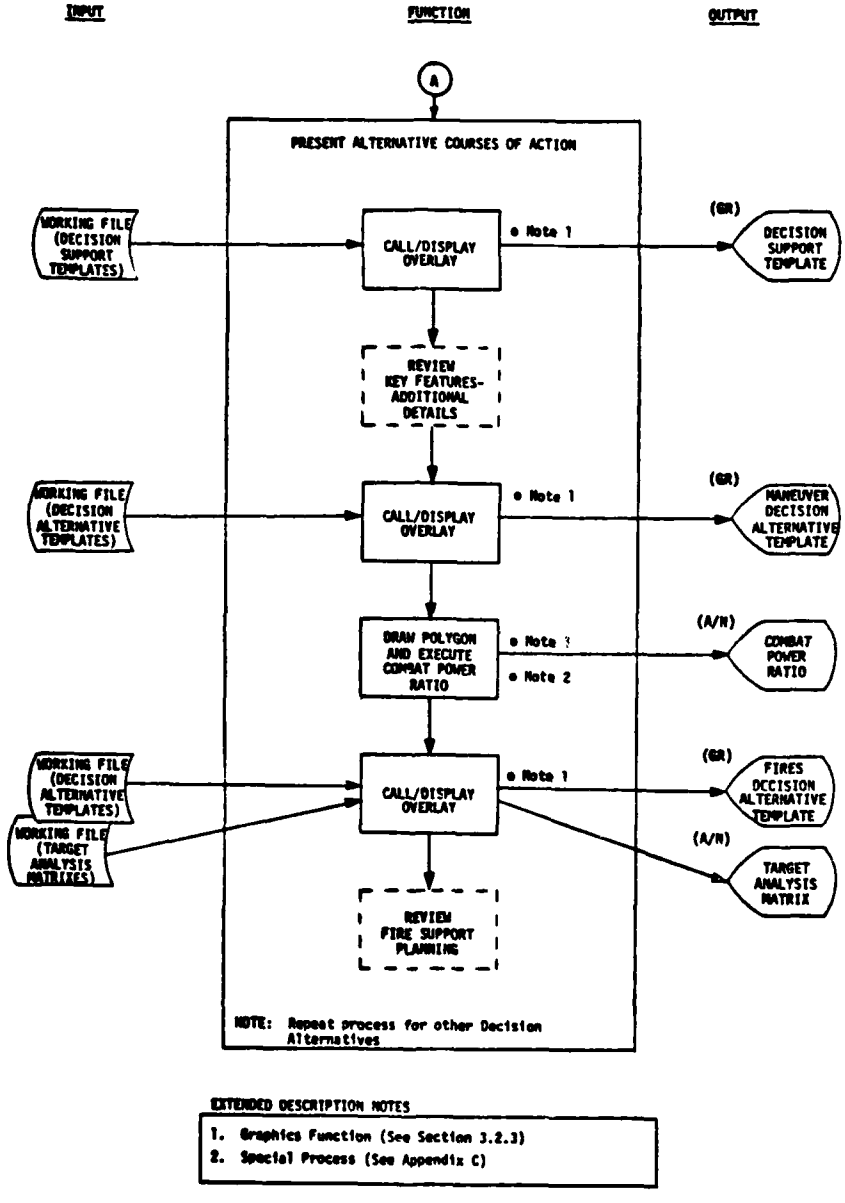


Figure 3.1.3-8. Commander's Decision Support Function (Sheet 2 of 2)

features which he desires to use in the new display. "Hooking" a symbol/flag, changing its color or blinking it, for example might serve as the way that symbol/flag is retained on the new display. A second way the analyst could create the new display is by deleting unwanted elements of the current display.

Once this "new overlay" is on the graphics CRT, the previously prepared (partial) decision support template is recalled from temporary storage and merged. This operation completes one decision support template. Others, as necessary, are similarly prepared.

Since decision support templates, in themselves, are not intended to present accomplished decisions to the commander, the next subfunction is to prepare one or more of these templates to the commander for his consideration and comment. As indicated in Sheet 2 of Figure 3.1.3-8 this process involves displaying a decision support template on the graphics CRT, augmenting it as necessary with maneuver details--represented by the maneuver decision alternative template and with the fire support planning--represented by the fires decision alternative template and the target analysis matrix. The essence of each friendly course of action is presented to the commander in graphic and A/N format. The ensuing discussion between the commander, G-3 and G-2 may require modification of one or more decision support templates. The analyst will make online changes during the discussion. The result would be useful graphic and alphanumeric expressions of the commander's decisions regarding operating plans.

Figure 3.1.3-9 is one example of a decision support template. The primary enemy course of action--a double envelopment attack by two second echelon divisions is shown in blue, an alternative--a penetration attack is shown in red, and the friendly line of defense is shown by dashed white lines. Additional symbols were not used in this example.

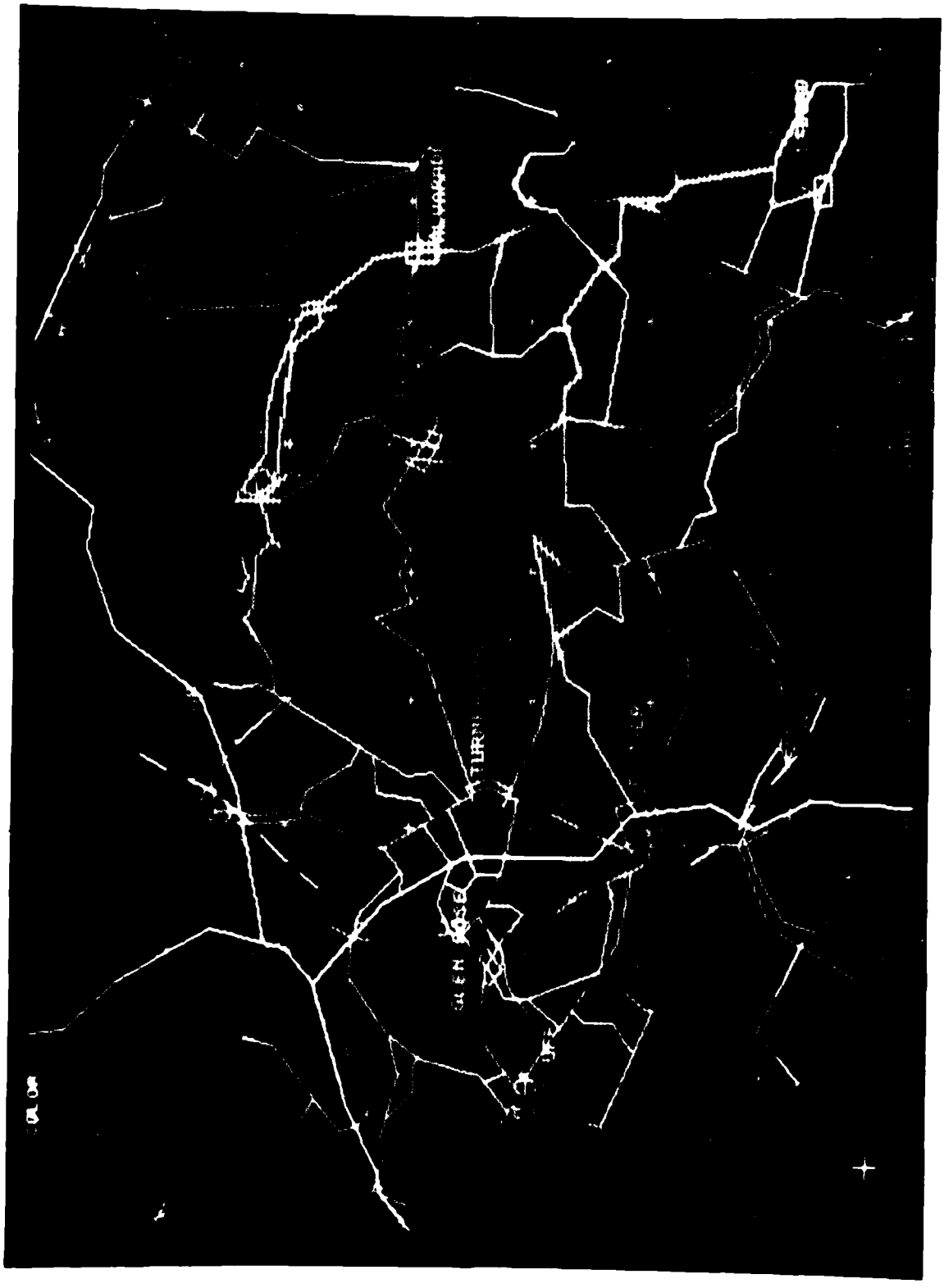


Figure 3.1.3-9 Example of Commander's Decision Support Template

3.2 SYSTEM SOFTWARE FUNCTIONS

The system attributes required to support IPB applications described in previous sections provide the foundation for the function definitions in this section. The focus is on the application-independent system software for IPB as part of an ASAS.

3.2.1 Operating/Control System Software Functions

The operating/control system software functions of IPB are similar to other ASAS applications. They include:

- Task/job initiation and termination
- Task and subtask management
- Device support
- Data management
- Software development facilities.

Task/Job Initiation and Termination

This function allows tasks or jobs to be initiated in a multi-tasking or multiprogramming environment. Tasks shall be initiated as background jobs or as online/real time jobs. Resources such as main memory, terminals, peripheral devices and data sets shall be allocated or assigned at task initiation and released at task termination.

Task/Subtask Management

This function allows tasks to spawn subtasks and tasks and subtasks to be executed on the basis of relative priority. This function manages internal and external interrupts and supervises the dynamic utilization of system resources.

Device Support

This function provides physical I/O handling for the devices required for IPB. These devices are direct access storage devices (disks), magnetic tape, alphanumeric terminals, colorgraphic displays and a graphic data tablet. I/O support for the colorgraphic displays is discussed further in Section 3.2.4.3.

Data Management

This function provides data management services or access methods for a device independent interface between application programs and the physical devices. The allocation of specific devices to application programs occurs at task initiation. The data management services shall provide a high level macro language for application programmers. Sequential, indexed sequential, partitioned, direct and telecommunication access methods are required.

Software Development Facilities

This function provides software development facilities for IPB application programming. The facilities required are:

- Compilers - FORTRAN, COBOL (for example)
- Assembler - Basic assembly language with macros
- Library Support - Structured programming support library
- Utilities - data transfer and data manipulation.

3.2.2 Terminal Processing Software Functions

The terminal processing software functions described in this section can be part of the operating/control system or execute as tasks running under the control of the operating/control system. The terminal processing software functions include:

- Terminal/display interface
- Online task supervision and event driven cycling
- Display formatting
- Terminal to terminal communications
- Online utilities.

Terminal/Display Interface

This function provides the software interface for the alphanumeric terminals and the colorgraphic displays. This interface shall support multiple terminals interfaced with the same or different data base management and graphic application programs. The interface shall support both demand and queued I/O. Queued I/O shall be supported with input error corrections and output paging capabilities.

Online Task Supervision and Event Driven Cycling

This function involves supervising the dynamic execution of data base management and graphic application programs based on operator interaction with the IPB terminals and displays. It includes dynamic resource management and subtask control based on terminal or event priority. This software supports event driven cycling of data base management and graphic application programs. This means that an application program shall be able to initiate or change a cycle of program executions based on the results of processing a particular input.

Display Formatting

This function provides the user oriented terminal interaction required for IPB activities. The alphanumeric terminal operator shall be able to call up display formats for data entry, query preparation, report selection and message generation. The display contents shall consist of prestored information, data from the data base management system or data to be entered by the terminal operator.

Terminal to Terminal Communications

This function can be ad hoc or automatic, that is, initiated by a terminal operator or initiated by an application program. The terminals involved are the alphanumeric terminals. Two modes of terminal to terminal communication are required. These are alert messages, which are immediately displayed on the bottom line of the display, and queued messages, which are placed on a message queue with an alert message to the operator to inform him that a message has been placed in the queue.

Online Utilities

These functions support the online interactive environment of the IPB analyst. The following capabilities are required:

- Online creation, modification, display and deletion of working files
- Printing of display contents, data sets and messages
- Terminal to computer operator messages
- Input and output queue management.

3.2.3 Data Base Management Software Functions

The data base management software shall support the IPB applications in a flexible manner to enable the IPB analysts to:

- Enter and retrieve all required data from the data base
- Automatically process inputs and outputs in a flexible manner to permit easy direction, tailoring, and highlighting of important information
- Readily pursue important information leads on an ad hoc basis
- Easily communicate results to other analysts and interfacing systems.

The basic data base management software shall contain capabilities for:

- Structure and structure revision of a broad set of files. This will ensure that as the application functions evolve, the data base can flexibly change to meet the new requirements in a time responsive manner.
- Complete background and online file maintenance to include initialization, change and purge of data contained within the various structured files.
- Online query processing to retrieve and output data to using analysts or graphic application programs.

Figure 3.2-1 presents an overview of the system environment, inputs, processes, and outputs which shall be incorporated in the data base management software function. Basic inputs are in the form of:

- Local terminal network inputs
- Graphic processing inputs
- Background task initiations.

