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Research Product 83-10

**Intelligence Aid for Evaluating
Enemy Courses of Action (ENCOA):**

**Manual for Use on the Apple II Plus
and IBM 5110/5120 Computers**

**Battlefield Information Systems
Technical Area**

March 1983

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assessment of the enemy situation as well as the communication and mutual understanding between intelligence analysts and their commander. A manual and HP41-C/HP41-CV calculator version of these procedures is described in ARI Research Product 82-06.

Research Product 83-10

INTELLIGENCE AID FOR EVALUATING ENEMY COURSES OF ACTION (ENCOA):
MANUAL FOR USE ON THE APPLE II PLUS AND THE IBM 5110-5120 COMPUTERS

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Intelligence Systems Procedures

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FOREWORD

The Battlefield Information Systems Technical Area is concerned with the demands of the future battlefields for increased user/system capacity to acquire, transmit, process, disseminate, and utilize information. Research is focused on user/system interface problems and interactions within command, control, and intelligence centers and is concerned with areas such as tactical symbology, user-oriented systems, information processing and management, and staff operations and procedures, as well as sensor systems integration and utilization.

One area of special interest is the development of procedures to support and enhance the decision-making process within command, control, and intelligence centers. The current research product is a manual describing procedures for evaluating enemy courses of action implemented on the Apple II Plus and IBM 5110/5120 desktop computers. Based on well-documented, decision-theoretic techniques, these procedures will encourage intelligence analysts to organize and evaluate available information logically and systematically in formulating their assessment and prediction of enemy intentions/activities/events. In addition, the computer provides various calculations, analyses, and feedback to the analyst. Use of these procedures is expected to enhance the analyst's assessment of the enemy situation as well as the communication and mutual understanding between intelligence analysts and their commanders. Manual and hand-held calculator versions of these procedures are described in ARI Research Product 82-06.



EDGAR M. JOHNSON
Technical Director

EXECUTIVE SUMMARY

Requirement:

To develop for intelligence analysts a set of procedures that will encourage logical and systematic organization of available information as well as support and enhance the decision-making process in the tactical evaluation of enemy intentions/activities/events.

Procedure:

The intelligence aid is based on a combined study of the intelligence process and decision-theoretic techniques. Using the well-documented technique of multiattribute utility assessment, this aid breaks into steps the overall problem of assessing the relative likelihood of enemy courses of action. The steps require an analyst to evaluate possible enemy courses of action on 25 component factors organized in five mutually exclusive categories. These component evaluations are then aggregated to produce an overall weighted assessment of the likelihood of each alternative course of action.

Findings:

General procedures to evaluate and predict enemy activities have been developed within the Army's doctrine of Intelligence Preparation of the Battlefield (IPB). These procedures, however, do not provide an explicit description of how to conduct actual analyses. This intelligence aid has been developed to supplement IPB procedures.

Utilization of Findings:

The manual contains complete background rationale for the aid, as well as computer instructions for implementation on the Apple II Plus and the IBM 5110/5120. It is intended for use by intelligence analysts in field operations, tactical training, and academic instruction. The aid will help the analyst organize relevant information concerning terrain, weather, and enemy forces, and provide a logical structure for using this information to evaluate the likelihood of alternative enemy courses of action. The aid is expected to enhance the analyst's assessment of the enemy situation as well as the communication and mutual understanding between intelligence analysts and their commanders.

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INTRODUCTION

The ENCOA (Enemy Course of Action) aid is intended for use in the tactical evaluation of opposing forces (see Figure 1 for an overview). This aid is designed both to help the intelligence analyst organize relevant information on terrain, weather, and opposing forces (size, disposition, capabilities, etc.) and to provide a logical structure for using this information to evaluate the likelihood of alternative enemy courses of action in any given tactical situation.

Army doctrine (FM 30-5, Combat Intelligence) explains the factors to be used in identifying the most likely enemy course of action. In addition, general procedures using templating techniques to evaluate and predict enemy activities have been developed by the Army within the doctrine of Intelligence Preparation of the Battlefield (IPB). These procedures, however, do not sufficiently explain how to conduct the actual analyses and predictions of enemy courses of action. Thus, the ENCOA intelligence aid has been developed specifically to supplement the procedures of FM 30-5 and IPB.

TC 30-27, Intelligence Preparation of the Battlefield, was prepared by the U.S. Army Intelligence Center and School as a guide for commanders, staff officers, and military intelligence personnel in G2/S2 sections and persons assigned to military intelligence organizations at all echelons. It standardizes basic tactical intelligence analytical functions, procedures, and techniques and identifies essential information for opposing forces (OPFOR), weather, and terrain. The techniques described apply to both offensive and defensive operations, focusing on the integration and analysis of OPFOR doctrine, terrain, and weather information relative to specific battlefield conditions and the commander's assigned mission in that situation.

The purpose of the IPB analysis is to determine and evaluate OPFOR capabilities, vulnerabilities, and possible courses of action as the basis for own force operations planning. The analysis permits the intelligence analyst to "see" the battlefield area of interest, evaluate possible OPFOR courses of action, determine the events that can be observed as the action unfolds for each OPFOR course of action, and develop an intelligence collection plan that will provide timely information to the commander. The analysis also permits the commander to see the battlefield area of interest in terms of enemy capabilities and possible courses of action, as well as the effects of terrain and weather factors on friendly possible courses of action to accomplish the mission. IPB does not provide, however, tools for evaluating the relative impact of such factors, or for assessing the likelihood of alternatives. The intelligence aid described in this report may be used for these purposes.

DESCRIPTION AND OVERVIEW

The ENCOA aid can be used by staff intelligence officers (G2/S2) and supporting intelligence analysts to evaluate alternative enemy courses of action in tactical situations. Its use assumes that the enemy's intent (e.g., attack, defend) and the objective of that intent have been determined. Given these conditions, and knowledge of the size and disposition of the opposing forces, the terrain, and the forecasted weather, the analyst can formulate alternative enemy courses of action for evaluation. This aid will help the analyst look at the battlefield from the perspective of the enemy commander in order to select the most likely alternatives from among those formulated.

The ENCOA aid is based on the simple but well-established procedures of multiattribute utility assessment. These procedures are based on the assumption that it is easier to break a problem down into its component parts, solve the component problems, and then aggregate back to the original problem. The ENCOA aid breaks down the overall problem of assessing the relative likelihood of enemy courses of action into a series of steps (see Figure 1). The steps require an analyst to evaluate possible enemy courses of action on 25 component factors, which are organized into five mutually exclusive categories, as shown in Figures 2 and 3. These component evaluations are then combined to produce an assessment of the overall relative likelihood of each enemy course of action. This method allows analysts to evaluate information logically one factor at a time, thus decreasing the memory load and ensuring that all relevant information is considered.

Figure 1 outlines the steps for using the ENCOA aid. First, the analyst must define and describe the reasonable courses of action (or avenues of approach, corridors of mobility, etc.) that the enemy may pursue. These should be defined such that the enemy can pursue only one avenue at a time. In step 2, the information on the factors listed in Figure 2 needs to be gathered or be readily available. At this point, the analyst is ready to evaluate the information numerically and to determine the relative likelihood of each course of action defined in the first step. In step 3, the numerical evaluation of the information is made by answering three questions: (1) How advantageous is each course of action on each factor for the enemy? (2) How important are the factors within each category, e.g., Fields of Fire within the Terrain category? and (3) How important is each category to the overall success of the enemy mission? In step 4, the computer calculates an overall score for each course of action; the score represents the relative desirability of that course of action for the accomplishment of the enemy's mission. In step 5, the relative probability of the enemy pursuing each course of action is inferred from the overall scores calculated in step 4.

The ENCOA procedures described in this manual are designed to be executed on the Apple II Plus, the IBM 5110, or the IBM 5120 desktop computers. The following sections explain the procedures for conducting an ENCOA analysis, describe the computer equipment and its operation, and outline the general organization of the ENCOA program. Finally, a step-by-step example of one way to work through an ENCOA analysis is provided.

summary of steps

The calculations for the ENCOA aid can also be performed manually or with the Hewlett Packard HP 41-C or HP41-CV calculator. Procedures for calculating an ENCOA evaluation in this way are explained in Intelligence Aid for Evaluating Enemy Courses of Action (ENCOA): Guide for Manual and HP41-C/HP41-CV Calculator Procedures (ARI Research Product 82-06).

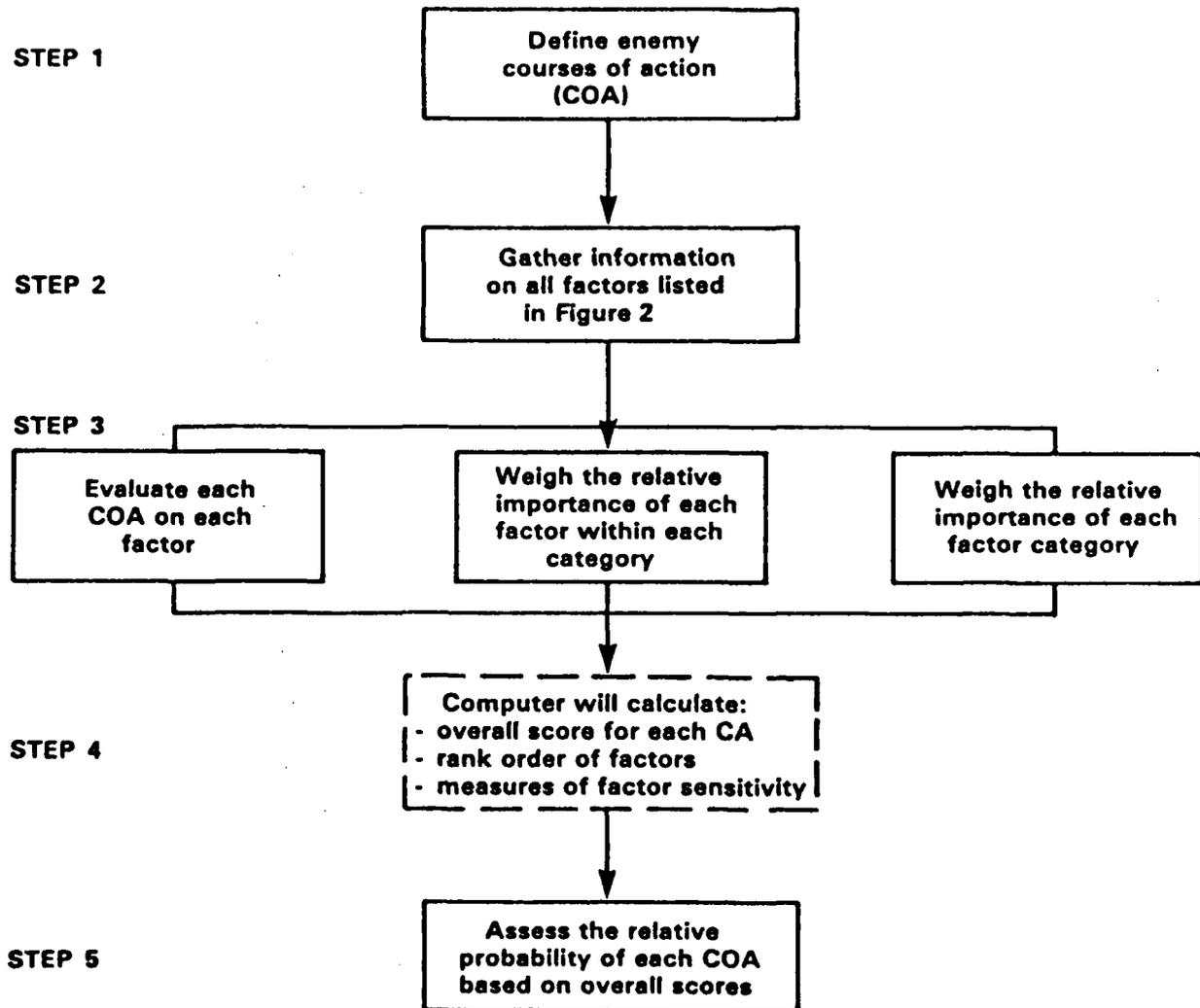


Figure 1. Summary of steps for evaluating the relative likelihood of enemy courses of action. Solid boxes indicate analyst steps; the dashed box indicates the step performed by the computer.

hierarchy of factors

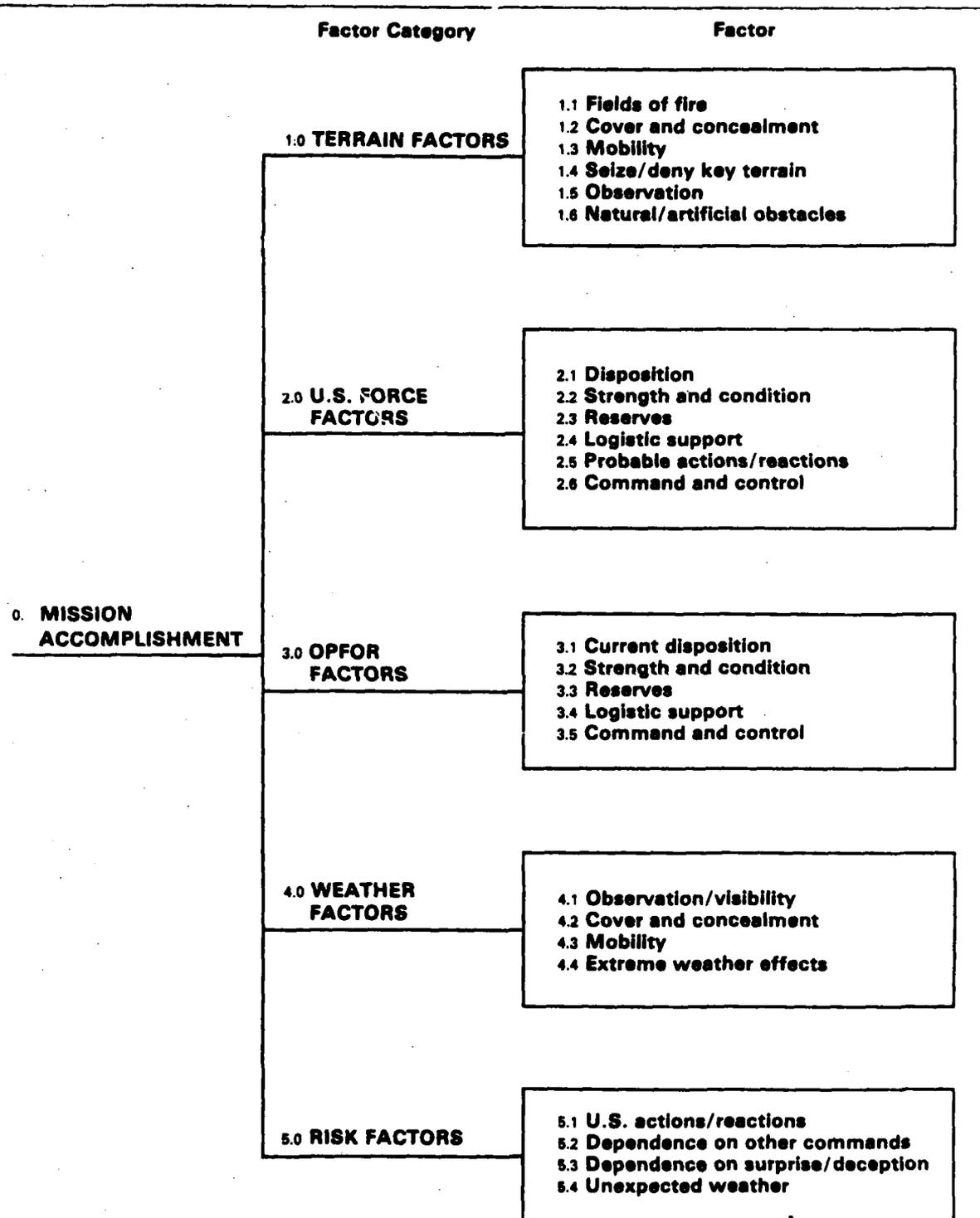


Figure 2. Hierarchy of factors.