Basic outputs are:

- Local terminal network outputs
- Outputs to graphics processing (qualified record data for graphical display).

In addition to these specific inputs and outputs, the data base is an input/output for many of the IPB processes.

3.2.3.1 File Structuring/Revision

The file structuring/revision subfunction permits the creation and reorganization of file structures which are supportive of the IPB functions. This subfunction permits non-programmers to specify data structures required to support the applications and evolutions of these applications. This is accomplished by a simple language convenient to the user. The file structuring subfunction, together with the operating/control system, shall permit a high degree of independence from the physical data storage.

File Concept

The system shall permit management of a broad spectrum of data in an organizational manner equivalent to the hierarchical organization

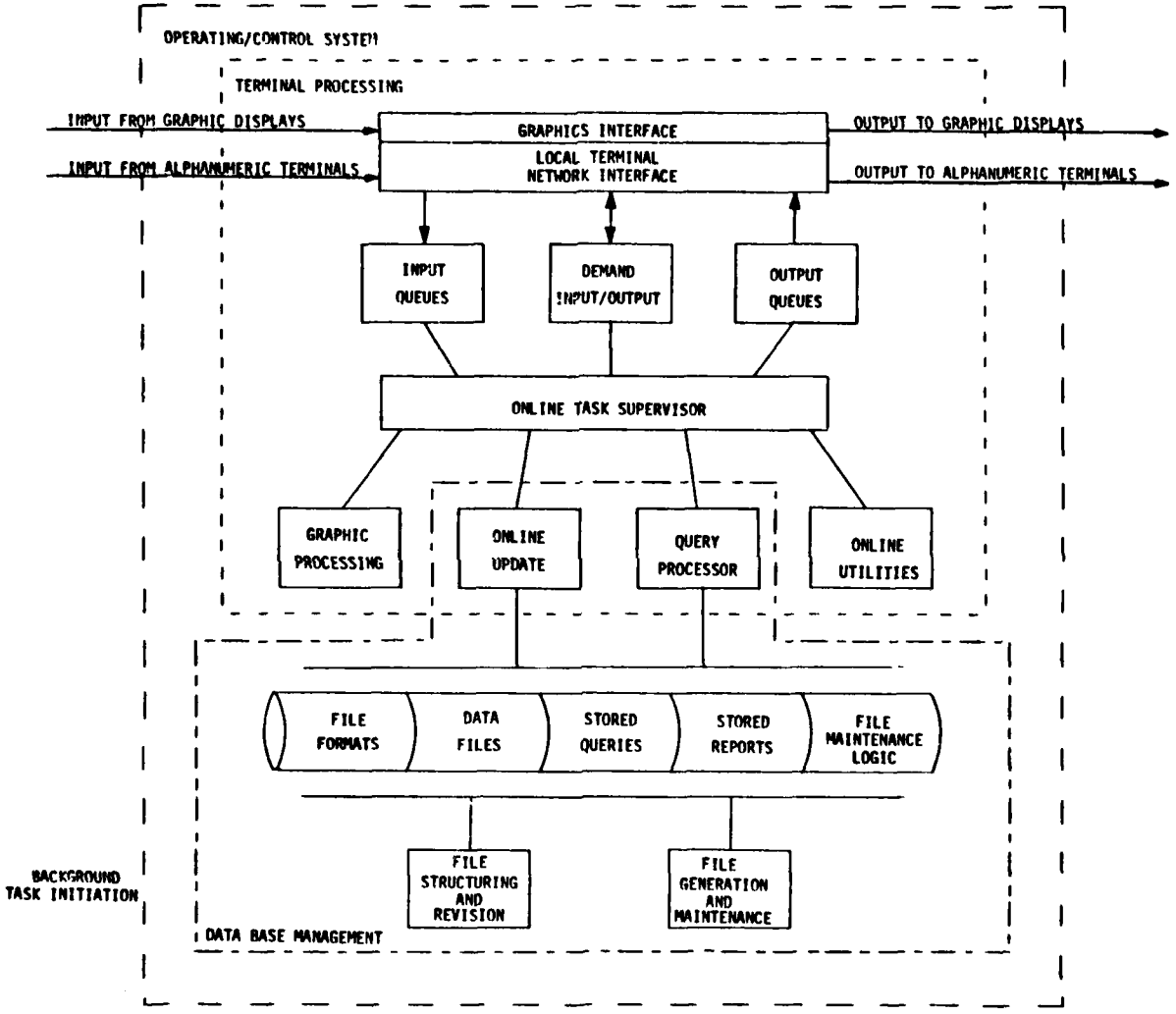


Figure 3.2-1. Data Base Management Subsystem Overview

shown on Figure 3.2-2. The description below is representative of the flexibility of the file structure necessary to support the IPB application.

The terms used in this subparagraph are defined as follows:

- Data Base — A collection of data, supporting the general mission or applications of the system. It is typically composed of many different logical data sets (commonly called files).
- Data File — A logical set of data elements, grouped into associated arrays called records.
- Data File Records — That collection of data elements identifiable by a unique data value or key.
- Field — A single data element.
- Secondary/ Keyword Indexing — The capability to index, or access, the contents of a data file by a means other than the record identifier. The index data set is a logical data set of all index values and the data records associated with each.

It shall be possible to carry both repetitive and nonrepetitive information in a file record in fixed and periodic information sets. Collections of field strings having the same format are called sets. Therefore, the string of fields containing nonrepetitive data in a file record is called the fixed set. Periodic fields, grouped and recurring as strings, are called periodic sets.

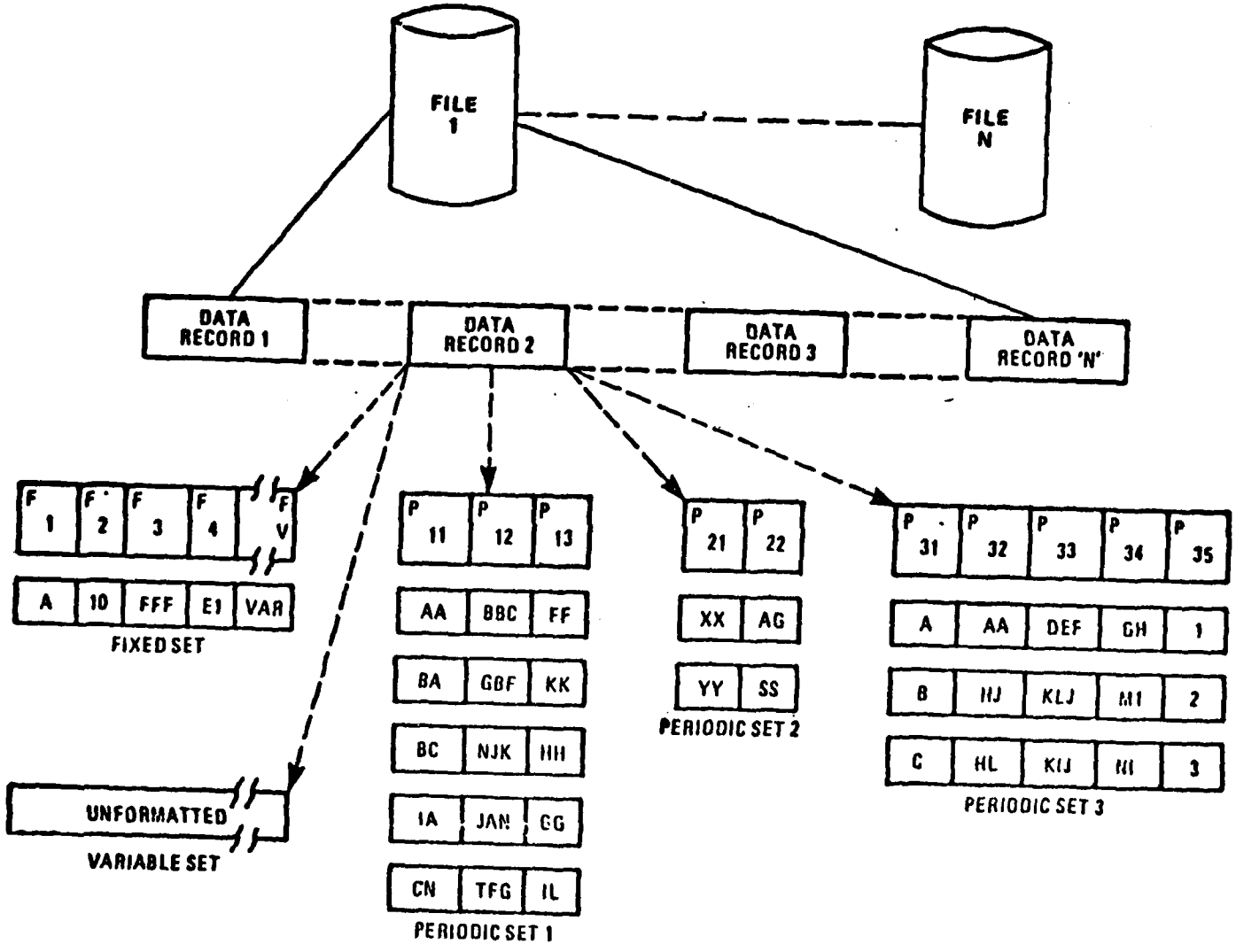


Figure 3.2-2. Data Base Organization for N File Data Base

The record structure within a file shall contain a fixed set, with a minimum of one level of subordination (the periodic set or sets). The format of a fixed set shall be constant throughout one file. More than one periodic set may be defined in the file structure, but as in the case of the fixed set, the format shall be constant throughout the file on a set-by-set basis. In other words, the format of the first periodic set in each record is the same, and the format of the second periodic set in each record is the same and so on. The formats of periodic set 1 and periodic set n, however, need not be the same.

The user shall be able to:

- Include a variable field within the definition of each of the fixed or periodic sets. (This field can contain variable length character strings and shall be included in physical storage only when there is actual data in the field.)

- Structure several variable sets. (Each variable set contains a variable length character string and shall exist only when data is present.)

- Retrieve records based on the content of variable data fields by either executing a scan of the field for the qualifying value(s) or by employing a keyword indexing capability.

Secondary and keyword indexing capabilities shall be available to enable a user to have more flexible control over his data. Secondary indexing shall permit the specification of fixed-length fields as indexes and retrieval of records based on the contents of those fields. Keyword indexing shall permit the specification of variable fields, variable sets, and fixed-length fields as indexes; selecting values from the field as keywords; and retrieving records based on the presence of the keywords within the queried fields.

File Structuring

File records (the collection of the fixed, periodic, and variable sets which are uniquely identified by a record identifier or key) shall not be unnecessarily restricted as to size. The system shall perform dynamically, giving the user a high degree of flexibility.

During the file definition process, the user shall be able to specify in advance certain automatic functions such as conversion of retrieval literals to coded file values, output data conversions, or editing. If file indexing is desired, the user shall be able to indicate which field or fields will provide the index values. The file structuring subfunction shall provide mechanisms for this purpose and record these characteristics. Record control or key fields may be defined as a single field or a string of multiple fields. Periodic subsets may also have data fields assigned for sequencing and control within the record. If the user does not desire to provide these subset control elements, the system shall create sequence numbers for the control function and maintain them as a normal part of the file maintenance subfunction.

File Revision

The file structuring/revision subfunction shall also provide the capability to revise the format in which data is stored in a data file. It shall be possible, under the file revision subfunction, to:

- Add, delete and relocate fields as well as change their storage mode, size and name

- Delete, relocate or add periodic sets (on adding a periodic set no data will be included as a result of the file revision subfunction)

- Split any set in the old file into several sets in the new file.

3.2.3.2 File Generation and Maintenance

The file maintenance subfunction shall provide the user with a capability for generating and maintaining data files. The user shall be able to add, delete, or change file records, periodic sets or subsets, and variable sets. Also, the user may modify or change file fields and may change (increase or decrease) the volume of data associated with any file record. If indexing is specified for the file, the index data set shall also be maintained. This index data set maintenance shall be automatic and transparent to the user.

All processing shall be controlled by logic statements provided by the user. These statements may be in either a macro-like programmer-oriented language or a high-level procedural English-like language which shall be easy to learn and simple to use. The languages shall include instructions that permit automatic table translation and validation or automatic linkage to user provided, special purpose, subroutines.

Data Initialization

A method shall be established to initialize the data required for IPB applications. After initialization, the appropriate new or changed information shall be made available in real time. Some of the IPB data shall be initialized at their default value with permitted review and change activity initiated by manual intervention. Other IPB data is not initialized but is input to the system in real time.

Recovery

A method shall be established to permit the IPB system to recover from certain short period outages employing system log/recovery processing techniques. Catastrophic short period outages, as well as long duration outages will not be recoverable but will require reinitialization of the system.

Purge

The system shall permit initiation of modifiable prestored purge commands which will delete data base information which is no longer needed. The modifiable prestored purge commands shall be capable of logical qualification based upon combinatorial logic involving virtually any of the stored data base fields. It shall be possible for example to purge based upon logical combinations of time, area, subject, and report source. The purge process shall not require cessation of the online functions. Data integrity shall be preserved during the purge process.

Online Update

The terminal processing system shall permit online file maintenance when initiated via terminal request or when initiated by another IPB application program.

The online update component shall permit translation of externally used data values to coded data base values as required. The translation function shall consist of an expandable argument/function dictionary. Upon input, the argument is the user or external system input name for the data element and the function substituted for this in the data base is the internally coded data element form. Often multiple user names

look up the same coded form. A separate table can be used by the output process modules to take the internally coded form as the argument and look up the user or esternal system output form. User or external system input values do not have to equal output values.

Online update shall be accomplished by means of executing a file maintenance logic statement against an update transaction entered either by an operator or another IPB application program. The input transaction is validated by the logic statement during execution, if errors are detected, immediate notification will be given to the terminal operator.

Online update shall perform a process called filtering during the execution of the file maintenance logic statements. The filtering function determines if a predetermined significant event has occurred as represented by the incoming transaction and its relationship to the data base. The result of the filtering function can be initiation of additional or different IPB application programs. An example would be a transaction which causes a prestored query to be executed and a graphic display to be updated.

3.2.3.3 Query Processor

The query processor shall give the user (either terminal user or other system processing module) an online data retrieval language and display language for outputting data. Such online processing shall include the capability to execute modifiable prestored retrieval commands.

File records shall be qualified for output by simple or compound conditions being met. Legal subjects of the conditional expression shall be any field names. The query processor shall be able to limit the numbe · of data records that must be examined in detail through the use of file indexing of potential candidate records when the secondary index function is utilized.

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INTELLIGENCE PREPARATION OF THE BATTLEFIELD (AUTOMATED IPB(A), --ETC
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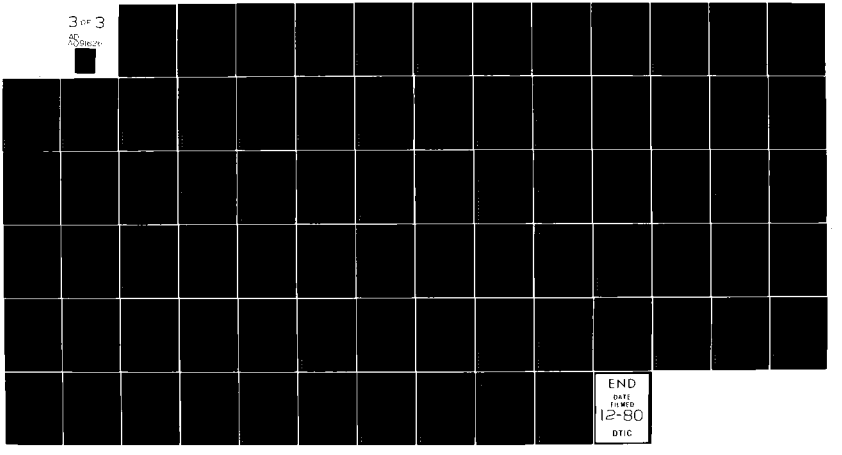


Relational operators shall be provided for equal to, greater than, greater than or equal, less than, less than or equal, between, and not-equal conditions. All relational operators may be preceded by the negative operator 'not'. Geographic search operators shall be provided for determining if a point is contained within an area, a line intersects or is contained within an area, a line intersects a line, or an area is contained within or overlays an area; or for testing if a geographic point lies within a circle defined by a literal consisting of a point and radius.

Any geographic area, line, or point shall also be usable as the selection criterion for producing an output report.

The query processor shall also provide a facility which allows the user to write his own subroutine to assist in record qualification and data presentation. The subroutine shall be written as a conditional clause and may have in the parameter list literals, field names, and work areas.

Compound conditional expressions shall be permitted by the use of the logical connectors AND or OR. An unlimited number and level of parentheses shall be allowed, and where nested parentheses are used, the expression contained in the most deeply nested parentheses is evaluated first. Successively higher levels are evaluated until the truth factor for the entire statement has been determined. The user shall be able to modify the logic of a query compound expression against an item of a repeating group with the ANY modifier. This modifier shall change the conditional logic so that successive terms against the same periodic set are not evaluated within one subset at a time, thus permitting a record to be qualified if an item of a repeating group has different values.

The query processor shall provide for subroutine conversion to qualify encoded values. Subroutine conversion may be specified in the retrieval statement or performed automatically for items designated for subroutine conversion at file definition time. This automatic subroutine conversion may be suppressed or overridden with another subroutine at retrieval time.

The query processor shall provide flexible display output operators. As an example, the user shall be permitted the capability to list the contents of any field in the file in such a manner as to produce a columnar report. The system shall generate as many columns and output lines as needed to list all of the specified fields; however, if all the fields will not fit on a single line of output, the fields will be sorted by set number and displayed accordingly. When more than one output line is generated for a record, all lines, except the first, shall be easily identified as a continuation of a record. Column headings shall be generated automatically from the output labels associated with the specified fields when the file was defined. If no output label was assigned to the field, the field name shall be displayed.

The query processor shall provide for computational/logical tailoring of output results to include summation and counting of selected data fields prior to output.

3.2.4 Graphics Processing Software Functions

Software functions for supporting IPB graphics processing are described in the following paragraphs. The intent is to describe representative functions but not indicate that any one or group of functions be performed in a specific way by a specific programming routine. Any software design approach which allows equally convenient and effective performance of these functions shall satisfy these requirements. The functions are described in two categories:

- Graphic Application - Graphic application functions are operator initiated and designed expressly for military applications such as IPB.

- Graphic Support - Graphic support functions are general purpose providing system support of image management and image generation which are basic to the graphic display capabilities.

An overview functional diagram of these elements is presented in Figure 3.2-3.

3.2.4.1 Interactive Controls

Interactive devices of the types enumerated below shall provide for user communication with displays. Graphics software functions shall provide the appropriate responses when activated by these or equivalent devices.

Function Keyboard

Function keys shall be used to start and terminate functions and routines. Each function key shall be reprogrammable by a computer programmer with sufficient skill and experience to understand the basic software system. Each function key shall indicate status of the function it controls by lighting, changing color, or by some other equally visible technique.

Software for translating function key codes shall be designed to support at least 45 separate function keys and at least 300 individual function codes assuming that a hierarchical control tree structure is employed.

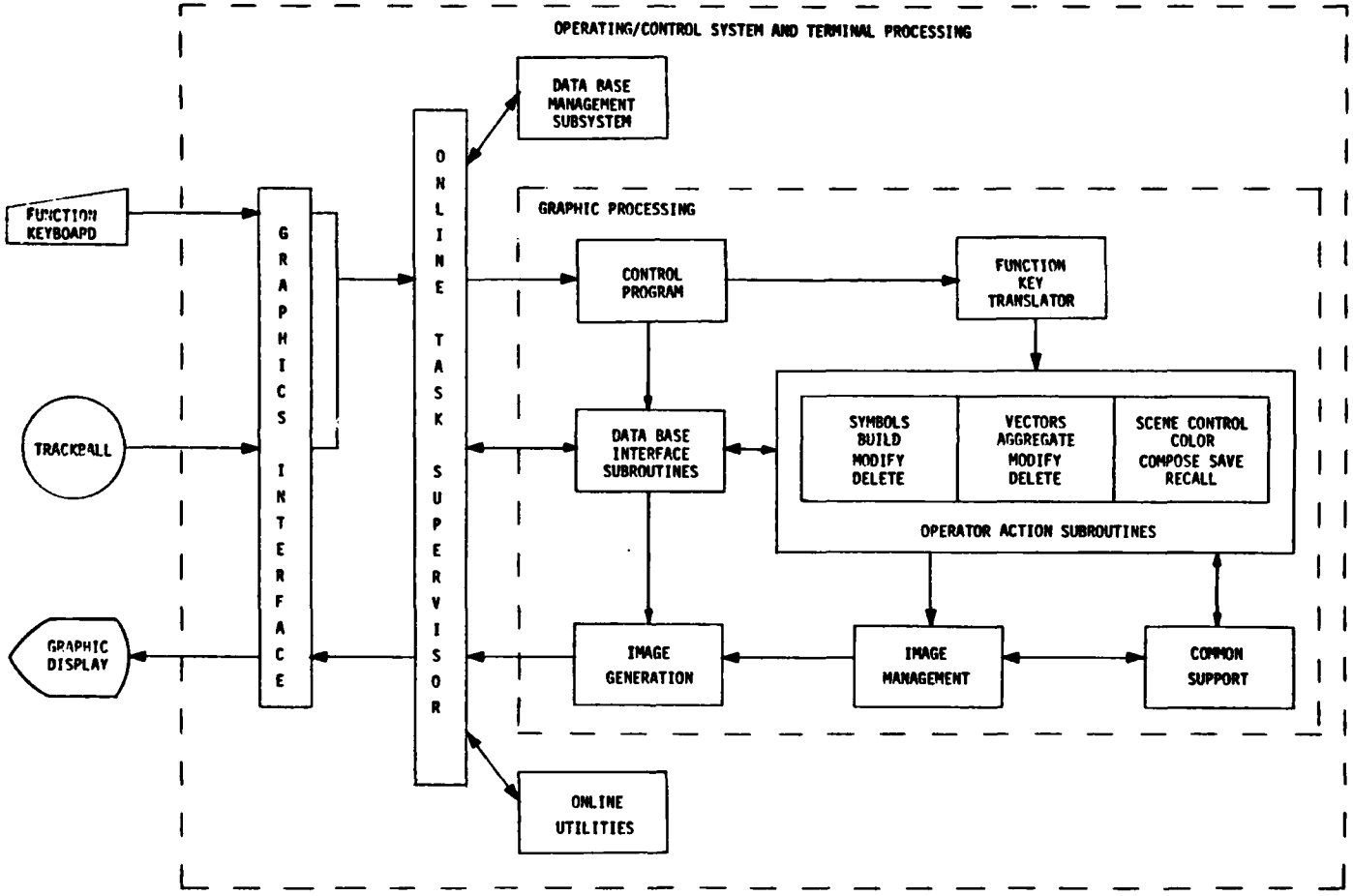


Figure 3.2-3. Graphic Processing Subsystem Overview

Where complex function key sequences are employed, preempting messages shall be provided to the operator to aid in performing the sequence.

Trackball/Cursor

A trackball/cursor combination (or equivalent control) shall be used in conjunction with the function keys and other interactive controls to move symbols, to draw lines, and to perform other functions that require positioning of a point or symbol on the display screen. The cursor, in a crosshair shape, shall be provided to allow the operator to sense location and movement on the screen in response to commands from the trackball. The system shall be designed so that upon request made by function key, the Military Grid Reference (MGR) coordinates of the cursor location are displayed either under the cursor or at some previously designated standard position on the screen.

Alphanumeric Character Set Controls

Suitable key functions shall be provided for displaying the full set of 64 ASCII characters. Supporting software shall be capable of interfacing the function keyboard with a standard typewriter keyboard configuration or interfacing with the equivalent functions implemented as a part of the function key hierarchical control tree structure.

3.2.4.2 Graphic Applications Software

The software functions making up the graphic applications software are described below in the following categories:

- Control program
- Data base interface subroutines

- Function key translator
- Operator action subroutines.

3.2.4.2.1 Control Program

The control program function shall handle external interrupt communications, the engagement/disengagement of the several application routines and the graphics processing initialization/table load functions. It shall operate in an asynchronous mode under the Terminal Processing System and Operating/Control System. Interrupts will be queued and handled in accordance with predefined priority rules. This program shall gain control of operations whenever all graphic application program outstanding requests are completed. At such time the control function enters the wait state until the next request for service is posted.

During initialization the system responds directly to operator communication via the function keyboard, trackball/cursor or alphanumeric keyboard. The objective is to assemble those files, tables and programs which satisfy the machine configuration, the connected display terminals, and the graphics performance requirements.

3.2.4.2.2 Data Base Interface Subroutines

The data base interface subroutines shall handle exchange of information between the graphics processing software functions and the data base management subsystem. These interface subroutines shall be designed to accomplish the transfer of formatted requests (generated from the interpretation of function key codes) through the terminal processing system to the data base subsystem and to receive information from the data base subsystem, causing this data to be linked back to the requesting terminal by the graphics processor subsystem.

Interface subroutines shall provide for:

- Query of the data base for specific data records.
- Search of the data base for logical combinations of data elements.
- Transfer to the data base management subsystem of MGR coordinates of a cursor identified symbol or other graphic feature with a link to the associated query/search.
- Transfer to the data base management subsystem of trackball generated polygon shape with a link to the associated query/search.

3.2.4.2.3 Function Key Translator

The Function Key Translator subroutines shall be designed to service all manual inputs received through the graphics display function keys. The subroutines shall interpret the key codes and shall invoke the appropriate operator action subroutines thereby enabling and causing execution of instructions for the display, manipulation, storage and recall of graphics data as selected by the display operator's actions.