1.0 TERRAIN FACTORS

As related to mission accomplishment and considering current OPFOR doctrine, score each OPFOR course of action in terms of how well it

- 1.1 Exploits field of fire afforded by terrain features.
- 1.2 Exploits cover and concealment afforded by terrain features.
- 1.3 Exploits mobility provisions due to terrain features.
- 1.4 Accomplishes rapid seizure or denial of key terrain.
- 1.5 Exploits observation provisions of terrain.
- 1.6 Exploits or accommodates natural and artificial obstacles.

2.0 U.S. FORCE FACTORS

As related to mission accomplishment and considering current U.S. doctrine, score each OPFOR course of action in terms of how well it exploits what you know or estimate about

- 2.1 U.S. disposition.
- 2.2 U.S. strength and condition.
- 2.3 U.S. reserves.
- 2.4 U.S. logistic support.
- 2.5 Probable U.S. actions/reactions.
- 2.6 U.S. command and control capabilities/vulnerabilities.

3.0 OPPOSING FORCE FACTORS

As related to mission accomplishment and considering current OPFOR doctrine, score each OPFOR course of action in terms of how well it exploits or accommodates

- 3.1 OPFOR current disposition.
- 3.2 OPFOR strength and condition.
- 3.3 OPFOR reserves.
- 3.4 OPFOR logistic support.
- 3.5 OPFOR command and control capabilities/vulnerabilities.

4.0 WEATHER FACTORS

As related to mission accomplishment, score each OPFOR course of action in terms of how well it exploits

- 4.1 Observation/visibility conditions forecast to exist due to weather.
- 4.2 Cover and concealment conditions forecast to exist due to weather.
- 4.3 Mobility conditions forecast to exist due to weather.
- 4.4 Effect of extreme conditions of forecast weather on personnel and equipment effectiveness.

5.0 RISK FACTORS

As related to mission accomplishment, score each OPFOR course of action in terms of

- 5.1 Ability to cope with surprises in terms of U.S. strength or U.S. actions/reactions.
- 5.2 Freedom from dependence on forces not under our own control.
- 5.3 Freedom from critical dependence on surprise or deception.
- 5.4 Suitability under unexpected adverse weather conditions.

Figure 3. Criteria for evaluating enemy courses of action on 25 factors.

EQUIPMENT AND OPERATING INSTRUCTIONS: APPLE II+ COMPUTER

Any one of three computers--the Apple II Plus, the IBM 5110, or the IBM 5120--can be used to implement ENCOA. This section covers two aspects of the Apple II Plus computer: what a properly configured system looks like, and how to use it. IBM equipment and operation are described on pp. 14 - 21.

The Apple II Plus system consists of several components that must be properly interconnected. This section will allow you to verify that all the necessary elements are present and properly connected, but it does not tell you how to hook up the system. If any internal connections (i.e., anything other than power cords) differ from the following, consult a qualified technician for assistance. Do not attempt to hook up the system because serious damage could result.

The following list includes all required and optional hardware elements:

- o Apple II Plus microcomputer with 48K bytes of memory
- o Apple Language Card with 16K bytes of memory
- o 80 column card
- o Display/video monitor
- o Keyboard
- o 2 Disk drives
- o Printer (optional)

You will also need the two diskettes labeled ENCOA 1 and ENCOA 2. Figure 4 shows a typical Apple system set-up, with a display, two disk drives, and a printer. Your set-up may look different because many different displays and printers may be used with the Apple.

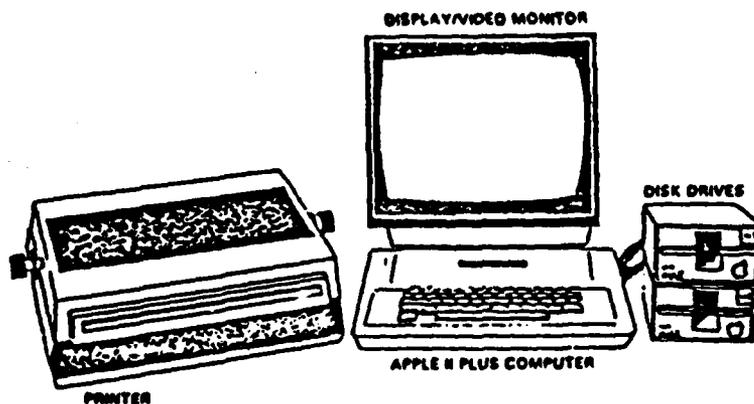


Figure 4. Typical Apple II Plus computer.

Internal Layout and Memory

The Apple computer must be outfitted with 48 bytes of random access memory (RAM). The memory resides on two printed circuit boards (PCBs) inside the Apple. The internal layout of the Apple is shown in Figure 5. The amount of memory can be verified by removing the Apple's cover,* counting the number of RAM integrated circuits (ICs) on the large PCB in the bottom of the case, and assuring that an Apple Language Card (or equivalent) occupies slot 0 (leftmost peripheral connector) on the large PCB.

Figure 6 shows the slot layout and numbering convention that we will use throughout the remainder of this section. Note that there are eight slots (connectors) shown in Figure 6 that are numbered from 0 to 7.

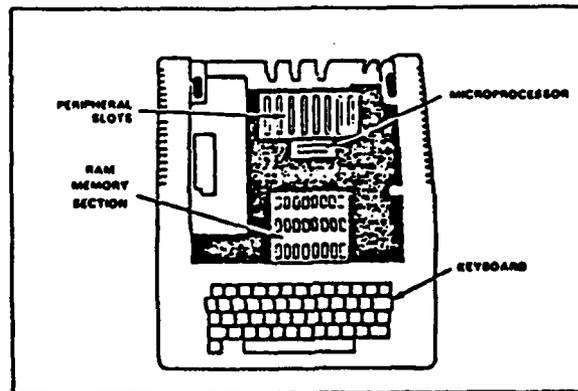


Figure 5. Inside the Apple II computer.

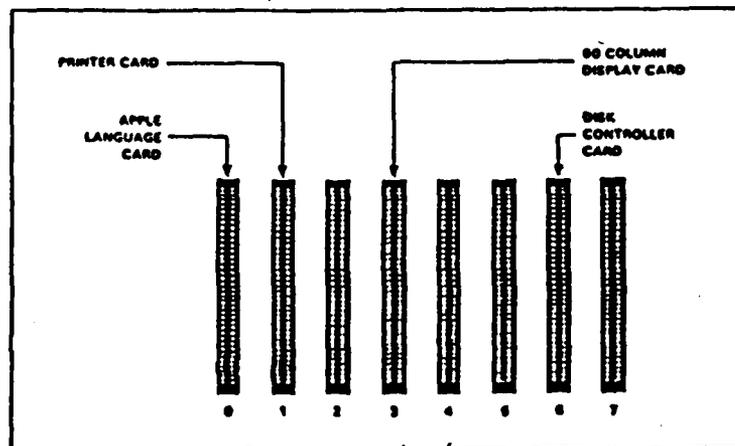


Figure 6. Peripheral slot assignments.

*To remove the cover, pull up on its rear edge until the two rear corner fasteners unsnap. Slide the cover away from the keyboard until it is clear of the case. Replace cover by reversing the procedure.

80 column card; display/video monitor

The area in which the RAM ICs are located on the large PCB is designated by a 4-by-4-inch square outlined in white and marked RAM. Twenty-four sockets populate this area of the board; 23 should contain ICs. The 24th socket (leftmost, rear of the 4-by-4-inch square) should be occupied by a plug connected to the Apple Language Card (occupying slot 0) via a ribbon cable.

80 Column Card

The Apple normally displays uppercase text in a 40 x 23 format, that is, 23 lines of 40 characters per line. The 80 column card converts computer-generated characters into upper and lower case and displays them in an 80 x 23 format.

The Videoterm 80 column card manufactured by VIDEX is a popular card for this purpose, although other manufacturers offer suitable substitutes. This card should be located in slot 3 (that's the fourth slot from the left; remember, start counting with zero). A cable runs from the top, front corner (edge nearest keyboard) of the card through the rear of the Apple case. The end that exits the case is fitted with an RCA-type connector which the display/monitor plugs into for its video signal.

Display/Video Monitor

The display/video monitor is a cathode ray tube (CRT) (see Figure 4) and is the computer's primary means of communicating with you. The monitor looks like a television without a channel selector. Its primary controls consist of an on/off switch and a brightness/contrast adjustment. Many brands of monitors can be used with an 80 column card as long as they have a bandwidth of 12 MHz or greater. Monitors built by Leedex and Sanyo have been found to work well with the Videoterm 80 column card.

The computer sends messages to the CRT for the following purposes:

- o To repeat the instructions you enter from the keyboard. This gives you immediate visual feedback to verify that what the computer interpreted from your typing is what you intended.
- o To provide you with prompts and requests for selecting a course of action or inputting data that the system needs to perform its analysis.
- o To notify you of the status of an ongoing process.
- o To furnish instructions that will help you use the system.
- o To display the results of the computer's calculations and analyses.

The monitor can display 23 lines of text with up to 80 characters per line (see 80 column card). The position at which a character you type will appear on the CRT is marked by a white rectangular figure called a cursor. As you type, the cursor advances one position to the right. When the cursor reaches the right edge of the display area, the next character typed will move it down one line and to the left edge of the display.

Disk Drive

The disk drive is used for storing and retrieving programs and data that the computer needs to satisfy your processing requirements. The programs and data are actually stored on a flexible diskette (also called a floppy disk) that can be inserted into and removed from the disk drive. The disk drive writes and reads data to and from the diskette as required.

The disk drive is a small device housed in a metal enclosure resembling a small shoebox 4 inches high by 6 inches wide by 9 inches long. It connects to the Apple by a ribbon connector to a disk controller card (PCB) located in slot 6 of the Apple (see Figure 6). Your system has two disk drives. Both of them connect to the same PCB in slot 6. One of the drives is designated as 1 and the other as 2. It is important that you consult your application's documentation to utilize the drives properly. The front of the disk drive has a slot and a small door or latch. It is through this slot that you insert the diskette you wish to use.

The diskette (Figure 7) must be handled carefully. It measures about 5-1/4 inches along each edge. Avoid bending it or touching the surfaces exposed by the oval cutouts on both sides of the protective plastic jacket. Do not force the diskette into the disk drive, or you may permanently damage it.

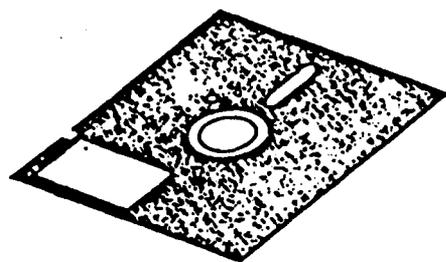


Figure 7. Diskette.

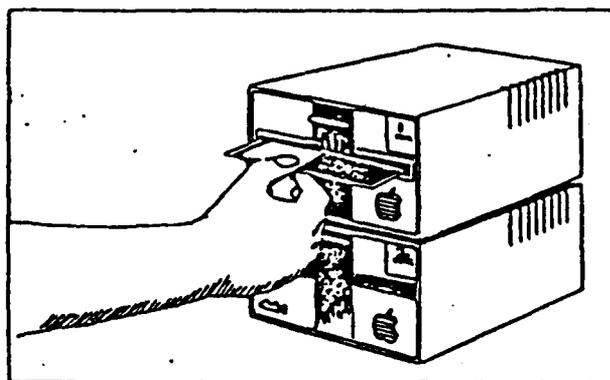


Figure 8. Inserting a diskette into an Apple II drive.

To insert a diskette into a drive, open the latch on the front of the drive by pulling outward on its lower edge. There is only one way that a diskette should be inserted into the drive. The label must face upward and the oval hole in the plastic jacket must enter the drive first. Any other orientation of the diskette is incorrect. An easy way to assure the proper orientation is to hold the diskette with your thumb over the label as you insert it into the drive (see Figure 8). Once the diskette is fully seated, close the drive latch by pushing down on it until it snaps into the closed position.

keyboard

Keyboard

The keyboard is used to communicate with the computer. Through the keyboard, you can give instructions, answer queries, make selections, or input required data. As characters are typed, they appear on the display at the location identified by the cursor.

While it is similar in layout to a standard typewriter keyboard, the Apple keyboard has some special keys you should know about. Figure 9 shows the keyboard arrangement.

ESC (row 2, position 1). The ESC (escape) key is a nonprinting character key. That is, although the computer recognizes that the key has been pressed and may even perform some programmed function, it does not display anything on the monitor; in fact, the cursor does not advance either. You will probably not need to use this key. If you press it inadvertently, it can be cancelled by pressing the ← (back arrow) key.