3.2.4.2.4 Operator Action Subroutines

The functions enumerated in this section are those that accomplish processing in response to operator instructions and data entered through the function keys and trackball/cursor. They are the routines that allow the user to build and manipulate symbols, to free draw graphics, and to call and remove scene data and overlays.

These are described below in terms of the function capabilities inherent in the keyboard and trackball/cursor controls.

SYMBOL CONTROLS

Build Symbol

The build symbol function will invoke the appropriate subroutine to create a new symbol in the graphic display area and simultaneously on the display screen.

If symbol type selected is a standard military flag (rectangle) the software function plus operator interactions shall compose this from multiple elements in the standard symbol library. A different software function shall be invoked to compose special military graphic symbols such as a minefield, missile site, artillery location, etc. Still a different software function shall be invoked to compose vector symbols which are formed by a series of line vectors in a specified arrangement and size.

Rotate Symbol

Another software function shall be invoked to permit rotation of the vector symbols during build or as a separate operation. Placement on the screen shall be accomplished either by fixing the symbol origin via trackball/cursor control or via entry of MGR data through the function keys. Software function design shall allow accuracy of placement to within $\pm$150 meters with respect to map background at a scale of 1:50,000. The accuracy of orienting vector symbols shall allow rotation to within $\pm$5° of the cursor-identified orientation.

Move Symbol

When this function is actuated, a subroutine will be enabled to move the cursor-identified symbol origin to a new screen location. The symbol and all amplifying data shall move as a group to a new screen location as identified by the cursor position. This subroutine will also allow repositioning of the symbol to a new location in response to coordinates entered through the function keyboard or the alphanumeric keyboard.

Declutter

When this function is actuated, a subroutine will be enabled to move the symbol flag (keeping the symbol origin fixed) to a new screen location to allow decluttering. The flag and all amplifying data shall move as a group to a new screen location as identified by the cursor position. This subroutine shall allow bending of the staff between flag and origin, placement of the inflection point being fixed by the cursor location marked by the operator.

Label

When this function is actuated a subroutine will be enabled to allow annotation (applied for the first time or modified) of a symbol.

Suppress

When this function is actuated a subroutine will be enabled to allow the temporary removal of a symbol, group of symbols, or overlay from the display screen. The element so identified is suppressed but not removed from the graphic data output area of memory. An element suppressed in this manner will be redisplayed automatically the next time the stored frame is called up for display.

Delete

When this function is actuated, a subroutine will be enabled to cause removal of a cursor identified symbol, group of symbols, or overlay from the screen and from the graphic data output area.

Cancel

When this function is actuated, any processing which has been initiated will be terminated.

Group

This function shall provide a capability to collect a number of unit symbols identified by cursor action for aggregation into one element. Thus function will cause an internal table to be written to keep track of the unit names and MGR coordinates associated with the element. The function will also provide the capability to return for display the data stored for each unit in the element.

Blink

The system shall be designed so that any character, symbol, or group of symbols and/or characters may be caused to blink on and off to call the blinking symbols to the attention of the console operator. The system shall be designed so as to start and stop blinking either by software command as a part of the software routine or as a result of depressing a function key and then hooking a symbol with the cursor or other control device.

FREE DRAW GRAPHIC CONTROLS

Select Dash Line Type

When this function is actuated a subroutine shall use a dashed line for lines being drawn.

Draw Line Series

When this function is actuated, a subroutine shall enable the cursor for placement of successive point locations which the system will connect with straight line segments. A means will be provided to allow termination of one line series and the commencement of a new line series in either the same or different line type.

Label Unit Boundaries

When this function is actuated, a subroutine shall enable the cursor and keyboard for entry of an echelon symbol and alphameric data identifying the military organization numerals on either side of the echelon symbol.

SCENE CONTROLS

Select Color

When this function is actuated the subroutine shall interpret the color selected to the system and the shading pattern for that color.

Change Symbol Size

When this function is actuated a subroutine will be invoked causing all standard military symbols on the display (except alphameric labels) to change size.

Scale

When this function is actuated, a subroutine will be invoked causing the cursor identified location to become a new center point and causing the screen picture to be appropriately repainted to the operator-specified scale. The function will include the capability to decrease scale, i.e., scale by a fraction. This subroutine shall handle the functions required to perform off-centering, expansion, contraction and scissoring of screen images. Off-centering shall allow selection by cursor of a new geographic center for an area to be enlarged. Expansion shall provide the computations necessary to rescale all symbol positions and line graphics which still appear in the enlarged image area. Scissoring shall provide for cutting off or stopping graphics data where it runs off the edge of the display screen. Provision shall be made for rescaling all symbol positions back to their basic position from expanded positions. This subroutine shall restore to the display screen any symbol and line vector data that was cut off when the base scene was expanded.

Save Scene (Temporary)
Save Scene (Permanent

This function shall provide for labeling and temporary or permanent storage of scenes.

Display Saved Scene

This function shall provide for calling from the data base of a previously stored scene and causing the display of this data on the graphics screen. Call up shall be by scene label.

Advance Scene

This function when actuated shall cause advance of the display picture from the scene on the screen to the next scene in a pre-defined sequence.

Recycle

This function when actuated shall cause the screen to be cleared of all image information and cause all graphic data output areas and buffers in the graphics processor to be reset.

Call Scene

When this function is actuated, the scene selected will be displayed on the screen, superimposed on any scenes already present.

Suppress Scene

When this function is actuated, the scene selected will be suppressed from the screen leaving on the screen any scenes previously present.

3.2.4.3 Graphics Support Software

IPB graphics processing shall incorporate the following basic software support packages:

- Common support software routines that allow the application programmer to work with the graphics processor without requiring him to have intimate knowledge of the display hardware or the data formats required by the hardware.

- Image management routines that support the sequencing and management of scenes on the graphic displays.

- Image generation routines that interface the display controller, the host computer and the data produced by the image management routines.

The capabilities to be provided in these support packages are described below. The intent in these paragraphs is to describe standard routines that in large measure are common to many commercially available graphics display software packages. Any set providing equivalent function would be satisfactory.

Common Support Software

The common support software shall utilize a library of subroutines to execute the functions of operator action subroutines and image management. The primary objective of these subroutines shall be to facilitate the design of application programs which need not repetitively incorporate the code for formatting and managing display elements. All the subroutines shall have standard linkages and shall be callable either from assembly language or compiler language programs

with standard call statements. The routines shall be table oriented and by collecting together common parameters, shall simplify the communication between routines and reduce the amount of memory required for parameters.

The design shall be such that the storage areas for these tables shall be established by controls carried in the application oriented programs; routines shall be available for initializing these tables.

Image Management

Image management routines shall be designed to serve three purposes. First, they shall be used to set up tables which serve as communication links between the operator action subroutine and the image generation routines. Second, they shall be used to generate scenes and subscenes by setting up an index to the area in which graphic data is stored and provide such functions as name maintenance and level search. Third, the image management routines shall provide the user with the ability to modify and delete scenes that have previously been generated.

The subroutines that shall comprise the basic image management support capability shall include functions of the types itemized below:

- Initialize control blocks
- Begin scene; assign scene name in scene correlation control block
- End scene
- Suppress scene from screen
- Restore scene to screen
- Compress data in the graphics data output area and scene correlation control block

- Add scene
- Replace scene
- Reallocate space for either the graphics data output area or scene correlation control block
- Change scene name
- Locate scene name in control block hierarchy.

Image Generation

The image generation subroutines shall be used to create appropriate control words to be used in requests for the display of individual characters, lines of characters, individual vectors, and connecting vectors. It shall be the function of the image generation subroutines to take data supplied by the user and interpreted in the graphic application programs and place it in a format that will be accepted by the graphic display controller.

Tables generated by the graphic application and image management routines serve to pass parameters to the image generation routines. The routines shall search these tables for indication as to what is to be done with the data and for addresses of other tables necessary in subsequent processing.

The subroutines that shall comprise the basic image generation support capability shall include functions of the types itemized below:

- Initialize screen parameter table. Define portion of the graphic display area to be used if an expansion or contraction of the screen image is called for.

- Compute and store scissoring parameters to control the rescaling of symbol screen positions for an expansion or contraction of the screen image.

- Store orders (instructions) for display of individual characters.

- Store order for display of a string of characters.

- Generate vectors for pairs of coordinates. Control order in which segments are connected

- Initialize a write command table containing a channel command word for each element in the graphic data output area.

- Transfer graphic information in the graphic data output area to the display terminal to replace previous contents of the display refresh buffer.

- Transfer partial graphic information in the graphic data output area to the display to be added to the contents of the refresh buffer.

- Transfer graphic information in the graphic data output area to the display to be deleted from the refresh buffer associated with a particular display.

3.3 SYSTEM PERFORMANCE/CAPACITY REQUIREMENTS

The following response times, processing times, accuracies, resolutions, and data capacities are the nominal requirements for effective implementation of the IPB software outlined in Section 3.1.

3.3.1 Response Time Requirements at Terminals

Response times acceptable to the IPB operator/analyst are specified for various activities at the terminals. Response times, unless mentioned otherwise, are measured from time of final manual action by the analyst to initiate the response to the time for the result requested to appear on the display screen. Emphasis is on those IPB activities that require the most time to complete and are generic to operator-initiated actions, namely:

1. System response to actions calling for display of directly addressable graphics, requiring no search of the data base. - Less than 2 seconds

   Examples:
   a. Display of query format
   b. Display of doctrinal template

2. System response to graphic function selection calling for modification to graphic display by the addition, relocation, or removal of graphic symbols or vectors. - Less than 2 seconds

Examples:

a. Display of graphic symbol at cursor designated position
b. Deletion of cursor identified symbol
c. Display of vector at the graphic terminal entered at the Data Tablet

3. System response to graphic function selection calling for extensive modification of the displayed graphics, requiring search through the data base/graphic library, but requiring no special algorithm processing. - Less than 4 seconds

Examples:

a. Display of a different map scale of the same general area
b. Display of response to query of disk-based data base

4. System response to graphic function selection calling for extensive modification of the displayed graphics, requiring special algorithm processing but not extensive search through the data base/graphic library. - Less than 8 seconds

Examples:

a. CCM/COM Build

b. Route Timing Overlay

c. Intervisibility Corridor Display

5. System response to graphic function selection calling for extensive search through the data base, modification of the displayed graphics, and special algorithm processing. - Nominally 10 to 16 seconds

Examples:

a. Combat Power Ratio

b. Order of Battle Search

(NOTE: Both examples involve identifying units meeting the IPB analyst's specified characteristics within areas defined by polygons.)

3.3.2 Special Processing Requirements

This section will focus on special requirements for CPU processing speed and performance. Figure 3.3-1 shows the basic analyst/system cycle. System activity is initiated by the analyst through his terminal keyboard selections. This system activity may include accesses to the data base, algorithm processing, and display processing associated with preparing and presenting the graphic response to the analyst. The analyst then completes the total cycle by considering the display presented and selecting the next activity. For purposes of this discussion the basic cycle can be said to be equally divided between manual activity by the analyst (time periods labeled D and A) and system response activity I (time periods labeled B and C).