CTRL (row 3, position 1). The CTRL (control) key does nothing by itself. It has an effect only when used in conjunction with another key. For CTRL to have an effect, it must be held down while another key is pressed (i.e., simultaneously pressing CTRL and another key). Control characters do not appear on the screen. Certain control characters may move the cursor about, interrupt program execution, or produce other unexpected results. Generally, you will not need to use CTRL.

SHIFT (row 3, position 1 and last). The SHIFT key permits some of the keys on the keyboard to have two functions. Those keys with dual functions are marked with two different characters on the same keycap. Pressing SHIFT and simultaneously pressing a dual function key produces the upper character shown on the keycap. The exception to this is "G," with which SHIFT has no effect.

RESET (row 1, last position). The RESET key aborts whatever process is going on and restarts the system. On some Apples, RESET must be pressed simultaneously with CTRL.

REPT (row 2, next to last position). The REPT (repeat) key pressed simultaneously with another key causes the other character to be repeatedly transmitted to the computer and repeatedly displayed on the CRT.

RETURN (row 2, last position). The RETURN key is similar to the carriage return key found on most electric typewriters. Pressing RETURN moves the cursor down one line and to the left edge of the CRT. RETURN is normally used after typing an instruction, query, or piece of data on the keyboard to signal the computer to accept the input. Each response you make through the keyboard must be terminated by a RETURN before the computer will act upon it.

← (row 3, next to last position). The left arrow moves the cursor left one position each time it is pressed. Its primary purpose is to allow you to make corrections to the line of text or data you are currently typing. To make the correction, press the left arrow until the cursor overlays the character you wish to correct. Pressing the correct character key at this point will replace the previous character. The remainder of the line must be retyped either by repeatedly striking the right arrow (→) key to the end of the data or text line or by rekeying each character. (Remember to terminate the line with a RETURN.)

The left arrow moves the cursor left until it reaches the left edge of the CRT. An additional press of the key moves the cursor up one line and to the right edge of the CRT. Note that using the left arrow and subsequently replacing characters on the CRT that have earlier been terminated by a RETURN will not alter that line. Once RETURN has been pressed, the computer acts upon the text/data preceding RETURN.

→ (row 3, last position). The right arrow moves the cursor one position to the right each time it is pressed. It is normally used in conjunction with the left arrow key to make corrections to the last line displayed on the CRT. When the cursor occupies the same position as a character, pressing the right arrow has the effect of retyping or confirming that character and moving the cursor one position to the right.

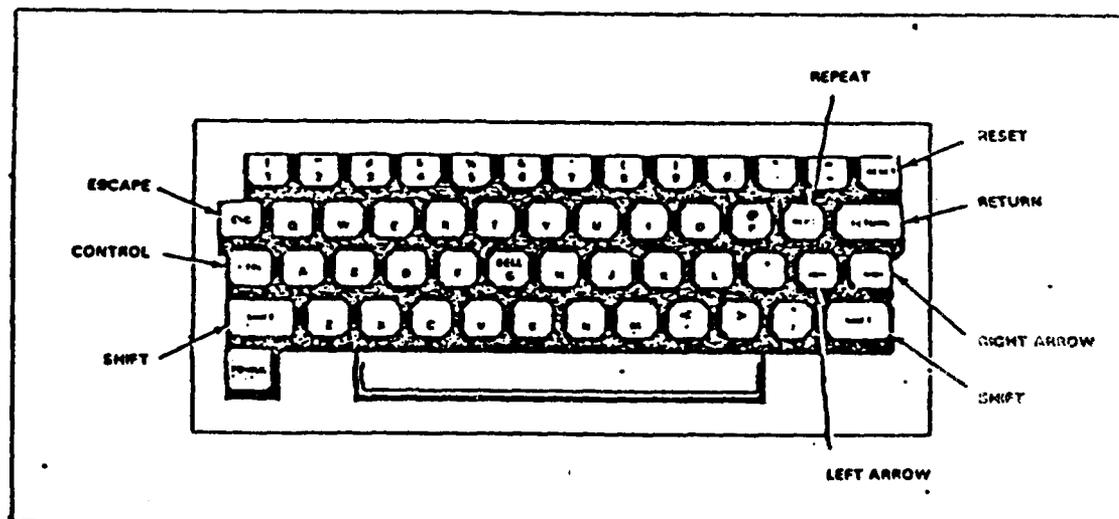


Figure 9. Apple II keyboard.

printer

Printer

The printer is the computer's secondary means of communicating with you. Generally, results that are lengthy, that you may want to keep permanently, or that you want to analyze in detail are the kinds of data that will be directed to the printer. If output is directed to the printer, it will not also appear on the display.

A typical printer is shown in Figure 10. Many brands and models are compatible with the Apple. All will likely have at least the features we will discuss below, although different manufacturers may use different names for the same feature or capability.

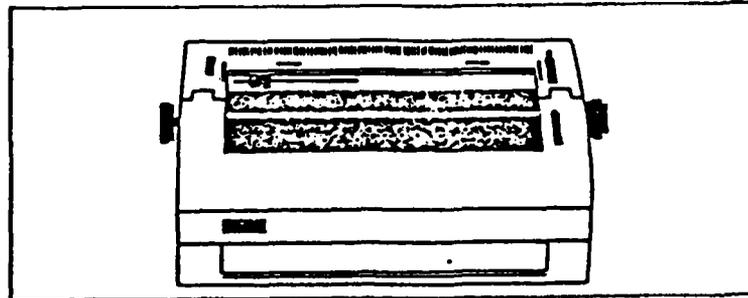


Figure 10. Printer.

The printer connects to the Apple through a ribbon cable that attaches to a printer interface card (PCB) that occupies slot 1 in the Apple. The printer's own power cord must be plugged into a 110 volt, 60 cycle wall outlet.

Paper for the typical printer comes in pages that are 11 inches long. Each page is joined along an easy-tear perforation toe-to-head with the next sheet. The paper is folded along the perforation in an alternating pattern so that it stacks compactly and feeds freely. The outer edge of the paper has uniformly spaced holes that match up with the sprockets found on the roller (platen) of the printer. This arrangement maintains accurate alignment and positive feed of the paper. Some printers do not use sprocket feed but rely on a friction feed mechanism similar to that used in an office typewriter. If paper is not already in the printer, consult the printer's user's manual for its proper installation.

On/Off Switch. The printer has its own ON/OFF switch, usually easily accessible on the front or right side (as you stand in front) of the printer. When the printer is on, an indicator light should also be lit.

On Line/Off Line Button. When ON LINE is selected, the printer is ready to accept output from the computer. In the OFF LINE mode, the printer notifies the computer not to send any data to it. The printer must be in the OFF LINE mode when doing either a FORM FEED or LINE FEED operation.

Form Feed Button. This may also be referred to as the TOF (top of form) button. Pressing this button advances the paper in the printer to the top of the next page. This feature needs to be calibrated each time the printer is turned on; details are covered in the user's manual of the printer.

Once the paper is positioned so that the perforation is just above the print head and the printer is initialized according to the manufacturer's instructions, FORM FEED will forward the paper so that the next perforation line moves to the same position above the print head as it did at initialization.

Line Feed Button. This button advances the paper a single line space each time it is pressed.

Additional Features. Additional features commonly available include:

- o Out of Paper Indicator Light. Notifies you that the last page of the paper has entered the printer. This condition may also trigger an audible sound to get your attention and place the printer in an Off Line status. The light will automatically go off when you resupply paper to the printer.
- o Form Length Selector. Synchronizes the FORM FEED feature with the length of the page you are using in the printer. The most commonly used paper length is 11 inches.
- o Character Spacing Selector. Controls the closeness of the characters printed. The two most common spacings are 10 and 12 characters per inch. Ten characters per inch is the most commonly used.

Starting Up the Apple System

Three of the components of the system require standard 110 volt, 60 cycle power: the Apple, the video monitor, and the printer. Make sure that each is plugged into a proper receptacle. Turn on the monitor and the printer. Next, insert the diskette labeled ENCOA 1 into disk drive 1, and the diskette labeled ENCOA 2 into disk drive 2. Now turn on the Apple (its switch is in the rear and can be reached with your left hand). The red light on the front of disk drive 2 will come on and the diskette will automatically be read into the computer. The program will then begin running.

Turning Off the Apple System

When you are ready to turn off the system, remove the diskettes from the disk drives. If you have printed output still in the printer, advance with the FORM FEED or LINE FEED buttons until the printed portion exits the printer. Tear off the paper containing your output.

You may now turn off the system by setting the power switch on each of the three components (Apple, video monitor, printer) to the OFF position. You may turn off these components in any order you wish.

EQUIPMENT AND OPERATING INSTRUCTIONS: IBM 5110/5120 COMPUTERS

The IBM 5110 and 5120 have five components that make up the basic self-contained system illustrated in Figures 11 and 12. These are the operator selection switches, display screen, keyboard, tape drive or disk drive, and the central processor with its associated memory. In addition, a printer accompanies this basic unit.

Basically, these machines are identical except that the 5110 operates with a cassette tape while the 5120 uses a diskette (also called a floppy disk). Remember that you cannot damage the equipment by pressing keyboard keys or switches. If you make a mistake, there will always be the opportunity for corrections.

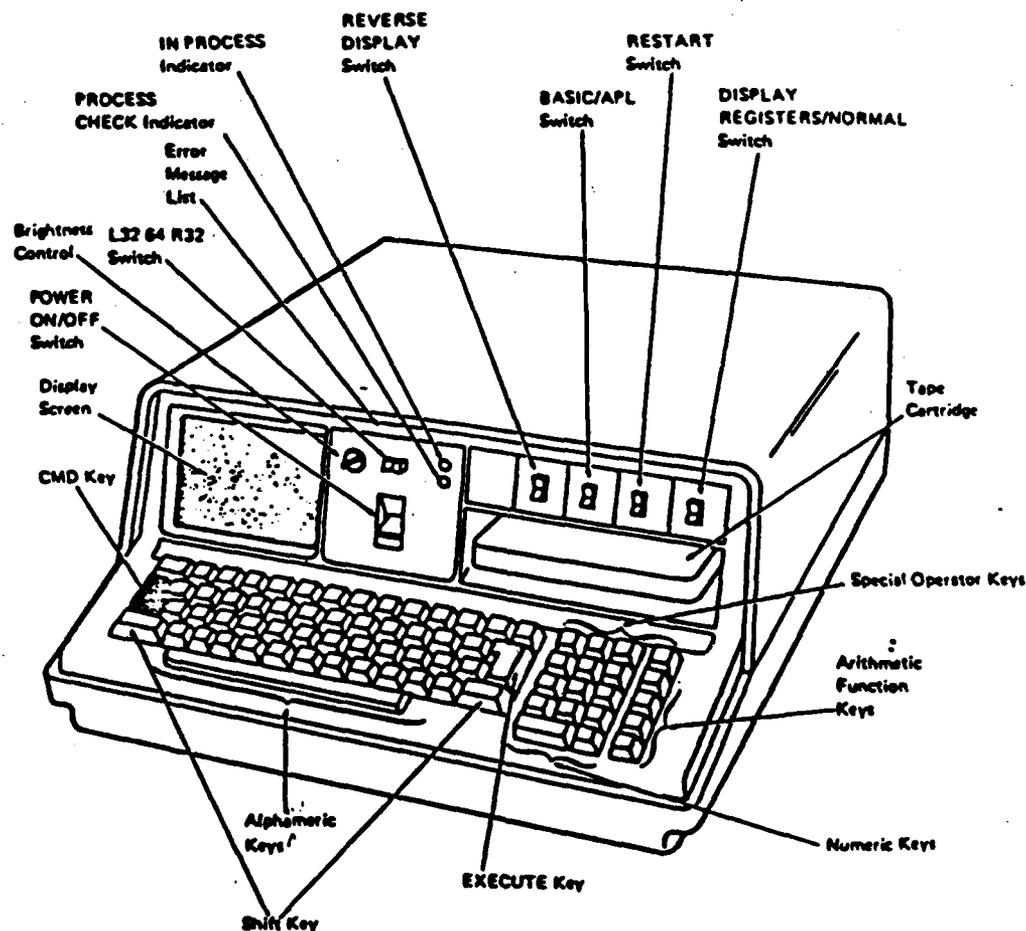


Figure 11. Diagram of the IBM 5110 Computer.

Operator Selection Switches

- o L32 64 R32 (IBM 5110 only). This three-position switch lets you display the left 32 characters of the display position (L32), the right 32 characters (R32), or the entire display of 64 characters (64). The ENCOA program requires that this switch be in the center position (64).
- o REVERSE DISPLAY (IBM 5110 only). Some users prefer viewing a black on white image to a white on black. The REVERSE DISPLAY switch allows you to select either type of image. Reversal of the display will require a brightness adjustment. Also, the REVERSE DISPLAY switch will not affect the image displayed on the auxiliary CRT monitor.
- o BASIC/APL. Since the ENCOA program is written in APL (a programming language), this switch must be in the APL position.
- o RESTART. The RESTART switch is used to reinitialize the computer. Depressing this switch is equivalent to turning off power to the machine and restarting.
- o DISPLAY REGISTERS/NORMAL. This switch should be in the NORMAL position when operating the ENCOA program. (The DISPLAY REGISTERS position provides a display of internal machine code used in diagnostic testing of the machine.)
- o BRIGHTNESS. This control varies the intensity of screen characters.