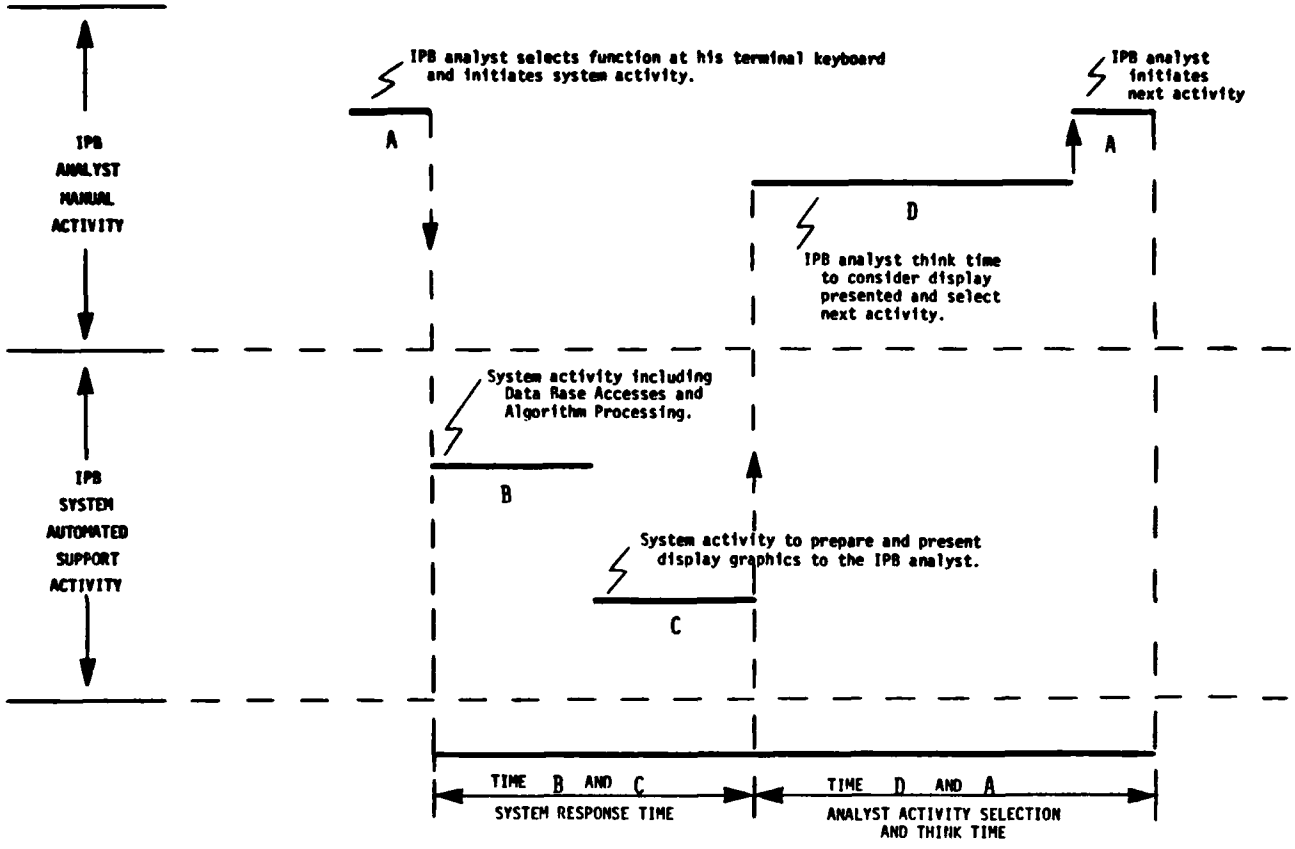


Figure 3.3-1. IPB Analyst/System Basic Cycle

From consideration of the basic cycle and the system activities it can be said that the requirements for CPU processing associated with the special analyst aids (e.g., corridor build, route timing, combat power ratio) are not the key driver in overall system design for the following reasons: (1) their occurrence is infrequent relative to other system activities, (2) any pure CPU processing of algorithms is only a portion of the total system requirement and intermixed with manual activities. The CPU processing requirements associated with these special analyst aids/algorithms shall meet the overall interactive system response requirements discussed in the previous Section 3.3.1 and are considered non-stressing.

The principal requirements that do stress and, thereby, determine CPU processing performance include the following:

1. Input and Output data handling and display management and generation associated with the display graphics subsystem.

2. Input and Output data handling and search, access, and management associated with the data base subsystem.

3.3.3 Accuracy/Resolution Requirements

The accuracy requirement for locating a cursor on the graphic screen measured in dimensions of the displayed graphics is a function of both the ability to position the cursor and the map scale. The cursor can be positioned with relative ease by the analyst near the display point of interest within 2 millimeters measured in screen dimensions. This 2 millimeters translates into displayed graphics dimensions of 100 meters for a 1 to 50,000 map scale. The accuracy requirement in displayed graphics dimensions for point location by cursor for query or symbol identification or placement is $\pm$150 meters

on the 1 to 50,000 scale, ±750 meters on the 1 to 250,000 scale, and ±3000 meters on the 1 to 1,000,000 scale.

The resolution requirement for map detail on the graphic screen is a function of the map scale. The resolution requirement is described in terms of the ability to display adjacent parallel vector lines. The closest that adjacent parallel vectors can be positioned for display allowing a minimum of one pixel space between the vectors is 62.5 meters for a 640 pixel screen line and 39 meters for a 1024 pixel screen line for the 1 to 50,000 map scale. These dimensions provide the measure for the resolution requirement for the 1 to 50,000 map scale. In these terms the resolution requirement is 64 meters for the 1 to 50,000 scale, 320 meters for the 1 to 250,000 scale, and 1280 meters for the 1 to 1,000,000 map scale.

3.3.4 Data Base Capacity Requirements

This section includes data base requirements for data items that are resident in the online, direct access data base (disks) for use by the IPB analyst in an ASAC at both Corps and Division. The sizing estimates for the data base are based on the following:

1. A map at any scale is described by 2,500 16-bit words (5,000 bytes) per display. This includes vector data plus alpha-numeric annotations and special symbols.

2. Terrain factor overlays require a total of 16 bytes of data for each 500 meter square area (1,200 squares per display). This means that for a 1:50,000 map (approximately 20 kilometers square) area the data base requirement is 25,600 bytes of data for terrain subfactors.

3. Each doctrinal template is described by a maximum of 200 vector equivalents estimated to require a total of 2,000 bytes of data.

4. Each IPB product/overlay is described by a maximum of 800 vector equivalents or 8,000 bytes of data.

The total data base requirements for IPB at Corps and Division are shown on Figure 3.3-2 based on the assumptions above and the further assumptions that the area of interest for Corps is 400 kilometers square and Division 100 kilometers square. The total data base requirement for IPB is estimated, including approximately 50 percent contingency, at 30 megabytes at Corps and 5 megabytes at Division. These estimates do not represent the total ASAS data base requirement.

IPB/ASAS REQUIREMENT BY ECHELON / DATA BASE ITEM	CORPS			DIVISION		
	NUMBER OF DATA ITEMS	DATA BASE REQUIREMENT PER DATA ITEM K BYTES	DATA BASE REQUIREMENT K BYTES	NUMBER OF DATA ITEMS	DATA BASE REQUIREMENT PER DATA ITEM K BYTES	DATA BASE REQUIREMENT K BYTES
MAPS:						
EACH, ANY SCALE	500	5	2,500	50	5	250
TERRAIN OVERLAYS:						
20 KM SQUARE	400	56.6	10,240	25	56.6	640
DOCTRINAL TEMPLATES	400	2	800	200	2	400
IPB PRODUCTS	600	8	4,800	300	8	2,400
TOTALS			18,340			3,690

Figure 3.3-2. IPB Data Base Requirements

APPENDIX A

IPB DEFINITIONS

APPENDIX A. IPB DEFINITIONS

OPTION	One of several alternative enemy battle plans - covers period from his position during planning cycle to his achievement of major objectives.
DOCTRINAL TEMPLATE	A graphic showing composition (unit make-up) and disposition (ground spacing) of an enemy unit based on doctrine without consideration of terrain or weather factors. Will vary depending on enemy mission (i.e., attack, defense, etc.).
SNAPSHOT	Graphic of postulated overall enemy and friendly unit locations at an instant in time in a single option on analyzed terrain. Some 5 to 10 snapshots along mobility corridors may be required to represent the execution of one option from inception to objective.
CURRENT SITUATION	Actual current enemy and friendly unit/force locations - as known or estimated in real time.
SITUATION TEMPLATE	A portion of a situation snapshot showing only those postulated unit locations at a point in time which enable analyst determination that the enemy is indeed pursuing this option--i.e., will allow him to distinguish between this and other options.
EVENT ANALYSIS MATRIX	Time ordered sequences of events (enemy activity that is recognizable in near real time from a single report or small group of reports) that immediately follow the time period represented by the snapshot they relate to. They focus on recognizable, near-term activities in time sequence.

NAI (NAMED AREA OF INTEREST)	Specified portion of terrain that will contain one or more of the events predicted in the event analysis matrix. They are normally identified during planning cycle, and their locations are shown on event templates.
EVENT TEMPLATE	Graphic layout of the NAI's associated with a specific event analysis matrix. Indicates NAI number and location as well as sequence number of each NAI within that event analysis matrix.
TARGET ANALYSIS MATRIX	A/N tabular listing similar to event analysis matrix but listing potential targets that FSE should plan for and monitor closely during time period immediately following the enemy's achieving the associated snapshot force disposition.
TAI (TARGET AREA OF INTEREST)	Same as NAI's except showing areas listed in the target analysis matrix.
TARGET TEMPLATE	Graphic layout of the TAI's associated with a specific event analysis matrix.
DECISION SUPPORT TEMPLATE	A situation snapshot selected at a point far enough ahead in the option to allow time for friendly force actions, and updated to reflect current knowledge of both enemy and friendly situations. Generally, several alternatives are compared contrasting varying preparation times, geographic factors, maneuver options, and targeting plans. The analyses also develop what is achievable within the time constraints. The Decision Support Template is the result of these analyses, and represents an achievable friendly force action in a snapshot format.
MAP BACKGROUNDS	These are outline maps including only major map features such as large bodies of water, rivers, bridges, primary and secondary roads, city and built-up area outlines.

LINES OF COMMUNICATION OVERLAY	This overlay provides mobility classifications for the roads, bridges, and railroads. A network of roads on this overlay is differentiated by colors to show mobility of mechanized forces.
BUILD-UP AREAS OVERLAY	This is an overlay indicating the geo-outlines of metropolitan areas, cities and large towns. These areas are treated as blocked or no-go zones when merged into the crosscountry movement overlay. When merged with lines of communication in the combined obstacles overlay, built-up areas may become traversible in one of the road mobility categories.
TERRAIN FACTOR OVERLAY	Individual overlays for slope, vegetation, soils and wetlands (hydrology) are included in this set. The first three are prepared for display as mosaics in which differing color and intensity are used to show mobility in up to 5 gradations. The basic mobility grade of each elemental square is entered for a "hot July day." Variants are prepared to represent changes for other seasonal conditions (i.e., vegetation state in winter; soil classification in wet season or in sub-freezing temperatures.
WETLANDS OVERLAY	The wetlands overlay is a representation of large bodies of water, rivers and streams. Segments are differentiated by color to show mobility of mechanized forces making crossings in up to 5 gradations. Variants are prepared to represent changes to mobility grades of crossings under extreme flooding conditions or freezing.
CROSSCOUNTRY MOVEMENT OVERLAY	This overlay is a composite of the four terrain factor overlays plus the effects of the built-up areas overlay. An algorithm technique will be designed to automatically combine the individual factors.

COMBINED OBSTACLES OVERLAY	This overlay is a composite of the cross-country movement overlay and lines-of-communication overlay. Merging of lines-of-communication factors further modifies the composite mobility picture or its inverse, the combined obstacles overlay.
OBSTACLE PLAN OVERLAY	This is a graphic representation of the friendly commander's barrier plan showing planned interdiction, mining and demolition blocks to deny or severely impede or rechannel enemy advances.
MODIFIED COMBINED OBSTACLES OVERLAY	This is a version of the combined obstacles overlay further modified to reflect the effects of an implementation of the friendly commander's obstacle plan.
MOBILITY CORRIDORS OVERLAY	This overlay is derived by analysis of basic battalion mobility over crosscountry terrain and over lines of communication. The analyst, working directly on the graphics display of combined obstacles, has the capability to construct and grade by mobility category the corridors available to enemy units.
INTERVISIBILITY OVERLAY	A composite of terrain, vegetation, elevation and atmospheric factors which depicts local average line of sight visibility for 500 meter grid boxes.
INTERVISIBILITY CORRIDORS OVERLAY	A graphic overlay derived from the intervisibility overlay that illustrates in any selected direction the grid boxes to which there is visibility from a chosen vantage point.
WEATHER OVERLAY	This is a graphic presentation which is used to show boundaries of general meteorological conditions (precipitation, fog, wind condition) over the areas of interest to the Corps and Division for use in selecting factor overlays for mobility or intervisibility.

Doctrinal Option Templates	A large scale graphic showing an overall enemy movement or operation (e.g., penetration or double envelopment) based on doctrine without consideration of terrain and weather factors. It portrays doctrinal spacing and composition of forces along multiple avenues of approach from start point to objective. It indicates gross rear assembly areas, deployment lines, lines of contact and objective areas; it indicates gross frontages, width and separation of avenues of approach and width and separation of forces at the line of contact.
Doctrinal Event/Target Menus	Tabular listings which doctrinally describe key events/key targets that are characteristic of enemy operations and maneuvers and can be related to particular phases of an enemy option sequence. A separate event and target menu, consisting of critical indicator/critical node type items is prepared for each major action type. They reflect enemy doctrine without consideration of terrain and weather. Their purpose is to enhance/speed-up the preparation of situation dependent Event and Target Matrices and Templates, serving both as a reference for the analyst as well as a means of saving key strokes in building event/target matrixes.

Planned Routes Template	A graphic depicting the avenues of approach/ routes of an enemy force as it would move from an initial static position to the achievement of its objective. It reflects a selection of routes based on analysis of enemy objectives, enemy doctrine, and specific terrain and weather effects on mobility. It is based on corridor rating/ route timing computations to establish comparative transit times along candidate routes and selection of optimum routes.
Snapshot Lines Template	A graphic depicting the key points in an option where snapshots will be developed. The key points are translated into a succession of contoured snapshot lines which are transverse to and intersect the routes of this option. The lines represent the locations of the lead units across the entire movement at the successive key points. Incremental times are shown between snapshot lines. The template is based on the Planned Routes Template and therefore reflects terrain and weather effects on mobility.

Decision Alternative

A graphic showing planned allocation of friendly units against postulated overall enemy unit locations. It is developed during the planning phase when time permits. It shows enemy/friendly force concentrations and combat power ratios for an anticipated battle situation. It incidates friendly unit doctrinal locations rather than locations placed on an alalyzed terrain. More careful unit placement as well as determination of what is achievable are refinements left to the Decision Support Template build step during hostilities. It indicates enemy unit planned locations as derived from the appropriate snapshot template.