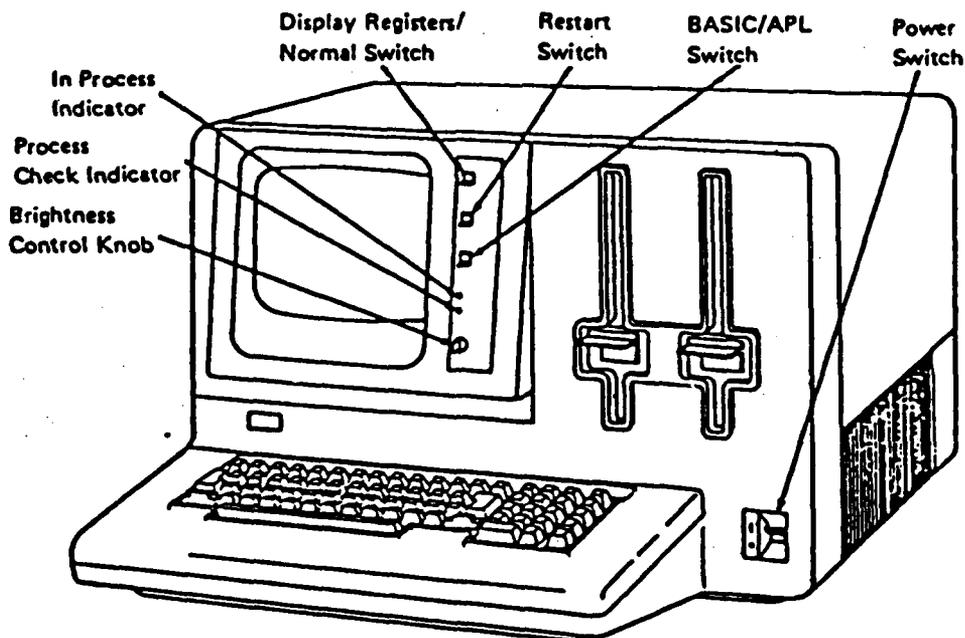


Figure 12. Diagram of the IBM 5120 Computer.

display and keyboard

Display

The display is a CRT that allows 16 lines of data to be displayed. Each line may contain up to 64 characters. The computer scrolls each line from bottom to top. Lines that scroll off the top are lost. The display screen has two functions:

- o As you type characters, they will appear on the bottom two lines of the screen. A flashing cursor (-) will indicate where the next character will be entered.
- o The computer will help you organize and summarize the data that you enter. Tables of these data will be displayed on the upper 14 lines of the display.

When the computer is making computations, the screen will often go blank and the red (IN PROCESS) light will come on.

Keyboard

The layout of the keyboard is similar to that of a standard typewriter. Many of the keys have special symbols embossed over the standard typewriter characters. These symbols are used to write programs in the APL language and are not necessary when operating the ENCOA program.

In addition to the standard keyboard, note that the computer has a numeric keypad, similar to that of an adding machine. These keys are interchangeable with the numbers appearing in the top row of the keyboard, and many users find them more convenient to use.

As characters are typed, they appear on the display at the location identified by the cursor. In general, this display will occur on the bottom line of the display screen.

Finally, a number of additional keys perform special functions. These keys are discussed below.

- o SHIFT or ↑ . The shift key performs the same function as a shift key on a typewriter.
- o FORWARD SPACE or → . When this key is pressed once, the cursor moves one position to the right. When this key is held down, the cursor continues to move to the right. When the cursor reaches the last position on one input line, it goes to the first position on the next input line.
- o BACKSPACE or ← . When this key is pressed once, the cursor moves one position to the left. When it is held down, the cursor continues to move to the left. When the cursor reaches position 1 on one input line, it goes to the last position on the previous input line.

- o HOLD. When pressed once, HOLD causes all processing to stop; when pressed again, it allows processing to resume. The primary purpose of HOLD is to permit reading the display information during an output operation, when the display is changing rapidly. When the hold is in effect (HOLD pressed once), only the COPY DISPLAY key is active.
- o EXECUTE. When this key is pressed, the input line of information on the display screen is processed by the system. This key must be pressed for any input to be processed.
- o ATTN. The ATTN key erases from both the computer's memory and the display screen everything beyond the space where the flashing cursor is positioned. It does not erase anything before the flashing cursor.
- o INSERT. When the CMD key is held down and the FORWARD SPACE is pressed once, the characters at and to the right of the cursor position (flashing character) are moved to the right one position, and a blank space is inserted at the cursor position. The cursor does not move. For example:

Flashing character

Before the insert operation: 123567

After the insert operation: 123_567

When both these keys are held down, the characters continue to move to the right and blank spaces continue to be inserted.

- o DELETE. When the CMD key is held down and the BACKSPACE key is pressed once, the character at the cursor position (flashing character) is deleted and all characters to the right are moved over one position to the left to close up the space. The cursor does not move. For example:

Flashing character

Before the delete operation: 1234456

After the delete operation: 123456

When both these keys are held down, the characters at the cursor position continue to be deleted and all the characters to the right are moved to the left.

storage: tape cassette and floppy disk

Tape Cassette and Floppy Disk

These devices are used to store the programs and data that you will use. To use ENCOA, you must load the program from a tape cartridge (5110) or floppy disk (5120). Also, after you have created a new model via the ENCOA program, the information concerning this new model must be stored if it is to be used again. The ENCOA program automatically handles the control of the tape or disk drive, but you must physically load the tape (Figure 13) or the diskette (Figure 14) in the machine.

If you plan to save a new model when using the 5110, you must ensure that the tape is not in the SAFE position (Figure 15). When the SAFE switch is on, the tape cannot be changed.

Insert the diskette into the diskette drive as illustrated in Figure 14. Be sure the permanent diskette label faces to the left, toward the display screen, as you insert the diskette into the diskette drive. Do not force or bend the diskette.

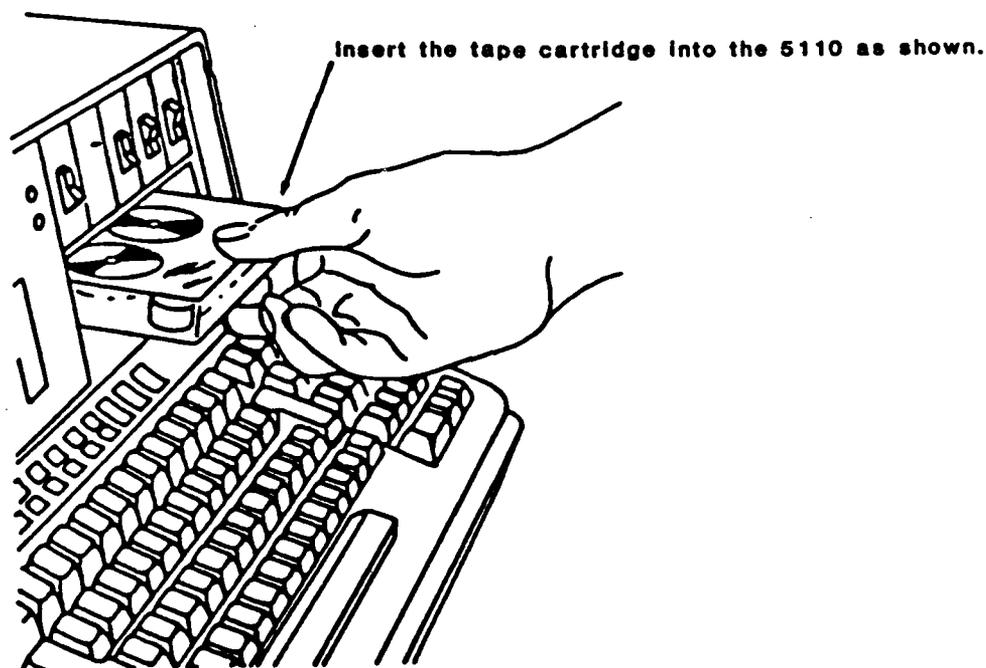


Figure 13. Inserting a tape cartridge into the IBM 5110 computer.

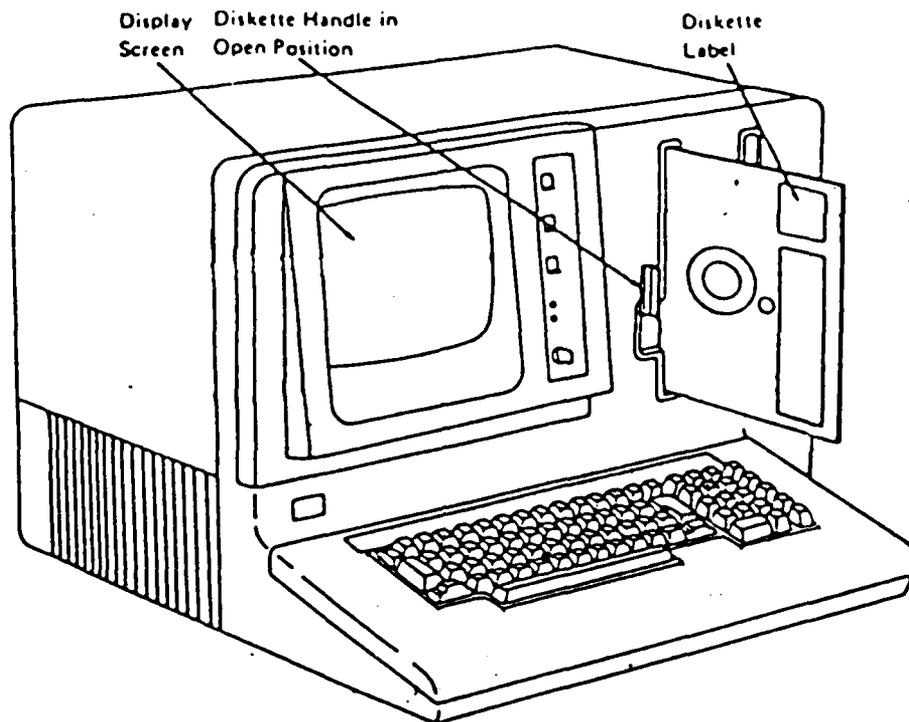


Figure 14. Inserting a disk into the IBM 5120 Computer.

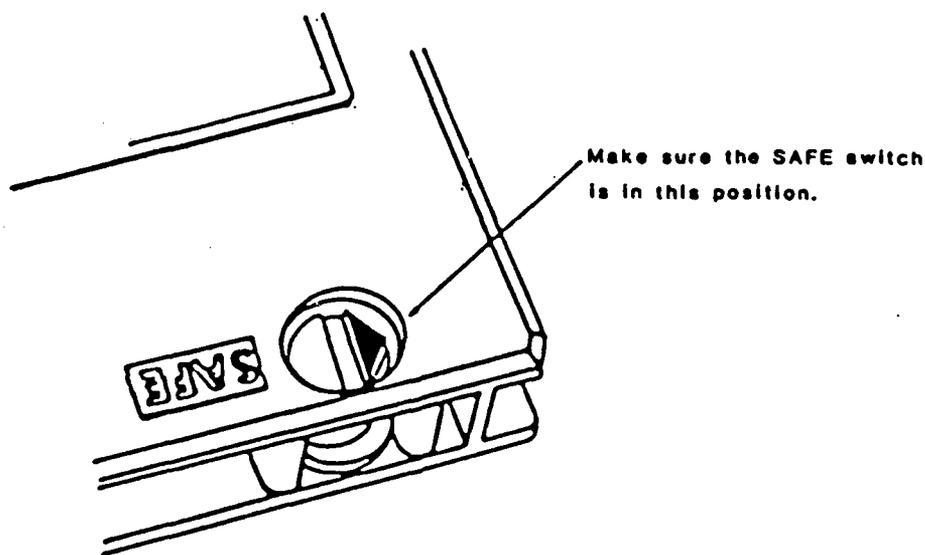


Figure 15. THE SAFE Switch.

central processor; printer; potential problems

Central Processor and Memory

The central processor is a microprocessor developed by IBM. This unit executes the commands stored in the computer's memory.

Printer

The printer, when turned on, will print each line of the CRT screen exactly as it is displayed. It will be to your advantage to maintain printouts of many of the displayed tables. Many of the tables are too long for the display screen, and the top portion will scroll off the display. It is often easier to read these long tables in printout form.

The disadvantage of the printer is that it is slower than the CRT display and will slow your progress. At different points in the exercise, the computer may suggest turning the printer on or off. The operation of the printer, however, is completely up to you.

If at any time the information on the display screen seems important enough to record, you can obtain a printed copy by turning on the printer and then simultaneously pressing the CMD key and the X key.

Potential Problems

The ENCOA program has many internal safeguards which should prevent most problems, but a few things can go wrong.

Typing Mistake. A common problem is that you will mistype a response to the computer. This mistake is easy to correct. Before depressing the EXECUTE key, simply type over the portion of the response that is incorrect, using the SPACE FORWARD and BACKSPACE keys. Remember that the computer will not process your response until you depress the EXECUTE key.

Tape or Disk Improperly Loaded. If the tape cartridge or disk is not properly loaded or the tape is in the SAFE position, ENCOA will not execute properly. To correct this situation in the IBM 5110, simply remove the tape, check the SAFE switch, reload the tape, depress the RESTART to clear the computer, and start over. To correct this situation in the IBM 5120, remove the disk, reinsert it in the correct position, depress RESTART, and begin again.

Process Check Error. If the PROCESS CHECK indicator (Figure 11 and 12) comes on, the computer has encountered internal problems. Depress RESTART and try again. If the light comes on again, call an IBM service representative.

Starting Up the System

Turn on the computer and check the position of the operator selection switches. If you are going to use the printer to record the output displays, make sure that it is connected properly before you turn on the computer. Do not connect or disconnect the printer in the middle of any operation. To connect the printer, screw the box-like appendage of the printer into the back of the computer. Be sure that the printer is plugged in.

When the computer has completed its internal check, the following display will appear in the lower left of the display screen:

CLEAR WS

Insert the ENCOA program cartridge or diskette and type the following instruction exactly as shown:

)LOAD 10 RUN

Press the EXECUTE key and the computer will load the ENCOA program from the data cartridge or diskette. When this process is completed, the computer will display the following instructions:

SELECT ONE OF THE FOLLOWING:

- 1) CREATE NEW MODEL
- 2) LOAD MODEL

ENTER THE NUMBER OF THE DESIRED OPTION:

At this point, the ENCOA system is loaded and ready to begin.

Turning Off the System

When you are finished with your work, you can bring down the system by removing the tape cartridge or diskette, turning off the computer power, and turning off the printer. You can turn off the system whenever the computer is waiting for input, but you should not turn it off while the printer is operating or while the tape cassette or diskette is operating.

THE ENCOA SYSTEM ORGANIZATION: THE PRELIMINARY MENU

The ENCOA system is designed to provide a wide variety of options for building and examining ENCOA models. The technique used to tell the computer what the user wants is called a menu system. Briefly, a menu is a list of numbered options. You can select an option by typing the appropriate number and pressing RETURN (Apple) or EXECUTE (IBM). Pressing that key transmits your request to the computer. Menus on the Apple and the IBM computers are identical except where noted in this manual.

The Preliminary Menu

The first menu you will encounter is the following:

SELECT ONE OF THE FOLLOWING:

- 1) CREATE NEW MODEL
- 2) LOAD MODEL

ENTER THE NUMBER OF THE DESIRED OPTION:

This menu informs ENCOA of your purpose. Essentially, the system anticipates that you intend to either construct a new model or examine an old one.

CREATE NEW MODEL

You will select Option 1 when developing a completely new model. ENCOA elicits descriptive information concerning the nature of the problem, the date, and your name. You must also define each course of action. ENCOA accepts up to eight courses of action.