APPENDIX B

ABBREVIATIONS

APPENDIX B. ABBREVIATIONS

ASAC	All Source Analysis Center
ASAS	All Source Analysis System
BSI	Battlefield Systems Integration Directorate
CCM	Crosscountry Mobility
COM	Combined Obstacles Matrix
CP	Command Post
CPR	Combat Power Ratio
CRT	Cathode Ray Tube
CSS	Combat Service Support
DARCOM	U.S. Army Materiel Development and Readiness Command
ETL	Engineering Topographic Laboratory, Fort Belvoir
EOB	Enemy Order of Battle
FA	Field Artillery
FEBA	Forward Edge of Battle Area
FSE	Fire Support Element
HIPO	Hierarchical Input, Processing, Output
INSCOM	U.S. Army Intelligence and Security Command
IPB	Intelligence Preparation of the Battlefield
IPB(A)	Intelligence Preparation of the Battlefield (Automated)
I/V	Intervisibility
KB	Keyboard
LOC	Lines of Communication
MET	Meteorological
MGR	Military Grid Reference
MRR	Motorized Rifle Regiment
NAI	Named Area of Interest
SAM	Surface to Air Missile
TAI	Target Area of Interest
TIAX	Tactical Intelligence Applications Experimentation

TO&E	Table of Organization and Equipment
TOC	Tactical Operations Center
USAICS	U.S. Army Intelligence Center and School
UTM	Universal Transverse Mercator

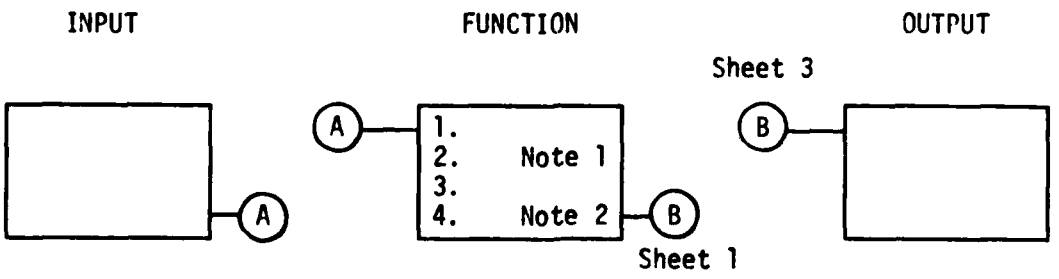
SYMBOLS AND GUIDANCE FOR THE INPUT/FUNCTION/OUTPUT DIAGRAMS:

- Functions describe what the system does
- Inputs are data items provided to the function
- Outputs are data items created or modified by the function
- Functions and subfunctions identified at a high level
- Arrows connect specific inputs to their subfunctions and subfunctions to their specific outputs
- Extended description notes are used to expand the Input/Function/Output diagrams
- Automated functions (supported principally by software) are differentiated from functions supported principally by the human in the man/machine interface. Non-automated functions are identified as analyst performed functions.
- Functions are described in diagrams labeled as figures, and shown below, with multiple sheets used as necessary to complete a figure and with extended description notes included on the last sheet of a figure.

NOTES: 1. Data item connectors use letters only when all related connectors are on the same sheet.

2. Data item connectors use letters with reference to sheet numbers when all related connectors are not on the same sheet. In the example below, at least three sheets are required to fully descirbe the function.

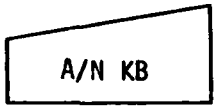
Figure 3-X Function: _____ Sheet ___ of n



Extended Description Notes:

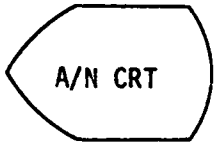
1.
2.

SYMBOLS FOR THE INPUT/FUNCTION/OUTPUT DIAGRAMS:



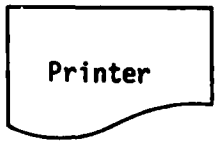
Information input by online keyboards:

- A/N KB
- Function KB
- Cursor
- Graphic Tablet



Online visual indicators:

- A/N CRT
- Graphic Color CRT
- Plotter
- Printer



Hardcopy devices:

- Printers

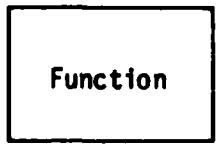
Information provided by online storage:

- Disk
- Magnetic Tape

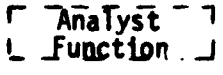
Information provided by magnetic tape

Information provided by card medium

Parameter independent of medium



Function or Subfunction
principally automated/performed by software



Function or Subfunction
principally non-automated/performed by analyst

Data Item Connector - same sheet

Data Item Connector - off sheet, same figure

APPENDIX C

WEATHER UPDATE MENU TABLES

APPENDIX C. WEATHER UPDATE MENU TABLES

Section 3.1.2.1 describes how weather inputs are entered into the system to enable building sets of terrain overlay or terrain overlay composites that take weather conditions into account. This appendix includes the factor data tables required for interpreting the effects of the weather inputs on the basic terrain data as stored in the data base.

Carrying weather factor data in a series of tables offers the following advantages:

- The factor data is easily modified by non-programming personnel
- Table look-up processing offers computational speed advantages over alternate methods
- Allows basic terrain data to be retained in the data base in source terms for easy traceability.

The following sections include the actual data tables and a brief summary of the contents of each.

C.1 INTERVISIBILITY OVERLAY INITIALIZATION TABLES

The following seven tables shall be used to produce all IPB(A) intervisibility graphic overlays described elsewhere in this document:

Table 1.1.1 - lists the tree height values that must be added to terrain elevation for computing intervisibility corridors during winter (foliaged tree) months

Table 1.1.2 - lists the tree height values that must be added to terrain elevation for computing intervisibility corridors during summer months

Table 1.2.1 - lists the data as discussed in Section 3.1.1.3, i.e., vector data table with UTM/MGR coordinates (not included in appendix)

Table 1.2.2 - an empty set

Table 1.3 - contains the visibility range factor to be used for computing a visibility range overlay (not included in appendix)

Table 1.4 - lists the translation of ETL vegetation data to IPB(A) vegetation categories for use in computing an intervisibility mosaic

Table 1.5 - lists the translation of ETL surface configurations and built-up area data to IPB(A) categories for use in computing an intervisibility mosaic

ETL VEGE-TATION OVERLAY KEY	A	B	C											D											E											F	G	H	I	J	K	L	M
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12								
ESTIMA-TED TREE HEIGHT	0	0	0	25	25	25	0	12	12	12	0	3	3	3	0	25	25	25	0	12	12	12	0	3	3	3	0	25	25	25	0	12	12	12	0	3	3	3	0	0	0	0	0	0	0	0

Table 1.1.1. Intervisibility Corridor - Tree Height (Summer)

ETL VEGE-TATION OVERLAY KEY	A	B	C											D											E											F	G	H	I	J	K	L	M
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12								
ESTIMA-TED TREE HEIGHT	0	0	0	25	25	25	0	12	12	12	0	3	3	3	0	0	0	25	0	0	0	12	0	0	0	3	0	25	25	25	0	12	12	12	0	3	3	3	0	0	0	0	0	0	0	0

Table 1.1.2. Intervisibility Corridor - Tree Height (Winter)

Table 1.4. Intervisibility Mosaic - Vegetation

ETL VEGETATION OVERLAY KEY		A	B	C											D												E												F	G	H	I	J	K	L	M
				1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12								
ALL YEAR INTERVISIBILITY	OPEN VEGETATION V_1	X	X	X				X				X				X				X				X				X				X				X				X						X	
	MEDIUM VEGETATION V_2				X	X			X	X			X	X			X	X			X	X			X	X			X	X			X	X			X	X			X		X	X		
	DENSE VEGETATION V_3						X				X				X				X				X				X				X				X				X					X	X		X

Table 1.5 Surface Configuration and Built-Up for Intervisibility

ETL SURFACE CONFIGURATION KEY	FLAT TERRAIN V_1	ROLLING TERRAIN V_2	RUGGED TERRAIN V_3
A	X		
B	X		
C		X	
D			X
E			X
F			X
ESCARPMENTS			X
FILL			X
CUT			X
QUARRY			X
MINE			X
EMBANKMENT			X
BUILT-UP			X

C.2 CCM OVERLAY INITIALIZATION TABLES

The following eleven tables shall be used to produce all IPB(A) mobility graphics overlays described elsewhere in this document:

Table 2.1.1 - lists the translation of ETL soil data to IPB(A) soil categories for use in either graphically displaying soils or computing a CCM for graphic display when the soil in the area is dry but there is flood plain flooding

Table 2.1.2 - used for same purpose as Table 2.1.1 but here there is no flood plain flooding and the soils are dry

Table 2.2.1 - used for the same purpose as Table 2.1.1 but here the soil condition in the area is wet and there is flood plain flooding

Table 2.2.2 - used for the same purpose as Table 2.1.1 but here the soils are wet and there is no flood plain flooding

Table 2.3.1 - used for the same purpose as Table 2.1.1 but here the soils are saturated and there is flood plain flooding

Table 2.3.2 - used for the same purpose as Table 2.1.1 but here the soils are saturated and there is no flood plain flooding

Table 2.1.1. Crosscountry Movement - Flooding and Dry

ETL SOILS KEY	CROSSCOUNTRY MOBILITY				
	GREEN GO DOCTRINAL SPEED	CYAN INHIBITED 1/2 DOCTRINAL SPEED	YELLOW SLOW 1/4 DOCTRINAL SPEED	MAGENTA VERY SLOW 1/12 DOCTRINAL SPEED	RED STOP 0 DOCTRINAL SPEED
1	1				
2	1				
3	1				
4	1				
5	1				
6	1				
7	1				
8	1				
9	1				
10	1				
11			1/4		
12	1				
13	1				
14					0
15					0
16	1				
1-					0
2-					0
3-					0
4-					0
5-					0
6-					0
7-					0
8-					0
9-					0
10-					0
11-					0
12-					0
13-					0
14-					0
15-					0
16-					0

NUMBERS CODED WITH MINUS (-) ARE FLOOD PLAIN

Table 2.1.2. Crosscountry Movement - Non-Flooding and Dry

ETL SOILS KEY	CROSSCOUNTRY MOBILITY				
	GREEN GO DOCTRINAL SPEED	CYAN INHIBITED 1/2 DOCTRINAL SPEED	YELLOW SLOW 1/4 DOCTRINAL SPEED	MAGENTA VERY SLOW 1/12 DOCTRINAL SPEED	RED STOP 0 DOCTRINAL SPEED
1	1				
2	1				
3	1				
4	1				
5	1				
6	1				
7	1				
8	1				
9	1				
10	1				
11			1/4		
12	1				
13	1				
14					0
15					0
16	1				
1-	1				
2-	1				
3-	1				
4-	1				
5-	1				
6-	1				
7-	1				
8-	1				
9-	1				
10-	1				
11-			1/4		
12-	1				
13-	1				
14					0
15-					0
16-	1				

NUMBERS CODED WITH MINUS (-) ARE FLOOD PLAIN

Table 2.2.1. Crosscountry Movement - Flooding and Wet

ETL SOILS KEY	CROSSCOUNTRY MOBILITY				
	GREEN GO DOCTRINAL SPEED	CYAN INHIBITED 1/2 DOCTRINAL SPEED	YELLOW SLOW 1/4 DOCTRINAL SPEED	MAGENTA VERY SLOW 1/12 DOCTRINAL SPEED	RED STOP 0 DOCTRINAL SPEED
1	1				
2	1				
3	1				
4	1				
5	1				
6	1				
7	1				
8	1				
9			1/4		
10			1/4		
11				1/12	
12	1				
13	1				
14					0
15					0
16	1				
1-					0
2-					0
3-					0
4-					0
5-					0
6-					0
7-					0
8-					0
9-					0
10-					0
11-					0
12-					0
13-					0
14-					0
15-					0
16-					0

NUMBERS CODED WITH MINUS (-) ARE FLOOD PLAIN

Table 2.2.2. Crosscountry Movement - Non-Flooding and Wet

ETL SOILS KEY	CROSSCOUNTRY MOBILITY				
	GREEN GO DOCTRINAL SPEED	CYAN INHIBITED 1/2 DOCTRINAL SPEED	YELLOW SLOW 1/4 DOCTRINAL SPEED	MAGENTA VERY SLOW 1/12 DOCTRINAL SPEED	RED STOP 0 DOCTRINAL SPEED
1		1			
2		1			
3		1			
4		1			
5		1			
6		1			
7		1			
8		1			
9			1/4		
10			1/4		
11				1/12	
12		1			
13		1			
14					0
15					0
16		1			
1-		1			
2-		1			
3-		1			
4-		1			
5-		1			
6-		1			
7-		1			
8-		1			
9-			1/4		
10-			1/4		
11-				1/12	
12-		1			
13-		1			
14-					0
15-					0
16-		1			