Note that ENCOA does not ask you for utility scores or attribute weights at this time. These are elicited later, under the main menu option: ENTER ALL VALUES.

Once a new model has been created, it is available in ENCOA's working space and need not be loaded prior to editing or examination. It must, however, be saved (see "Save Model," page 25) before you load another model or deactivate the system. Otherwise, the newly created model will be lost.

LOAD MODEL

This option is selected when you want to review or edit a model that was created during a previous ENCOA session. ENCOA displays a list of the models that it currently stores and asks you to select one. After you make a selection, the designated model is loaded into ENCOA's working space and can be edited or examined.

These two preliminary options are described in greater detail under the heading, "The ENCOA Options" beginning on page 25.

THE HIERARCHY OF OPTIONS

After one of the preliminary activities has been both selected and implemented, ENCOA displays the main menu. This menu contains nine options, two of which are the CREATE NEW MODEL and LOAD MODEL options discussed earlier. The menu appears as follows (see Figure 16):

- 1) DISPLAY
- 2) SENSITIVITY
- 3) EDIT SELECTED ITEMS
- 4) PRINT
- 5) LOAD MODEL
- 6) SAVE MODEL
- 7) ENTER ALL VALUES
- 8) CREATE NEW MODEL
- 9) ERASE A MODEL
- 0) TERMINATE (Apple only)

ENTER THE NUMBER OF THE DESIRED OPTION:

This menu provides access to ENCOA's most basic options. It is the top level of ENCOA's hierarchy of options. For many of these options, additional suboptions can be performed. Figure 16 presents this arrangement of options and suboptions. Options that appear within a box are presented together on a menu. Any option with an arrow leading from it has suboptions, which will appear on a menu if the option is selected. In this manner, you can successively refine an option. When there are no further suboptions to select, ENCOA implements your request (see the next section for details).

This hierarchical organization of menus is quite simple to use provided that you remember where you are in the hierarchy and what the rules are for moving from one level to another. As stated earlier, lower level menus appear as soon as the appropriate higher level option is selected by typing the option number followed by RETURN (Apple) or EXECUTE (IBM). In most cases, once ENCOA implements a request, it returns to the last menu that appeared. For example, after LOAD MODEL, ENCOA returns to the main menu, since this option has no suboptions. After EDIT WEIGHTS, however, ENCOA returns to the second level menu under EDIT SELECTED ITEMS, thereby anticipating the possibility that further editing may be required (see Figure 16). Without any additional capability, this tendency to return to the last menu would eventually trap you at a low-level menu and make it difficult to continue. To overcome this difficulty, ENCOA lets you return from any low-level menu to the next higher level menu by pressing EXECUTE alone (IBM) or by selecting the appropriate option in the menu (Apple). Thus, movement from the main menu down through the hierarchy (left to right in Figure 16) requires a number followed by EXECUTE or RETURN, while movement up requires either an EXECUTE alone (IBM) or a number followed by RETURN (Apple).

hierarchy of options

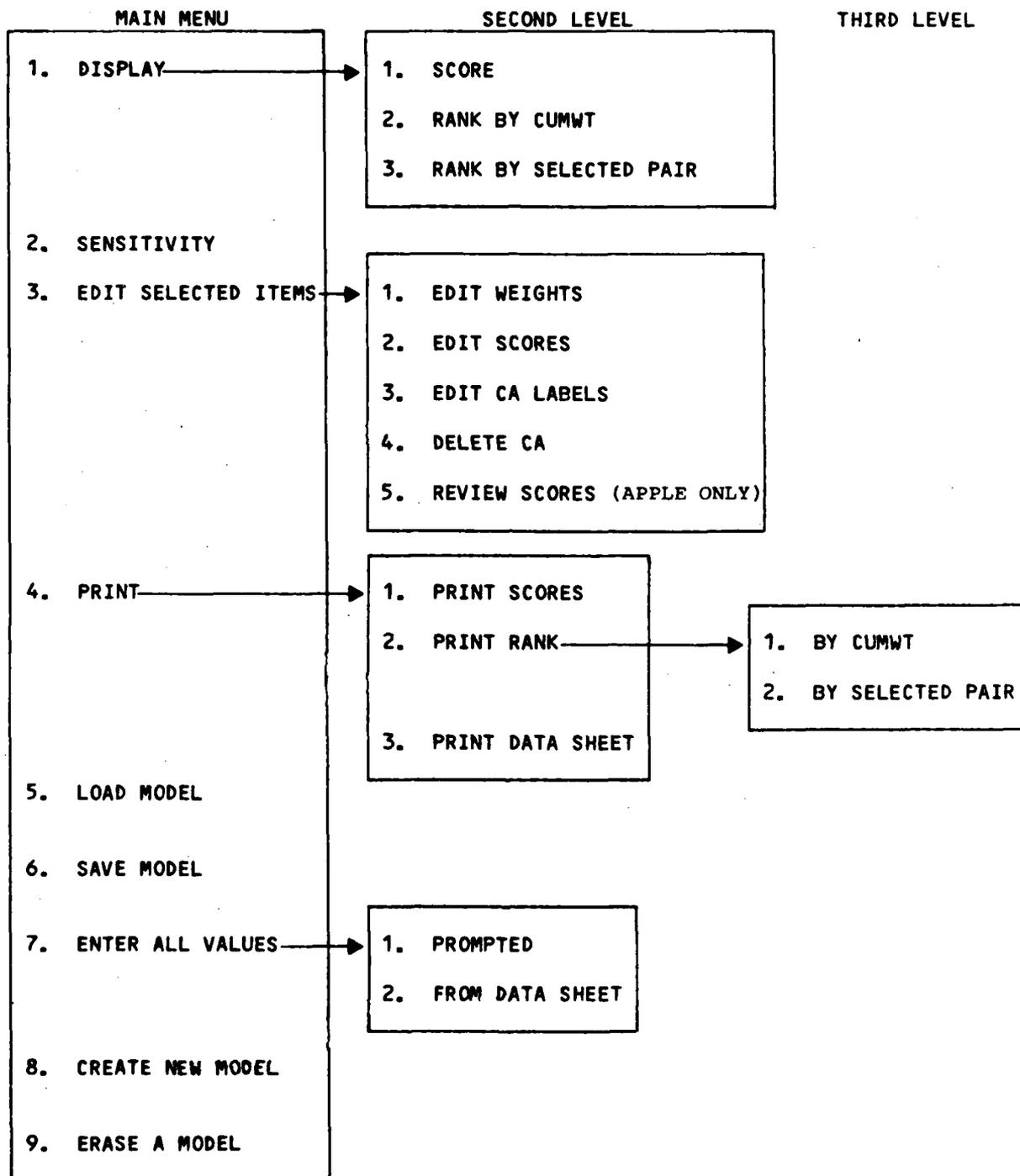


Figure 16. ENCOA's hierarchy of options.

THE ENCOA OPTIONS: CREATING, SAVING, LOADING, AND ERASING MODELS

Figure 16. ENCOA'S hierarchy of options.

Three types of options appear on ENCOA's main menu. Options of the first type allow you to operate on whole models, entering or deleting models from the list of available options, creating new models, or loading models into ENCOA's work space. Options of the second type allow you to enter or modify model values. Options of the third type allow you to examine the implications of a model and display these results.

Creating, Saving, Loading, and Erasing Models

The ENCOA system can save seven independent models, any one of which can be used on a particular run. Thus, it is necessary to have options which permit the user to control which models are included on the list and which model is being examined at any given time. Two of the four options for doing this, CREATE NEW MODEL and LOAD MODEL, were discussed earlier but will be discussed again. The other two options are SAVE MODEL and ERASE MODEL.

CREATE NEW MODEL

This option creates a new model with all scores and weights set to zero. In addition, it loads the new model into ENCOA's work space so that it is ready for further use. When you select this option, the computer asks for the name of the new model. You should type in the name and press RETURN (Apple) or EXECUTE (IBM). Next, the computer will ask for your name. You should type your name and press RETURN or EXECUTE. Finally, ENCOA requests the date. After you provide the date, ENCOA returns to the main menu. The following is an example of the three requests:

```
ENTER THE NAME OF THE NEW MODEL: EXAMPLE
ENTER YOUR NAME: PATTERSON
ENTER TODAY'S DATE: 1/10/80
```

SAVE MODEL

After creating a new model or editing an old model, you should ordinarily save the model for future recall. You do this by using the SAVE MODEL option.

When you select the SAVE MODEL option, the computer displays something similar to the following:

```
THE MODELS CURRENTLY ON THE DISC ARE:
OPFOR TACVAL(SCA'S)
5 CA DEMO[EDITED]
JAYHAWK BKW
JAYHAWK DL
JAYHAWK PJD
*VACANT
*VACANT
ENTER THE NAME OF THE MODEL THAT IS TO BE SAVED:
```

saving, loading models

In other words, the computer lists the models already saved and requests the name of the model that will be saved. ENCOA saves the model that is currently in its work space under whatever name is provided. Thus, a modified version of an old model could be stored under a new name if necessary or desirable.

To replace an existing model with a revised version of the model, simply specify the name of the existing model when storing the revised model. To verify your intent, ENCOA displays the following:

THIS NAME IS CURRENTLY USED, DO YOU WISH TO REPLACE IT?

If you indeed wish to store a revised version of an old model, type YES or the single letter Y followed by RETURN (Apple) or EXECUTE (IBM); if not, then type NO or the single letter N followed by EXECUTE. The reason for this additional precaution is that the old version is erased by the new version and, therefore, is no longer available.

It is suggested that you save a partially completed model at convenient steps toward its completion. Saving the model in this way may save time later recreating the model in case an interruption or power failure occurs.

LOAD MODEL

The LOAD MODEL option places a model in ENCOA's work space so that it can be edited or examined. When you select this option, the computer displays a list of the available models and a request for the desired model. The following is an example of what you might see:

THE FOLLOWING MODELS ARE AVAILABLE ON THIS TAPE:

- 1) OPFOR TACVAL (5CA's)
- 2) 5 CA DEMO[EDITED]
- 3) JAYHAWK BKW
- 4) JAYHAWK DL
- 5) JAYHAWK PJD
- 6) EXAMPLE
- 7) *VACANT

ENTER THE NUMBER OF THE DESIRED OPTION:

You should enter the number of the desired model. Once this is done, ENCOA confirms the request. For instance, if you entered 6, ENCOA would print:

THE MODEL YOU HAVE JUST LOADED IS:

EXAMPLE 1/10/80 PATTERSON
IS THAT CORRECT?

Entering Y followed by RETURN (Apple) or EXECUTE (IBM) confirms the request, while typing N causes ENCOA to reissue the original request.

ERASE MODEL

This option is used to remove an existing model from the list of available models, creating additional storage space for new models. When you select this option, ENCOA lists the available models and asks which is to be erased.

THE MODELS ON THE DISC ARE:

OPFOR TACVAL (5CA'S)
5 CA DEMO[EDITED]
JAYHAWK BKW
JAYHAWK DL
JAYHAWK PJD
EXAMPLE
*VACANT

ENTER THE NAME OF THE MODEL TO BE ERASED:

Enter the appropriate name and press RETURN (Apple) or EXECUTE (IBM).

THE ENCOA OPTIONS: ENTERING OR MODIFYING MODEL VALUES

When you first create a model, discover an error, or simply revise earlier thinking, you must change the scores and weights of the ENCOA model. This can be done by selecting either of two options on the main menu: ENTER ALL VALUES or EDIT SELECTED ITEMS.

ENTER ALL VALUES

After you create a model, you will need to identify the courses of action (CAs) that will be analyzed, enter the scores for each action on each variable, and give weights to the relative importance of each variable. This can be done by selecting the ENTER ALL VALUES option.

Once you enter this option, the computer will display the following menu:

WHICH METHOD OF SCORING DO YOU WANT?

- 1) PROMPTED
- 2) DIRECT FROM DATA SHEET

ENTER THE NUMBER OF THE DESIRED OPTION:

Both suboptions do three things: they request the CA definitions, they collect the scores, and they collect the weights.

The first suboption, PROMPTED, collects scores and weights in a rather detailed fashion. It should be selected if you have not already carefully written out all scores and weights in advance.

The DIRECT FROM DATA SHEET suboption assumes that you have written out all scores and weights and need only to communicate these to ENCOA. To facilitate this, a PRINT DATA SHEET option (see p. 44) is available to produce a blank form onto which scores and weights can be written.

Prompted Entry--Defining CA. Upon selecting PROMPTED entry, ENCOA displays the following:

HOW MANY COURSES OF ACTION DO YOU WISH TO COMPARE?

You can have up to eight CAs and should attempt to include as many as seem reasonable. Although you can delete CAs at a later time, any CAs that were not initially anticipated cannot be added. Therefore, you should include as many as possible at the outset. For this example, five CAs were defined.

Once you define the number of CAs, ENCOA requests two names for each CA. The first name can contain up to 30 characters, and the second name can contain up to 5 characters. The second name is the one that appears on most displays and should be an abbreviated reminder of the more readable first name.

prompted entry of CAs, scores

The following example depicts the sequence of requests that ENCOA might issue. The odd lines are ENCOA requests and the even lines are user responses.

```
ENTER DESCRIPTION OF COURSE OF ACTION 1 (UP TO 30 CHARS.)
FROM THE RIGHT, HIGH
ENTER A 5 CHARACTER ABBREVIATION.
R HI
ENTER DESCRIPTION OF COURSE OF ACTION 2 (UP TO 30 CHARS.)
FROM THE LEFT, HIGH
ENTER A 5 CHARACTER ABBREVIATION.
LL HI
ENTER DESCRIPTION OF COURSE OF ACTION 3 (UP TO 30 CHARS.)
FROM THE LEFT, LOW
ENTER A 5 CHARACTER ABBREVIATION.
L LO
ENTER DESCRIPTION OF COURSE OF ACTION 4 (UP TO 30 CHARS.)
THROUGH THE CENTER, HIGH
ENTER A 5 CHARACTER ABBREVIATION.
C HI
ENTER DESCRIPTION OF COURSE OF ACTION 5 (UP TO 30 CHARS.)
THROUGH THE CENTER, LOW
ENTER A 5 CHARACTER ABBREVIATION.
C LO
```

Note that the short name for CA2 was mistyped as LL HI rather than L HI. Because this error was not caught before pressing RETURN or EXECUTE, it cannot be corrected until all data entry is completed. At that time, an EDIT option (discussed later) can be used to modify the CA name.

Prompted Entry--Supplying Scores. After all CA names have been provided, ENCOA will ask you for the scores. Beginning with the first data level factor, ENCOA asks which CA is best with respect to the factor and then which CA is worst. Once this information is provided, a scale from 0 to 100 is displayed, with the worst CA placed at the 0 end of the scale and the best CA placed at the 100 end of the scale:

1 TERRAIN - 1.1 FIELD OF FIRE

CA1: R HI CA2: LL HI CA3: L LO CA4: C HI CA5: C LO

WHICH CA IS THE BEST IN RESPECT TO FIELD OF FIRE 2
WHICH CA IS THE WORST IN RESPECT TO FIELD OF FIRE 3
INDICATE THE RELATIVE POSITION OF THE REMAINING CA'S.

```
0          20          40          60          80          100
|-----|-----|-----|-----|-----|-----|-----|
3                                               2
```

prompted entry (continued)

The cursor is on the line below the scale and can be moved by using the BACKSPACE and FORWARD SPACE keys. To assign a score to a CA, center the cursor under an appropriate value and type the number of the CA. This should be done for all CAs other than the two extreme ones before pressing RETURN (Apple) or EXECUTE (IBM). The display might look like this:

```
0      20      40      60      80      100
|-----|-----|-----|-----|-----|
3              5              4 1              2
```

Such a display implies that the difference between CA3 and CA5 is 30% as beneficial as the difference between CA3 and CA2. In other words, it reflects the relative benefit of each CA. Once all the CA numbers have been properly placed, press RETURN or EXECUTE.

To ensure that the scores entered are indeed the ones that are desired, ENCOA displays the scores and requests verification that they are correct. To answer this request, you can type Y or N. Y leads to a prompt for the next factor's scores, while N leads to a prompt for the revised scores on the current factor. This prompt is not as elaborate as the initial one. It prints the ordering of the CAs and asks for direct entry of the new scores:

```
ENTER DESIRED SCORES FOR CA'S 3 4 5 1 2:
0 30 50 70 100
```

Once you have provided the revised scores, ENCOA proceeds to the next set of scores and does not request verification again. If all CAs are equal on a factor or the factor is not relevant to the situation at hand, you should enter ALL or the single letter A when asked which CA is best. ENCOA will then score all CAs equally on that factor and subsequently not request a weight for that factor.

Following the elicitation of scores on all data level factors, ENCOA provides the following menu of options:

- 1) REVIEW SCORES
 - 2) DELETE CA
 - 3) EDIT SCORES
 - 4) CONTINUE DATA ENTRY (Apple only)
- ENTER THE NUMBER OF THE DESIRED OPTION:

These basic display and edit options (described in detail later) are made available now so that you can review the work, correct typographical and other errors, and drop any CAs that additional thought may have deemed improbable. When you are ready to proceed, select option 4 (Apple) or press EXECUTE alone (IBM) to continue with the PROMPTED entry of values.

prompted entry of weights

Prompted Entry--Supplying Weights. During the remainder of PROMPTED entry, ENCOA requests the factor weights. It starts by factor category, e.g., Weather, Terrain, displaying the factors within a category and the CAs that were designated as best and worst for each factor. The following example depicts this display:

```
4 - WEATHER
  |1|          |2|          |3|          |4|
  |OBSRVATN  |COVER &  |MOBILITY  |EXTREME
  |&VSIBLTY  |CONCEAL  |          |WX EFFCT
-----|-----|-----|-----|
BEST|  R HI    |  C LO    |  LL HI    |  R HI
  |          |          |          |          |
WRST|  LL HI    |  C HI    |  C HI    |  LL HI
  |          |          |          |          |
-----|-----|-----|-----|
```

ORDER THE FACTORS FROM BEST TO WORST:

At this time, ENCOA requests only the order of the factors from best to worst. Later, actual weights will be requested. You should keep in mind that each factor is being evaluated for both its importance and the magnitude of the difference between the two extreme CAs on that factor. This is why the display is provided. For instance, if L HI and C HI were insignificantly different on the mobility factor, they should receive a weight of zero regardless of the importance of mobility. Similarly, Cover and Conceal could receive a high weight simply because C LO and C HI are so vastly different in terms of this factor. The user must combine judgments of a factor's importance with judgments of the CA differences to obtain a single value, which can be used to rank the factors.

Once the factors are ranked, ENCOA requests verification of the ranking. The proper response is either Y or N, with Y leading to a careful assignment of weights and N leading to a repeat of the initial prompt. An example of the prompt for weight assignments is depicted below:

```
  |1|          |2|          |3|          |4|
  |OBSRVATN  |COVER &  |MOBILITY  |EXTREME
  |&VSIBLTY  |CONCEAL  |          |WX EFFCT
-----|-----|-----|-----|
BEST|  R HI    |  C LO    |  LL HI    |  R HI
  |          |          |          |          |
WRST|  LL HI    |  C HI    |  C HI    |  LL HI
  |          |          |          |          |
-----|-----|-----|-----|
```

```
ENTER RELATIVE WEIGHT FOR FACTORS 1 4 2 3
  0      20      40      60      80      100
  |-----|-----|-----|-----|-----|
                                     3
```

ENCOA reiterates the ordering of factors and provides a scale with the highest weight defined as 100. Using the BACKSPACE and FORWARD SPACE keys, you must once again move the cursor below the scale, entering numbers at points that

entering data from data sheets

reflect the weight of each factor. These entries should correspond to a factor's weight in relation to the weight of 100 assigned to the most heavily weighted factor. After placing these factor numbers beneath the scale, press RETURN (Apple) or EXECUTE (IBM).

In response to the entry of weights, ENCOA displays the normalized weights (adjusted weights that add to 100) and requests verification. Typing Y causes ENCOA to proceed to the next factor category. An N response causes ENCOA to list the weights and request direct adjustment without using the sliding scale.

After the factors within a category have been weighted, ENCOA requests the weights for the categories. This is done in the same way as the factors.

At this point, all the data for a model are completely entered. If any errors have been made that were not caught in time, you should use the EDIT option to correct mistakes. To help review the model and determine whether any mistakes have been made, you can use the PRINT SCORES option. Finally, after correcting any errors you should immediately SAVE the corrected model; otherwise, it could be easily forgotten and lost.

Entering Data From Data Sheets. The option to enter scores and weights from data sheets is quite similar to the PROMPTED option. CA names and factor weights are requested in the same manner, but scores are elicited in a more streamlined fashion. Only the procedure for scores will be discussed here. You should review the section on PROMPTED entry to better understand entry FROM DATA SHEETS.

After eliciting the CA names, ENCOA requests the scores, one factor at a time. On the IBM computers, a series of zeros appears for each factor, with one zero for each CA. You can clear these by pressing ATTN and then entering the CA scores on the same line as the factor name. The first number corresponds to the score for the first CA, the second number for the second CA, and so forth. After entering the numbers, press EXECUTE. Then ENCOA will proceed to the next factor.

On the Apple, no zeros appear as place holders; however, the procedure is the same as with the IBM. The user should enter the corresponding CA scores on the same line as the factor name. After the scores for a single factor have been entered, you should press RETURN and the next factor will appear. An example of the display is depicted below.

1.1 - FIELD OF FIRE	100 80 50 0 20
1.2 - COVER & CONCEAL	0 20 30 50 100
1.3 - MOBILITY	70 80 100 0 60
1.4 - S/D KEY TERRAIN	90 100 50 20 0
1.5 - OBSRVATN	50 20 60 0 100
1.6 - NAT/ART OBSTACLE	40 20 50 100 0
2.1 - DSPOSITN	0 100 100 50 20
2.2 - STRNGTH& CNDITION	0 0 100 100 50
2.3 - RESERVES	100 100 100 40 0
2.4 - LOGISTIC SUPPORT	70 50 20 0 100

entering data from data sheets (continued)

There are some constraints on the scores being entered which ENCOA can recognize. The number of values must equal the number of CAs. At least one value must be a zero and another a 100, unless all scores are equal and entered as 100. Also, all scores must be between 0 and 100. When ENCOA detects one of these errors, it displays a message that characterizes the error and suggests that you press RETURN or EXECUTE to continue.

```
2.5 - PROB ACT & REACT          100 20 50 60
YOU DID NOT ENTER 5 VALUES.
PRESS RETURN TO CONTINUE...
2.5 - PROB ACT & REACT          40 50 20 30 60
YOU MUST ENTER AT LEAST ONE 0 AND AT LEAST ONE 100,
OR ALL 100'S IF ALL CA'S ARE EQUAL.
PRESS RETURN TO CONTINUE...
2.5 - PROB ACT & REACT          500 600 20 100 0
SCORES MUST BE BETWEEN 0 AND 100.
PRESS RETURN TO CONTINUE...
2.5 - PROB ACT & REACT          0 100 20 50 40
```

Once all the scores are entered, ENCOA displays the following menu:

- 1) REVIEW SCORES
 - 2) DELETE CA
 - 3) EDIT SCORES
 - 4) CONTINUE DATA ENTRY (Apple only)
- ENTER THE NUMBER OF THE DESIRED OPTION:

As in prompted data entry, this menu gives you the options of reviewing and editing the scoring judgments that have been made up to this point. Selecting option 4 (Apple) or pressing EXECUTE without selecting an option (IBM) causes ENCOA to continue with the data entry option.

Having elicited all scores, ENCOA begins prompting for weights as it did for the PROMPTED option. When the weights have been entered, ENCOA returns to the main menu. At this time, you can review current work with the DISPLAY option or correct errors with the EDIT option, but eventually you must use the SAVE option to preserve the model.

editing weights

EDIT SELECTED ITEMS

When you select this option, ENCOA displays:

- 1) EDIT WEIGHTS
 - 2) EDIT SCORES
 - 3) EDIT CA LABELS
 - 4) DELETE CA
 - 5) REVIEW SCORES (Apple only)
 - 6) RETURN TO MAIN MENU (Apple only)
- ENTER THE NUMBER OF THE DESIRED OPTION:

These suboptions let you modify an existing model by modifying its weights, its scores, or its CA names. It is also possible to delete a CA, but no provision is made for adding CAs. For this reason, you should strive to include all reasonable CAs at the time a model is entered. To preserve edited work for future sessions, the SAVE MODEL option must be selected at some point.

Editing Weights. The procedure for editing weights is identical to the procedure for entering weights; however, you can directly select a factor category rather than being required to do each category sequentially. When you select this suboption, ENCOA displays the following:

ENTER NODE ID:

This is ENCOA's way of requesting the factor or factor category of interest. For a factor category like Terrain or Weather, you should enter a 1 or 4 followed by RETURN (Apple) or EXECUTE (IBM). To edit the weights of the factor categories, you should enter 0. Data level factors, e.g., 1.1 Field of Fire, cannot be weighted. ENCOA will tell you this as follows:

ENTER NODE ID: 1.1
THIS FACTOR HAS NO SUBSECTIONS. PLEASE TRY AGAIN
PRESS RETURN TO CONTINUE

Once you enter a proposed Node ID, ENCOA proceeds as it did under the ENTER ALL VALUES option. First, it asks you to rank the factors within the factor category. (The boxed information in the illustration below represents user response to ENCOA queries.) Then it confirms the ordering.

```
1 - TERRAIN
  |1      |2      |3      |4      |5      |6
  |FIELD OF|COVER &|MOBILITY|S/D KEY|OBSRVATN|NAT/ART
  |FIRE    |CONCEAL|        |TERRAIN|        |OBSTACLE
-----|-----|-----|-----|-----|-----
BEST |LL HI  |  C HI  |  L LO  |  R HI  |  LL HI  |  R HI
WRST | L LO  |  L LO  |  LL HI  |  L LO  |  L LO  |  L LO
-----|-----|-----|-----|-----|-----
ORDER THE FACTORS FROM BEST TO WORST: 6 3 5 2 4 1
FACTORS 1 2 3 4 5 6 ORDERED AS 6 3 5 2 4 1. IS THIS CORRECT? Y
```

Next, ENCOA displays a sliding scale under which you should place numbers corresponding to the factors. Finally, it asks for confirmation of the normalized weights.

	1 FIELD OF FIRE	2 COVER & CONCEAL	3 MOBILITY	4 S/D KEY TERRAIN	5 OBSRVATN	6 NAT/ART OBSTACLE
BEST	LL HI	C HI	L LO	R HI	LL HI	R HI
WRST	L LO	L LO	LL HI	L LO	L LO	L LO

ENTER RELATIVE WEIGHT FOR FACTORS 1 4 2 5 3 6

0 20 40 60 80 100

1 4 2 5 3

THE NORMALIZED WEIGHTS FOR (1 4 2 5 3 6) ARE: 5 8 13 17 23 35

ARE THESE CORRECT?

One point that you should keep in mind is that the weights represent a combined assessment of a factor's importance and the extent of the difference between the worst and best options in relation to that factor. This is why ENCOA carefully lists the best and worst options for each factor. When making weight assessments, you must attempt to evaluate how much of a difference the worst and best options represent and then adjust this according to the importance of the difference. ENCOA automatically assigns the greatest weight a value of 100 and assigns all other weights in relation to this greatest weight. For additional discussion of this weighting procedure, you might find it useful to reread the section on PROMPTED entry of all values beginning on page 28.

After weighting one factor, ENCOA returns to the request for a Node ID. This step lets you keep changing weights on several different factor categories. To return to the menu of EDIT suboptions, you must press RETURN (Apple) or EXECUTE (IBM) alone without first entering a Node ID.

Editing Scores. The EDIT SCORES option follows the same procedure as that used for PROMPTED entry of scores. As with the EDIT WEIGHTS option, the first request is the following:

ENTER NODE ID:

Unlike the EDIT WEIGHTS option, however, scores can be entered only for data level factors. Thus, entry of a factor category Node ID produces the following type of display:

ENTER NODE ID: 1
THIS FACTOR IS NOT A DATA LEVEL FACTOR
PRESS RETURN TO CONTINUE...

editing scores (continued)

Once a proper data level Node ID, e.g., 1.1 Field of Fire, has been entered, ENCOA will prompt you for scores. This is done by first ascertaining which CA is best and which CA is worst with respect to the factor. (If all CAs score equally well, then you should enter A or ALL to the request for the best CA.) Then ENCOA displays a scale from 0 to 100 with a number representing the worst CA at 0 and a number representing the best CA at 100. You must place the remaining CAs beneath the scale in a position that reflects their effectiveness in relation to the two extremes. Pressing RETURN or EXECUTE transmits them to ENCOA, which then requests confirmation. This sequence of events is depicted below. (The boxes indicate user input.)