NUMBERS CODED WITH MINUS (-) ARE FLOOD PLAIN

Table 2.3.1. Crosscountry Movement - Flooding and Saturated

ETL SOILS KEY	CROSSCOUNTRY MOBILITY				
	GREEN GO DOCTRINAL SPEED	CYAN INHIBITED 1/2 DOCTRINAL SPEED	YELLOW SLOW 1/4 DOCTRINAL SPEED	MAGENTA VERY SLOW 1/12 DOCTRINAL SPEED	RED STOP 0 DOCTRINAL SPEED
1	1				
2	1				
3	1				
4	1				
5	1				
6	1				
7	1				
8	1				
9					0
10					0
11					0
12	1				
13	1				
14					0
15					0
16	1				
1-					0
2-					0
3-					0
4-					0
5-					0
6-					0
7-					0
8-					0
9-					0
10-					0
11-					0
12-					0
13-					0
14					0
15-					0
16-					0

NUMBERS CODED WITH MINUS (-) ARE FLOOD PLAIN

Table 2.3.2. Crosscountry Movement - Non-Flooding and Saturated

ETL SOILS KEY	CROSSCOUNTRY MOBILITY				
	GREEN GO DOCTRINAL SPEED	CYAN INHIBITED 1/2 DOCTRINAL SPEED	YELLOW SLOW 1/4 DOCTRINAL SPEED	MAGENTA VERY SLOW 1/12 DOCTRINAL SPEED	RED STOP 0 DOCTRINAL SPEED
1	1				
2	1				
3	1				
4	1				
5	1				
6	1				
7	1				
8	1				
9					0
10					0
11					0
12	1				
13	1				
14					0
15					0
16	1				
1-	1				
2-	1				
3-	1				
4-	1				
5-	1				
6-	1				
7-	1				
8-	1				
9-					0
10-					0
11-					0
12-	1				
13-	1				
14-					0
15-					0
16-	1				

NUMBERS CODED WITH MINUS (-) ARE FLOOD PLAIN

Table 2.4.1 - used for the same purpose as Table 2.1.1 but here the soils are frozen and there is flood plain flooding

Table 2.4.2 - used for the same purpose as Table 2.1.1 but here the soils are frozen and there is no flood plain flooding

Table 2.5.3 - lists degradation factors to be used to compute the CCM as a function of snow depth

Table 2.6 - lists the IPB(A) mobility conversion factors for vegetation as a function of ETL classification

Table 2.7 - lists the IPB(A) mobility conversion factors for surface configuration and built-up areas

C.3 LOC OVERLAY INITIALIZATION TABLES

Three tables shall be required to initialize roads as a function of ambient conditions:

Table 3.1 - selects the doctrinal rate degradation factor as a function of day/night movement

Table 3.2 - selects the doctrinal movement rate degradation factor as a function of road condition: dry, wet, ice covered, snow covered

Table 3.3 - selects the roads to be affected by Table 3.2 factors.

Table 2.4.1. Crosscountry Movement - Flooding and Frozen

	CROSSCOUNTRY MOBILITY				
ETL SOILS KEY	GREEN GO DOCTRINAL SPEED	CYAN INHIBITED 1/2 DOCTRINAL SPEED	YELLOW SLOW 1/4 DOCTRINAL SPEED	MAGENTA VERY SLOW 1/12 DOCTRINAL SPEED	RED STOP 0 DOCTRINAL SPEED
1	1				
2	1				
3	1				
4	1				
5	1				
6	1				
7	1				
8	1				
9	1				
10	1				
11					
12	1	1/2			
13	1				
14			1/4		
15			1/4		
16	1				
1-					0
2-					0
3-					0
4-					0
5-					0
6-					0
7-					0
8-					0
9-					0
10-					0
11-					0
12-					0
13-					0
14-					0
15-					0
16-					0

NUMBERS CODED WITH MINUS (-) ARE FLOOD PLAIN

Table 2.4.2. Crosscountry Movement - Non-Flooding and Frozen

ETL SOILS KEY	CROSSCOUNTRY MOBILITY				
	GREEN GO DOCTRINAL SPEED	CYAN INHIBITED 1/2 DOCTRINAL SPEED	YELLOW SLOW 1/4 DOCTRINAL SPEED	MAGENTA VERY SLOW 1/12 DOCTRINAL SPEED	RED STOP 0 DOCTRINAL SPEED
1	1				
2	1				
3	1				
4	1				
5	1				
6	1				
7	1				
8	1				
9	1				
10	1				
11		1/2			
12	1				
13	1				
14			1/4		
15			1/4		
16	1				
1-	1				
2-	1				
3-	1				
4-	1				
5-	1				
6-	1				
7-	1				
8-	1				
9-	1				
10-	1				
11-		1/2			
12-	1				
13-	1				
14-			1/4		
15-			1/4		
16-	1				

NUMBERS CODED WITH MINUS (-) ARE FLOOD PLAIN

Table 2.5.3. Snow Impact

FOR CCM, IF SNOW DEPTH IS:		
0.00 to 12.7 cm	multiply by	1.00
12.7 to 25.4 cm	" "	0.50
25.4 to 50.8 cm	" "	0.25
50.8 to 76.2 cm	" "	1/12
> 76.2 cm	" "	0

Table 2.6. Crosscountry Movement - Vegetation

ETL VEGETATION OVERLAY KEY	GREEN GO DOCTRINAL SPEED	CYAN INHIBITED 1/2 DOCTRINAL SPEED	YELLOW SLOW 1/4 DOCTRINAL SPEED	MAGENTA VERY SLOW 1/12 DOCTRINAL SPEED	RED STOP 0 DOCTRINAL SPEED
A	1.0				
B	1.0				
C 1	1.0				
2	1.0				
3	1.0				
4	1.0				
5	1.0				
6	1.0				
7					0
8					0
9		0.5			
10		0.5			
11		0.5			
12				1/12	
D 1	1.0				
2	1.0				
3	1.0				
4	1.0				
5	1.0				
6	1.0				
7		0.5			
8					0
9			0.25		
10			0.25		
11				1/12	
12					0
E 1	1.0				
2	1.0				
3	1.0				
4	1.0				
5	1.0				
6	1.0				
7			0.25		
8					0
9		0.5			
10		0.5			
11			0.25		
12					0
F	1.0				
G	1.0				
H	1.0				
I	1.0				
J					0
K				1/12	
L	1.0				
M					0

Table 2.7. Effect of Surface Configuration for CCM

ETL SURFACE CONFIGURATION KEY	CROSSCOUNTRY MOBILITY				
	GREEN GO DOCTRINAL SPEED	CYAN INHIBITED 1/2 DOCTRINAL SPEED	YELLOW SLOW 1/4 DOCTRINAL SPEED	MAGENTA VERY SLOW 1/12 DOCTRINAL SPEED	RED STOP 0 DOCTRINAL SPEED
A	1.0				
B	1.0				
C		0.5			
D			0.25		
E				1/12	
F					0
ESCARPMENTS					0
FILL					0
CUT					0
QUARRY					0
MINE					0
EMBANKMENT					0
BUILT-UP					0

Table 3.1 Time

DAY	- Use Doctrinal Rate = $\frac{X}{}$
NIGHT	- Use Doctrinal Rate = $\frac{X}{2}$

Table 3.2 Road Condition

DRY	Multiply Table Selection 3.1 by		1.0
WET	Multiply Table Selection 3.1 by		0.9
ICE	Multiply Table Selection 3.1 by		0.0
SNOW	0 to 12.7	Multiply Table Selection 3.1 by	1.00
	12.7 to 25.4	Multiply Table Selection 3.1 by	0.50
	25.4 to 50.8	Multiply Table Selection 3.1 by	0.25
	50.8 to 76.2	Multiply Table Selection 3.1 by	1/12
	> 76.2	Multiply Table Selection 3.1 by	0.0

Table 3.3 Road Class

Modify ALL Road Classes According to Table Selection 3.2
Modify AUTOBAHN According to Table Selection 3.2
Modify PRIMARY ROAD According to Table Selection 3.2
Modify SECONDARY ROAD According to Table Selection 3.2
Modify TERTIARY ROAD According to Table Selection 3.2

C.4 COM CURRENT WEATHER UPDATE

Table 4.0 lists the degradation factors to be used when listed precipitation effects are expected to occur in the named area of interest.

Table 4.0 COM Current Weather Degradation Factors

NONE	- Degrade CCM/LOC by	1.0
LIGHT RAIN	- Degrade CCM/LOC by	1.0
MODERATE RAIN	- Degrade CCM/LOC by	0.5
HEAVY RAIN	- Degrade CCM/LOC by	0.25
LIGHT FREEZING RAIN	- Degrade CCM/LOC by	0.25
MODERATE FREEZING RAIN	- Degrade CCM/LOC by	0.1
HEAVY FREEZING RAIN	- Degrade CCM/LOC by	0.0
LIGHT SNOW	- Degrade CCM/LOC by	1.0
MODERATE SNOW	- Degrade CCM/LOC by	0.5
HEAVY SNOW	- Degrade CCM/LOC by	0.1

APPENDIX D

SLIDING WINDOW SEGMENT COMPUTATION
(CROSSCOUNTRY CORRIDOR)

APPENDIX D. SLIDING WINDOW SEGMENT COMPUTATION (CROSSCOUNTRY CORRIDOR)

1. Referring to Section 3.1.2.2.2, the width of the test corridor shall be no larger than the maximum width of a doctrinal front of the echelon expected to traverse the corridor. For example, if a battalion front is nominally 1.5 kilometer and maximally 2.5 kilometers in crosscountry movement (as opposed to deployed for combat), the test corridor width should be 2.5 kilometers.

   Since the length of the sliding window equals the width of the test corridor, the length of the window equals the maximum width of the front of the echelon expected to traverse it. The corridor width (window length) shall not, however, be hard programmed. Default values shall be programmed such that the analyst can change them if he suspects that doctrine is either not being followed or has been changed.

2. The rating value of a single window area segment of a corridor is defined as follows:

$$A = \frac{V_S \times W_C}{W_D \times D_D} \quad \left(\frac{\text{Units}}{\text{Hr}}\right) \tag{1}$$

   By appropriate substitution this can be found to be equivalent to:

$$A = \frac{S_D \times V_T \times L_W}{C_T \times W_D \times D_D} \quad \left(\frac{\text{Units}}{\text{Hr}}\right) \tag{2}$$

where,

V_S = average speed permitted in the window (km/hr)

W_c = calculated width of the corridor (km/unit type)

W_D = doctrinal width of front of input echelon (km/unit type). This should be a default value that can be changed by analyst input.

D_D = doctrinal length of input echelon (km/unit type). This should be a default value that can be changed by analyst input.

L_W = the length of the window as determined by the echelon expected to travel the corridor. Should have default value that can be changed by analyst input.

C_T = the total number of blocks contained in the window

V_T = the sum of the normalized speed values of the individual blocks contained in the window. That is, go = 1.0, inhibited = 0.5, slow = 0.25, very slow = 0.0825, no go = 0.00.

S_D = doctrinal speed (e.g., 12km/hr) changeable default value.

It should be noted that L_W, W_D, D_D and S_D in equation (2) are all prestored table look-ups. The first three being a function

of echelon and are input automatically as initializing data when the analyst selects the echelon. V_T is a simple sum of the block values and C_T is the total number of blocks.

The rating of the window segment is then determined by comparing the calculated value of "A" in equation 2, to a table like that contained in Figure D-1. In the figure, with the assumption indicated in the footnotes it is seen that for a regiment traversing the nominated corridor and the value of "A" determined to be 2.5 battalions/hour, the corridor segment is rated as inhibited and painted cyan.

CORRIDOR RATING	BATTALIONS			REGIMENTS		
	CORRIDOR RATING (BATTALIONS/HR) (A_B)	CORRIDOR RATING TRANSLATED TO SPEED (KM/HR)	TIMING DEFAULT	CORRIDOR RATING (BATTALIONS/HR) (AR)	CORRIDOR RATING TRANSLATED TO SPEED (KM/HR)	TIMING DEFAULT
Go = Green	≥4.0 Bn/Hr	≥ 7.2 Km/Hr	12 Km/Hr	≥3.34 Bn/Hr	≥9.0	12 Km/Hr
Inhib = Cyan	≥2.0 but < 4.0	≥3.6 but < 7.2	6 Km/Hr	≥1.67 but < 3.34	≥4.5 but < 9.0	6 Km/Hr
Slow = Yellow	≥ 1.00 but < 2.0	≥1.8 but < 3.6	3 Km/Hr	≥0.84 but < 1.67	≥2.24 but < 4.50	3 Km/Hr
Very Slow = Magenta	≥0.33 but < 0.75	≥0.60 but < 1.8	1 Km/Hr	≥0.20 but < 0.84	≥0.75 but < 2.24	1 Km/Hr
Stop = Red	≥0.00 but < 0.33	≥ 0 but < 0.60	0 Km/Hr	≥0.00 but < 0.20	≥0.00 but < 0.75	0 Km/Hr
	$A_B = V_{SB}\left(\frac{LW}{W_D \cdot D_D}\right)$ or $V_{SB} = A_B\left(\frac{W_D \cdot D_D}{LW}\right)$ for Battalions: $W_D = 1.5$, $D_D = 3.0$, $LW = 2.5$ $\therefore V_{SB} = 1.8\ A_B$			$A_R = V_{SR}\left(\frac{LW}{W_D \cdot D_D}\right)$ or $V_{SR} = A_R\left(\frac{W_D \cdot D_D}{LW}\right)$ for Requirements $W_D = 3.0$, $D_D = 4.5$, $LW = 5.0$ $\therefore V_{SR} = 2.7\ A_R$		

Figure D-1. Corridor Rating Boundaries/Speed Conversions

APPENDIX E

TERRAIN SOURCE DATA REQUIREMENTS

(EXISTING DATA)

APPENDIX E. TERRAIN SOURCE DATA REQUIREMENTS (EXISTING DATA)

Five categories of terrain data shall be required for the automated IPB system: terrain elevation, surface configurations, vegetation, soils, wetlands and built-up areas. For areas where terrain analysis has been completed for other purposes and the data exists in more detailed conventional form, it shall be supplied on magnetic tape and in a form shown in Figure E-1. The figure shows that the acetate overlays, commonly provided by ETL, are treated as a coarse-grained digital terrain model with an implicit cartesian coordinate matrix composed of the mobility class values of the various terrain subfactor categories. The 1:50,000 scale sheets shall be digitized to 500 meter x 500 meter squares center-to-center and the UTM/MGR coordinate origins used shall be common to all maps including the LOC map data (see paragraph 3.1.1.1). Each 500 meter square shall be digitized to include data relative to the five categories (vegetation, soils, etc.) plus MGR coordinate location of the square. Each category of data shall be classified and stored according to the current ETL code:

- Surface Configuration - 12 classes (6 classes of slope plus escarpments, fills, cuts, quarries, mines, embankments)

- Vegetation - 46 classes (cropland, grassland/pasture/meadow, 12 classes of coniferous forest, 12 classes of deciduous forest, 12 classes of mixed forest, forest clearing, grassland and scattered trees, orchards/nurseries, hop-gardens/vineyards, swamps/marshes, brushland, bare ground, peat cuttings)

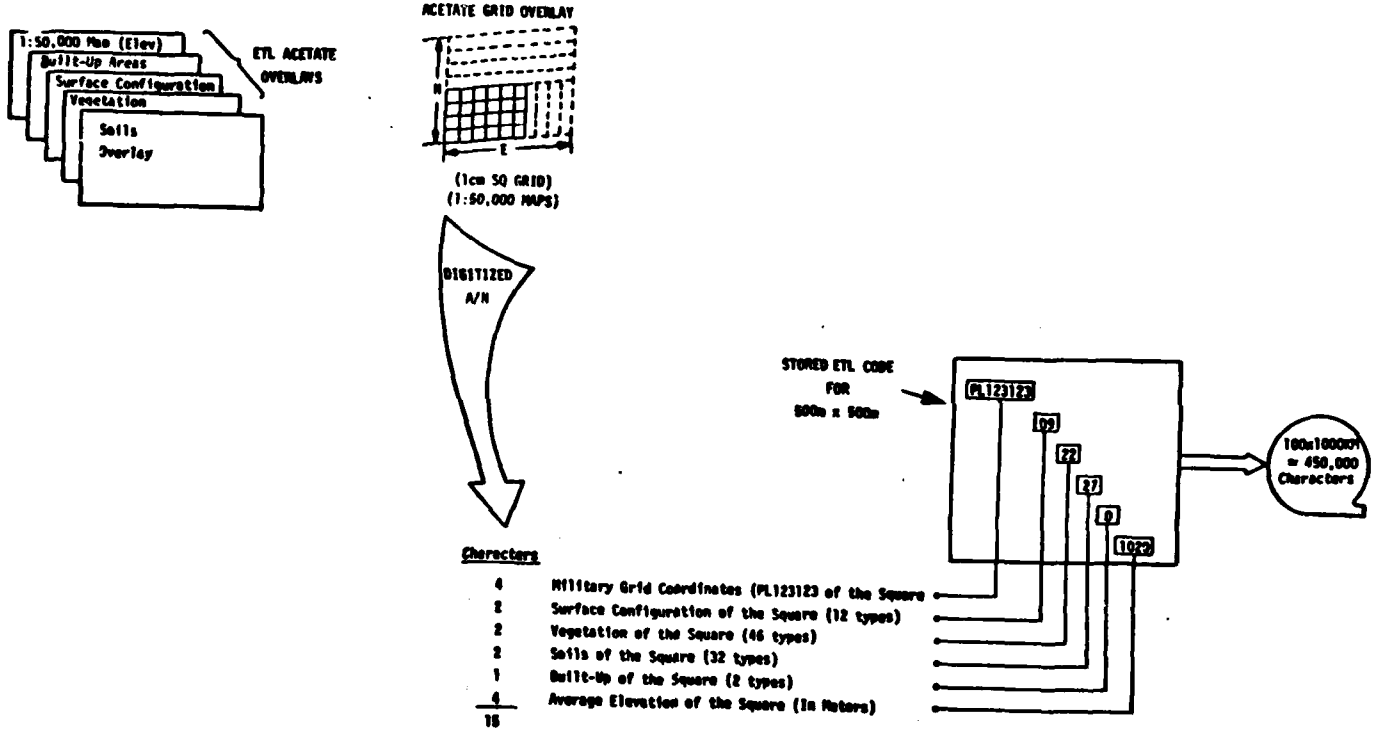


Figure E-1. Terrain Subfactor Digitization

- Soils - 32 classes (16 soil groups classed according to the Unified Soil Classification System (USCS) plus each class coded for flood plain

- Built-Up - 2 classes (built-up or not).

Again, from Figure E-1, it is seen that 15 characters shall be required to digitally categorize and classify each 500 meter x 500 meter square block. This is approximately equivalent to half a million characters to digitize a 100 x 100 kilometer area.

With the data digitized and coded in this fashion a number of overlays can be built on the graphic display by the analyst through the automated IPB system. These shall include, but not be limited to, the following:

- Slope
- Vegetation
- Soils
- Built-Up Areas
- Intervisibility Overlay
- CCM
- COM
- CCM, LOC and Intervisibility corridors

The technique for translating the ETL subfactor terrain data into the five-part IPB(A) code shall be accomplished as discussed in the reference materials (TIAX Final Report Phase A, TIAX Interim Report Phase II). Section 3.1.2.2 in this document describes how the data is used to build the various terrain composites required for the IPB process.

APPENDIX F

ADDITIONAL ANALYST AUTOMATION AIDS

APPENDIX F. ADDITIONAL ANALYST AUTOMATION AIDS

Besides the standard IPB system graphics and data base management software functional capabilities, there are several automated aids to the analyst that have been identified in the course of IPB(A) development but not thoroughly specified due to time/resource limitations. They are described here in sufficient detail to form the basis for further implementation. The aids described in this appendix are:

- Combat power ratio
- Symbol matching
- Symbol replot
- Situation template file search.

F.1 COMBAT POWER RATIO

This automated aid is intended to assist the analyst in rapidly performing the comparison of enemy to friendly forces considering there are a number of occasions in the G-2 and G-3 uses of IPB when that comparison is required.

Depending on the nature of the requirement, the IPB analyst will call a current situation graphic display or a snapshot or a decision alternative template (all of which contain both enemy and friendly forces). In any case he must have the appropriate map background in addition to the particular military scene in order to obtain

UTM coordinates from the graphics CRT. He reviews the military scene displayed and decides whether or not it is as complete as he desires. For example, have all units in the enemy ground order of battle been accounted for? If required, he may review the OB by executing a standard data base management query against the ENSIT data base and compare the output on the A/N CRT with the graphic display. If he elects to modify the graphic display, he uses standard graphics functions to move flags, build new ones or delete unwanted ones. When the graphics display of the military situation is as desired, the analyst defines the geographic area and/or the group of military units (flags) on the graphic display for which the combat power ratio will be calculated by drawing a polygon outlining the area/flags of interest.

By means of the function keyboard, the analyst initializes the computational portion of this function. The graphics software converts screen coordinates to UTM, for each corner of the polygon and transfers them to the A/N data base. Similarly locations and characteristics of the flags or symbols are transferred from the graphics to the alpha-numeric data base. If the initial problem is applicable to the current situation, the A/N data base already has unit identity and location data.

In the next step the specified enemy units are converted to equivalent friendly units in order to permit proper comparison. A total of enemy and friendly units is computed. The system will allow other input factors to be considered in the totaling process. For example, the analyst may elect to modify unit count by the degree of effectiveness assigned to each unit counted. After the equivalent enemy and friendly totals are calculated the arithmetic ratio is made and the results are automatically displayed on the A/N CRT.

F.2 SYMBOL MATCHING

During the IPB build process the analyst must compare two graphic displays (templates) in order to determine uniqueness or special quality. One example is in the snapshot build process when flags/symbols unique to the option will be given a different color than those common to more than one option. Another example is in decision alternative template building when desired number/location of a friendly unit is to be differentiated from the current location--using different colors and/or blinking. The IPB system aids the analyst by automated comparison in lieu of visual.

The symbol matching process consists of two basic steps: first, the primary or controlling flag/symbol and area of interest must be identified so that the system knows how to make comparisons and what action to take; second, a search must be conducted for like units and when they are found the fact that they are common must be indicated.

The analyst has the two overlays merged on the screen which constitute the comparison problem. The overlays must be color contrasted, must be at the same scale, and must overlay the same geographic area although no map background is necessary. The IPB(A) system links each overlay to a specific map, therefore UTM coordinates associated with the two overlays are available within the system.

The analyst defines the area of interest--the boundaries of the search--and inputs the parameters which determine match qualification, i.e., flag/symbol must be within X kilometers of the primary in order to qualify as a match. The function keyboard/cursor provide the analyst the tools to accomplish these actions.

The matching function must be tailored to the specific activity. An example of one approach follows.

The system scans the search area to find the first primary symbol. It then does a circle search at the prescribed radius around that symbol's location. If another, like symbol is found it is compared to the primary for type, echelon, etc., and for color. If a legal match is found, the system deletes the secondary symbol, if not search continues. If no legal match is found, the primary, unmatched symbol is blinked. The search moves to the next primary symbol, etc., when the matching is completed the system automatically deletes the area polygon. The resulting display on the graphic CRT shows the primary symbols in their original color, unblinking if matched, blinking if unmatched, and any secondary symbols not matched to a primary in their original color and locations.

If a third overlay is now to be compared to the primary, the blinking/non-blinking quality of the primary symbol would be considered in the matching logic as necessary. Also use of a third color in lieu of blinking is an alternative way to indicate those primary matched/unmatched symbols.

F.3 SYMBOL REPLOT

During the build process and also the G-3 use phase of IPB there are a number of situations wherein the analyst performs detailed analysis with IPB products at a 1:50,000 scale. Once all geographic areas of concern have been analyzed and the results reflected by positioning flags/symbols on overlays at that scale, the analyst must aggregate the total by building or modifying a 1:250,000 scale overlay. For example, having built a decision alternative template (1:250,000 scale) to the degree of accuracy possible at that scale, the analyst may look at unit locations more precisely using terrain features, intervisibility route timing, etc., at the 1:50,000 scale. Then he may want to return to the 1:250,000 template and make adjustments that reflect those made on the 1:50,000 scale.

The automated aid called symbol replot supports the analyst in retaining a symbol type and location when moving to a smaller scale. With the completed 1:50,000 scale display/overlay on the graphic CRT the analyst initializes the report function. He uses the cursor to identify a symbol/flag. The system automatically stores the symbol characteristics and UTM location in a temporary data set. The analyst acquires all the flags/symbols by cursor that he wants to be included in the larger area overlay. He then calls the 1:250,000 overlay he wants to adjust. The system uses the temporary data set to add these flags/symbols to the larger area scene now on the graphics CRT. The analyst then uses standard add, move, delete symbol capability to make final adjustments to the 1:250,000 scale template.

F.4 SITUATION TEMPLATE FILE SEARCH

The IPB analyst builds and stores many situation templates in the course of planning several enemy options. During the use phase he frequently needs to know what situation templates he has in a certain area. This section describes a system aid to meet this need. The analyst identifies a geographic location of interest for a situation template search by positioning the cursor on a display that includes a map background. The analyst then initializes the function by means of the function keyboard. The cursor position (in UTM) is used to set the parameter for a search of the graphics data base. Each situation template is linked to a map which therefore enables the UTM boundaries of that template to be identified and hence used to determine if the cursor UTM coordinates fall within the boundaries of that template or not. If the situation template qualifies the system extracts other data from its data base record, i.e., identify, lower left corner UTM coordinates and other significant information. The extracted data is stored temporarily on a data set until all situation templates in the data base have been checked. Then a prestored, data base management

query is executed against that data set and the results displayed on the A/N CRT. The resulting display lists the Situation Templates in the file that include the specified cursor location as a point. The analyst may then access the templates by number.

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