1 TERRAIN - 1.1 FIELD OF FIRE

CA1: R HI CA2: LL HI CA3: L LO CA4: C HI CA5: C LO

WHICH CA IS THE BEST IN RESPECT TO FIELD OF FIRE
WHICH CA IS THE WORST IN RESPECT TO FIELD OF FIRE
INDICATE THE RELATIVE POSITION OF THE REMAINING CA'S.

0 20 40 60 80 100

-----|-----|-----|-----|-----|-----|

2

THE SCORES ASSIGNED ARE 60 0 100 30 50

ARE THESE CORRECT?

After scoring one factor, ENCOA repeats the request for a Node ID, letting you make an indefinite number of changes. To return to the menu of EDIT suboptions, press RETURN or EXECUTE without first entering a Node ID.

Frequently when scores are changed, it is also necessary to adjust the weights for the factor whose scores have been altered. This is particularly true when the CAs assigned scores of zero or 100 change, because then the overall difference between the extremes on a factor is likely to be altered. Whenever these extreme scores are assigned to CAs other than the ones that previously had them, ENCOA keeps track of this fact so that it can request weight modifications later on. Thus, occasionally when you finish editing scores and try to return to the menu of EDIT suboptions, this display appears:

CHANGES HAVE BEEN MADE THAT REQUIRE HIGHER
LEVEL WEIGHTS TO BE REASSESSED.
PRESS EXECUTE TO CONTINUE...

When RETURN (Apple) or EXECUTE (IBM) is pressed, ENCOA prompts you for weight modifications. This is done according to the same procedure outlined under "Editing Weights." All factors within the factor categories affected by the score changes must be reweighted, and then the factor categories themselves must be reweighted. Once this is completed, ENCOA returns to the menu of EDIT suboptions.

Editing CA Labels. When you select the EDIT CA LABELS suboption, ENCOA requests the CA number. Once this is entered, ENCOA first requests a new 30-character name and then lists the current name. To modify this name, you can simply type over it or, on the IBM, use the ATTN button to erase the old name and then enter the new one. Regardless of how the editing is done, whatever is on the line when RETURN or EXECUTE is pressed becomes the new name. Thus the old name can be kept by pressing RETURN or EXECUTE without doing any editing.

After the long name is edited, ENCOA prompts for a new 5-character name. Again, ENCOA provides the old name, and modifications should be made on top of the old name. Whatever appears on this line when RETURN or EXECUTE is pressed becomes the new name.

At this point, ENCOA requests another CA number, thereby permitting an indefinite number of CA label changes. To return to the menu of EDIT suboptions, you must press EXECUTE alone. The following example demonstrates the procedure for modifying a CA label. (Remember that CA2 had an incorrect short label, i.e., LL HI.)

```
ENTER COURSE OF ACTION NUMBER: 2
ENTER NEW 30 CHARACTER DESCRIPTION:
FROM THE LEFT, HIGH
ENTER NEW 5 CHARACTER DESCRIPTION:
L HI
ENTER COURSE OF ACTION NUMBER:
```

Deleting a CA Option. When you select the DELETE CA option, ENCOA displays the following:

```
WARNING: DO NOT DELETE ANY CA'S IF YOU HAVE NOT ENTERED ANY SCORES OR
WEIGHTS.
PRESS RETURN TO CONTINUE...
```

This warning is included lest you attempt to delete a CA from an unscored model. The problem arises because deletion of CAs causes ENCOA to reevaluate scores, and since the deleted CA may have been best or worst on a given factor. Newly created models, however, do not have realistic scores or weights (they are all zero) until ENTER ALL VALUES is selected. These unrealistic values can potentially thwart ENCOA's efforts to make adjustments when a CA is deleted. Therefore, you are warned against deleting CAs from unscored models. On the IBM computer, to heed the warning and not delete a CA, you need only press EXECUTE when later asked to select a CA for deletion. On the Apple, you must choose the option NONE OF THEM.

reviewing scores

Once you continue past the warning, ENCOA lists the available CAs and asks which is to be deleted. The following demonstrates the display:

WHICH COURSE OF ACTION DO YOU WANT TO DELETE?

- 1) R HI
- 2) L HI
- 3) L LO
- 4) C HI
- 5) C LO
- 6) NONE OF THEM (Apple only)

ENTER THE NUMBER OF THE DESIRED OPTION:

The CA to be deleted can be selected by entering the appropriate number and pressing EXECUTE.

When ENCOA is finished deleting the CA, it issues the following message:

NOTE: YOU MAY WANT TO REVIEW THE SCORES
AND CHANGE THE WEIGHTS.

PRESS RETURN TO CONTINUE...

Once RETURN or EXECUTE is pressed, ENCOA returns to the menu of EDIT suboptions. Since deleting a CA is a major change in a model, it is difficult for ENCOA to fully adjust the remaining data in a manner that reflects your true evaluations. Therefore, it is advisable when selecting this option to carefully review all scores and weights following the CA deletion. For the most part, the new model will be an adequate and accurate reflection of your assessments. A few scores and weights may not, however, seem appropriate. Thus, you should DISPLAY the new model and EDIT any weights or scores that seem inappropriate.

Reviewing Scores. The REVIEW SCORES suboption is available only on the Apple computer. When you select it, CA scores for each factor are displayed. To make any revisions, however, you must choose the EDIT SCORES suboption.

THE ENCOA OPTIONS: EXAMINING A MODEL'S IMPLICATIONS

ENCOA offers a variety of options for examining a model. The most basic is the DISPLAY option, which allows you to review a model. Parallel to this option is the PRINT option, which produces hard copy of a model's results. Finally, the SENSITIVITY option permits you to examine the effect of changes in a model's weights. These options are discussed below.

DISPLAY

Once the user selects the DISPLAY option, ENCOA displays the following menu of suboptions.

- 1) SCORES
 - 2) RANK BY CUMWT
 - 3) RANK BY SELECTED PAIR
 - 4) RETURN TO MAIN MENU (Apple only)
- ENTER THE NUMBER OF THE DESIRED OPTION:

The first suboption displays the scores and weights for a designated factor. The other two suboptions display lists of the data level factors ranked according to their importance to the ENCOA evaluation.

Displaying Scores. When you select the SCORES suboption, ENCOA first displays a summary of the effectiveness of each CA. An example of the display is depicted below:

SUMMARY OF SCORES:

	AVE	RATIO TO BEST
CA1:	61.6	1.0
CA2:	62.0	1.0
CA3:	29.6	.5
CA4:	51.3	.8
CA5:	42.8	.7

PRESS RETURN TO CONTINUE...

For each CA, the column marked AVE represents its cumulative score over all factors. This is the "bottom line" and reflects the relative effectiveness of the enemy courses of action. In this case, CA1 and CA2 seem desirable from the enemy's point of view, while CA3 is considerably less desirable. The column marked RATIO TO BEST reflects how effective each CA is in relation to the best CA. Thus, CA5 yields a ratio of .7 because its score of 42.8 is approximately 70% of the top score of 62.0. When you finish examining this summary, press RETURN (Apple) or EXECUTE (IBM) to continue.

ENCOA's next display is a request for a node number. In this case, ENCOA expects you to enter numbers corresponding to factor categories, i.e., 1, 5, or the number corresponding to the top-level assessments, i.e., 0. ENCOA will reject data level node numbers such as 1.1 or 2.3.

displaying rank by cumulative weight

After a node number is entered, ENCOA displays a matrix of the scores and weights for the factors within the designated factor category:

CA1: FROM THE RIGHT, HIGH
 CA2: FROM THE LEFT, HIGH
 CA3: FROM THE LEFT, LOW
 CA4: THROUGH THE CENTER, HIGH
 CA5: THROUGH THE CENTER, LOW

1 TERRAIN

FACTOR	WT	CA1	CA2	CA3	CA4	CA5	CUMWT
1) FIELD OF FIRE	*(25)	80	100	0	90	10	3.52
2) COVER & CONCEAL	*(9)	60	90	0	100	20	1.23
3) MOBILITY	*(17)	20	0	100	40	50	2.37
4) S/D KEY TERRAIN	*(4)	100	80	0	90	10	.62
5) OBSRVATN	*(14)	80	100	0	70	30	1.94
6) NAT/ART OBSTACLE	*(31)	100	80	0	60	20	4.40
TOTAL		75	75	17	70	23	14.07

ENTER NODE NUMBER:

The asterisk (*) following the factor name indicates that there are no lower level divisions of the factor. The column marked WT indicates the weight assigned to each factor. The columns CA1 through CA5 indicate the scores assigned to each CA. The column marked CUMWT indicates the percentage of the overall score attributed to a particular factor. Finally, the TOTAL row presents the weighted average of a CA's scores on the set of factors depicted.

After displaying the matrix, ENCOA requests another node number, thereby letting you examine an indefinite number of nodes. To return to the menu of DISPLAY suboptions, you must press RETURN or EXECUTE by itself.

Displaying Rank by Cumulative Weight. The RANK BY CUMWT suboption allows you to obtain a list of the factors arranged according to their importance. An example of the display follows:

FACTORS RANK ORDERED BY CUMWT

FACTOR	R HI	L HI	L LO	C HI	C LO	CMWT	SUM
2.6 COMMAND& CONTROL	100	70	0	60	10	10.96	10.9
2.2 STRNGTH & CNDITION	20	0	100	50	90	8.99	19.9
3.2 STRNGTHR CNDITION	100	10	0	32	70	8.37	28.3
2.1 DSPOSITN	80	100	0	40	20	8.11	36.4
4.3 MOBILITY	30	100	20	0	40	8.05	44.4
3.4 LOGISTIC SUPPORT	70	100	0	30	50	6.70	51.1
2.3 RESERVES	50	0	70	100	30	5.70	56.8
4.2 COVER & CONCEAL	20	90	50	0	100	5.48	62.3
3.3 RESERVES	0	80	70	10	100	4.69	67.0
1.6 NAT/ART OBSTACLE	100	80	0	60	20	4.40	41.4

DO YOU WISH TO SEE MORE FACTORS?

displaying rank by selected pair

The score for each CA is listed under its short name. The CUMWT for each factor is listed under CMWT. The sum of the CUMWTs preceding and including a given factor is listed under SUM.

Using this ranking, you can obtain valuable insights. For instance, the previous example reveals that over 70% of the total points that could be gained are provided by 10 factors. These are critical factors on which the CAs differ greatly. As such, they probably deserve the closest review.

Once ENCOA has listed 10 factors, it asks whether you want to see more of the listing. A Y response will provide a display of the next 10 factors. An N response will return ENCOA to the menu of DISPLAY suboptions. If you choose to see the entire list of factors by entering Y after each successive set of 10, ENCOA will ask you to press RETURN or EXECUTE alone after the last set of factors. This returns you to the menu of DISPLAY suboptions.

Displaying Rank by Selected Pair. Another technique for ranking factors is in terms of the extent to which they distinguish two CAs. RANK BY CUMWT lists factors in terms of the largest difference between two CAs regardless of which CAs they are. In contrast, RANK BY SELECTED PAIR allows you to designate a pair of CAs. Then it lists the factors according to the size of the weighted difference between the two CAs.

After you select this option, ENCOA displays the CAs with their "bottom line" scores and asks you to select a pair of CAs. An example of this option follows:

CA	AVE
CA1: FROM THE RIGHT, HIGH	61
CA2: FROM THE LEFT, HIGH	61
CA3: FROM THE LEFT, LOW	28
CA4: THROUGH THE CENTER, HIGH	46
CA5: THROUGH THE CENTER, LOW	46

WHICH TWO COURSES DO YOU WANT TO SEE?

1 3

You should select two CAs and enter the appropriate numbers, being sure to place a space between them, then press RETURN or EXECUTE. (The boxed information above represents a user entry.)

print options

ENCOA's next display is a list of the first 10 factors:

FACTORS RANK ORDERED BY CA1 VS. CA3

FACTOR		CA1	CA3	CUMWT	DIFF	SUM
2.6	COMMAND& CONTROL	100	0	10.96	10.96	10.96
3.2	STRNGTH & CNDITION	100	0	8.37	8.37	19.33
2.1	DSPOSITN	80	0	8.11	6.49	25.82
3.4	LOGISTIC SUPPORT	70	0	6.70	4.69	30.50
1.6	NAT/ART OBSTACLE	100	0	4.40	4.40	34.90
1.1	FIELD OF FIRE	80	0	3.52	2.81	37.72
4.4	EXTREME WX EFFCT	100	30	3.38	2.37	40.08
2.5	PROB ACT & REACT	80	0	2.19	1.75	41.84
1.5	OBSRVATN	80	0	1.94	1.55	43.39
5.3	DEPND ON SUPR/DCV	70	0	2.15	1.50	44.89

DO YOU WISH TO SEE MORE FACTORS?

The columns marked CA1 and CA3 list the scores for each CA. The column marked CUMWT reflects the overall importance of the factor. The column marked DIFF presents the weighted difference between the two CAs. It is the score for CA1 minus the score for CA3 multiplied by the CUMWT/100. It reflects the extent to which the factor distinguishes between the two CAs. Finally, the column marked SUM represents the sum of the DIFFs up to and including the designated factor.

You should avoid misinterpreting the SUM as a percentage. Typically it will rise as the factors favoring one CA are added in and then it will fall as the factors favoring the other CA are added in. (It falls because these last DIFFs are negative.) The final value of SUM is equal to the difference in the "bottom line" scores for the two CAs.

As with the earlier RANK option, ENCOA displays 10 factors at a time and asks you whether to continue. N returns to the menu of DISPLAY options, and Y lists more factors. After all factors have been displayed, a RETURN or EXECUTE alone is required to return to the menu of DISPLAY options.

PRINT

When this option is selected, ENCOA displays the following:

- 1) PRINT SCORES
- 2) PRINT RANK
- 3) PRINT DATASHEET

ENTER THE NUMBER OF THE DESIRED OPTION:

The first two suboptions are, for the most part, similar to the DISPLAY options. They are, however, to be used when you want a printed copy of the data rather than simply a display. The final suboption is used to print a blank form, which can be used to score an ENCOA model.

Printing Scores. The printout for the PRINT SCORES option is identical to the matrices provided by the DISPLAY SCORES suboption.

When this option is chosen on the Apple Computer, ENCOA first displays a summary of scores. After examining this summary, you should press RETURN to continue. ENCOA then requests a node number corresponding to a factor category (e.g., 1., 5.). After a node number is entered, ENCOA prints the scores and weights for the factors within the specified category. ENCOA then requests another node number. To return to the menu of PRINT options, you must press RETURN alone.

On the IBM computers, the procedure is slightly different. This option begins by asking you to turn on the printer, align forms, and then press EXECUTE. ("Forms" refers to the paper in the printer.) Align the paper so that the printout will start at the top of a new page.

Once you press EXECUTE, ENCOA prints a preliminary list of the CAs, a summary table, and then matrices of the model assessments starting with node 0 and proceeding through nodes 1 through 5. Upon completion of the printout, ENCOA asks you to turn off the printer and press EXECUTE. This action returns you to the menu of PRINT suboptions.

Printing Ranks. When you request, PRINT RANK, ENCOA displays this menu:

- 1) BY CUMWT
 - 2) BY SELECTED PAIR
 - 3) PREVIOUS MENU (Apple only)
- ENTER THE NUMBER OF THE DESIRED OPTION:

These suboptions refer to the two types of ranking mentioned on pp. 40-41 under DISPLAY.

On the Apple computer, selection of the BY CUMWT option will provide a printed list of the first 10 factors ranked by CUMWT. ENCOA then asks whether you want to see more factors. A Y response will provide the next 10 factors. A N response will return you to the menu of PRINT RANK suboptions. You can elect to see the entire list by entering Y after each set of 10 factors.

On the IBM computers, ENCOA first requests that the user turn on the printer, align forms, and then press EXECUTE. This last step leads to a complete listing of the BY CUMWT ranking. Finally, ENCOA asks you to turn off the printer and then press EXECUTE. This returns you to the menu of PRINT RANK suboptions.

On the Apple computer, selection of the BY SELECTED PAIR option first provides a summary of scores and then asks which two CAs you want to examine. A sample request is presented below. Once the two CAs have been entered, ENCOA automatically prints the first 10 factors, ranked in terms of their ability to distinguish between the two CAs. ENCOA then asks whether you want

printing the data sheet

to see more factors. A N response returns you to the menu of PRINT RANK suboptions. A Y response will provide the next 10 factors. You can elect to see all of the factors by entering a Y after each set of 10.

CA	AVE
CA1: FROM THE RIGHT, HIGH	61
CA2: FROM THE LEFT, HIGH	61
CA3: FROM THE LEFT, LOW	28
CA4: THROUGH THE CENTER, HIGH	46
CA5: THROUGH THE CENTER, LOW	46

WHICH TWO COURSES DO YOU WANT TO SEE: 1 3

On the IBM computers, ENCOA first displays a request for two CAs. Once the CAs have been entered, ENCOA then asks that you turn on the printer, align forms, and press EXECUTE. Once EXECUTE is pressed, ENCOA prints a complete RANK BY SELECTED PAIR in the same general format as was used in the DISPLAY option. This printout is followed by a request to turn off the printer and then press EXECUTE. This action returns you to the menu of PRINT RANK suboptions.

Printing the Data Sheet. The PRINT DATA SHEET option generates a blank data sheet on which to record scores and weights. Once this option is selected, ENCOA requests to adjust the printer and press RETURN (Apple) or turn on the printer, align forms, and then press EXECUTE (IBM). This action causes ENCOA to print a data sheet, which begins like the one in Figure 17. ENCOA

EXAMPLE	1/11/88	PATTERSON
CA1: HI R-FROM THE RIGHT, HIGH		
CA2: HI L-FROM THE LEFT, HIGH		
CA3: LD L-FROM THE LEFT, LOW		
CA4: HI C-THROUGH THE CENTER, HIGH		
CA5: LD C-THROUGH THE CENTER, LOW		
0 MISSION ACCOMP		
1 TERRAIN	R M	
1.1 FIELD OF FIRE	(/)	0 20 40 60 80 100
1.2 COVER & CONCEAL	(/)	0 20 40 60 80 100
1.3 MOBILITY	(/)	0 20 40 60 80 100
1.4 S/D KEY TERRAIN	(/)	0 20 40 60 80 100
1.5 OPSRVATH	(/)	0 20 40 60 80 100
1.6 NAT/ART OBSTACLE	(/)	0 20 40 60 80 100

Figure 17. Example of the beginning of a data sheet, reduced.

automatically returns you to the menu of PRINT RANK suboptions when the printout is completed on the Apple computer. Upon completing the printout on the IBM, ENCOA asks you to turn off the printer and then press EXECUTE. This returns you to the menu of PRINT suboptions.

SENSITIVITY

The SENSITIVITY option lets you systematically vary the CUMWT for a factor in order to determine whether such modification might change the "bottom line" scores.

On the Apple computer, ENCOA first requests that you specify the node level in which the sensitivity analysis will be performed; that is, either the factor level, e.g., 1.1 or 2.5, or the factor category level, e.g., 1. or 2. A sensitivity analysis cannot be performed on the top level, node 0. ENCOA then displays a request for the Node ID.

On the IBM computers, ENCOA begins with a request for a Node ID. This can be either factor level, e.g., 1.1 or 2.5, or factor category level, e.g., 1 or 2 but not 0.

After a Node ID is entered, the procedure is the same on both types of computers. ENCOA first displays the current CUMWT for the designated factor. This is followed by a request for a minimum CUMWT and then a request for a maximum CUMWT. These last two requests should be answered by numbers between 0 and 100 followed by RETURN (Apple) or EXECUTE (IBM). An example of the display follows. (The boxes indicate the user's entries.)

```

2 US FORCE           CURRENT CUMWT: 37.04
THE MINIMUM CUMWT IS: 
THE MAXIMUM CUMWT IS: 

```

When the maximum CUMWT is entered, ENCOA displays the cumulative scores ("bottom line" scores) for each CA while varying the CUMWT for the designated factor:

```

2 US FORCE           CURRENT CUMWT: 37.04
WT   R HI  L HI  L LO  C HI  C LO
30.0 60   62*  28   45   47
31.0 60   61*  28   45   47
32.0 61   61*  28   45   47
33.0 61   61*  28   45   47
34.0 61   61*  28   45   47
35.0 61   61*  28   46   46
36.0 61*  61   28   46   46
37.0 61*  61   28   46   46
38.0 61*  60   29   46   46
39.0 61*  60   29   47   46
40.0 61*  60   29   47   46
PRESS RETURN TO CONTINUE...

```

sensitivity (continued)

The column marked WT lists the CUMWT for the factor systematically incremented through 10 steps from the minimum to the maximum. The other columns list the cumulative score for each CA, which result from the modified CUMWT. For any particular level of CUMWT, the CA with the highest score is identified by an asterisk. By and large, the purpose of a sensitivity analysis is to ascertain whether the top-ranked CA will change when the CUMWT is modified.

When you finish examining the sensitivity results, pressing RETURN on the Apple will return you to the main menu. Pressing EXECUTE on the IBM returns to another request for a Node ID. The IBM lets you perform an indefinite number of sensitivity analyses prior to exiting this option. To return to the main menu, you must press EXECUTE without first entering a Node ID.

WORKING THROUGH AN ENCOA ANALYSIS

This section provides a walkthrough of an ENCOA analysis so that you can understand the sequence of activities. The separate ENCOA options will not be described in detail, since this was done in the previous section. Instead, the emphasis will be on the sequence of events in a typical analysis. This sequence will be illustrated with examples that show what you can expect to see on ENCOA's display. (The boxed portions of an example represent user input to ENCOA.)

In general, two types of situations can bring you to ENCOA. First, you may be just beginning an analysis, and so the goal is to create an ENCOA model and assign it scores and weights. Second, you may have already set up an ENCOA model and now need to analyze or modify it. These two situations are discussed separately.

To start up on the Apple system, insert the ENCOA 1 diskette in drive 1 and the ENCOA 2 diskette in drive 2; then turn on the computer and printer. To start up on the IBM 5110 or 5120, turn on the computer and insert the ENCOA tape cartridge or diskette. When the computer displays CLEAR WS, type)LOAD 10 RUN. Each of these procedures brings ENCOA to the preliminary menu:

SELECT ONE OF THE FOLLOWING:

1) CREATE NEW MODEL

2) LOAD MODEL

ENTER THE NUMBER OF THE DESIRED OPTION

CREATING A NEW MODEL

When CREATE NEW MODEL is selected from the preliminary menu, ENCOA makes three requests:

ENTER THE NAME OF THE NEW MODEL:
ENTER YOUR NAME:
ENTER TODAY'S DATE:

When you complete your responses, ENCOA creates a new model and loads it into the work space. This new model has all scores and weights set to zero.

After creating the model, ENCOA displays the main menu:

- 1) DISPLAY
 - 2) SENSITIVITY
 - 3) EDIT SELECTED ITEMS
 - 4) PRINT
 - 5) LOAD MODEL
 - 6) SAVE MODEL
 - 7) ENTER ALL VALUES
 - 8) CREATE A NEW MODEL
 - 9) ERASE A MODEL
 - 0) TERMINATE (Apple only)
- ENTER THE NUMBER OF THE DESIRED OPTION:

Since the new model does not yet contain any meaningful scores or weights, the first thing to do is select option 7, ENTER ALL VALUES. This will let you place information in the otherwise empty model.

entering scores from the data sheet

Once ENTER ALL VALUES is selected, ENCOA displays the following:

WHICH METHOD OF SCORING DO YOU WANT?

- 1) PROMPTED
- 2) DIRECT FROM DATA SHEET

ENTER THE NUMBER OF THE DESIRED OPTION:

PROMPTED should be selected if you are still thinking through the problem and have not yet actually scored the various courses of action. DIRECT FROM DATA SHEET can be used when you have already written out the scores for each course of action on each factor. (A blank data sheet can be obtained by selecting the appropriate PRINT suboption.)

In the present case, DIRECT FROM DATA SHEET was selected. The two options are, however, quite similar in terms of the information gathered. First, they ask you to identify the CAs. This step involves a series of user inputs, depicted as follows:

HOW MANY COURSES OF ACTION DO YOU WISH TO COMPARE?
ENTER DESCRIPTION OF COURSE OF ACTION 1 (UP TO 30 CHARS.)

ENTER A 5 CHARACTER ABBREVIATION.

ENTER DESCRIPTION OF COURSE OF ACTION 2 (UP TO 30 CHARS.)

ENTER A 5 CHARACTER ABBREVIATION.

ENTER DESCRIPTION OF COURSE OF ACTION 3 (UP TO 30 CHARS.)

ENTER A 5 CHARACTER ABBREVIATION.

ENTER DESCRIPTION OF COURSE OF ACTION 4 (UP TO 30 CHARS.)

ENTER A 5 CHARACTER ABBREVIATION.

ENTER DESCRIPTION OF COURSE OF ACTION 5 (UP TO 30 CHARS.)

ENTER A 5 CHARACTER ABBREVIATION.

entering scores from the data sheet (continued)

Next, ENCOA asks you to score each CA on each factor. For the PROMPTED option, this is a rather elaborate procedure designed to help you develop well-considered scores (see p. 29).

For the DIRECT FROM DATA SHEET option, scoring is a straightforward entry of numbers, one line at a time, with as many numbers as there are CAs.

On any given line, at least one number must be 0 and at least one number must be 100. The other numbers must be between 0 and 100. If it is necessary to set all scores to the same value, they should all be entered as 100s.

1.1 - FIELD OF FIRE	80	100	0	90	10
1.2 - COVER & CONCEAL	60	90	0	100	20
1.3 - MOBILITY	20	0	100	40	50
1.4 - S/D KEY TERRAIN	100	80	0	90	10
1.5 - OBSRVATN	80	100	0	70	30
1.6 - NAT/ART OBSTACLE	100	80	0	60	20
2.1 - DSPOSITN	80	100	0	40	20
2.2 - STRNGTH& CNDITION	20	0	100	50	90
2.3 - RESERVES	50	0	70	100	30
2.4 - LOGISTIC SUPPORT	60	80	0	100	50
2.5 - PROB ACT & REACT	80	100	0	50	20
2.6 - COMMAND& CONTROL	100	70	0	60	10
3.1 - DSPOSITN	20	70	0	100	50
3.2 - STRNGTH& CNDITION	100	10	0	32	70
3.3 - RESERVES	0	80	70	10	100
3.4 - LOGISTIC SUPPORT	70	100	0	30	50
3.5 - COMMAND& CONTROL	30	50	100	40	0
4.1 - OBSRVATN & VSIBLTY	100	0	60	40	20
4.2 - COVER & CONCEAL	20	90	50	0	100
4.3 - MOBILITY	30	100	20	0	40
4.4 - EXTREME WX EFFCT	100	0	30	80	50
5.1 - US ACTN/ REACTION	50	100	70	0	30
5.2 - DEPND ON OTH CMDS	20	0	70	50	100
5.3 - DEPND ON SUPR/DCV	70	100	0	30	10
5.4 - UNEXPCTD WEATHER	100	50	0	20	90

After the scores have been entered, ENCOA displays the following menu:

- (1) REVIEW SCORES
 - (2) DELETE CA
 - (3) EDIT SCORES
 - (4) CONTINUE DATA ENTRY (Apple only)
- ENTER THE NUMBER OF THE DESIRED OPTION:

You have the opportunity to review the scores entered up to this point and correct any errors. Selection option 4 (Apple) or press EXECUTE (IBM) to continue if none of the options is desired.

prompting for weights, scores

Next, ENCOA begins prompting you for weights. Using the score you assigned, ENCOA displays the best and worst CAs on each factor. Then it asks you to order the factors within a category based on both the importance of a factor and the magnitude of the difference between the best and worst option on a factor. ENCOA's request is depicted as follows:

5 - RISK

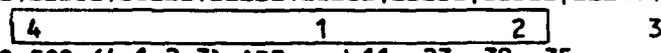
	1 US ACTN/ REACTION	2 DEPND ON OTH CMDS	3 DEPND ON SUPR/DCV	4 UNEXPCTD WEATHER
BEST	L HI	C LO	L HI	R HI
WRST	C HI	L HI	L LO	L LO

ORDER THE FACTORS FROM BEST TO WORST:
 FACTORS 1 2 3 4 ORDERED AS 3 2 1 4. IS THIS CORRECT? Y

Once the factors are ordered, ENCOA prompts you to assign scores. This is done by placing numbers, which represent the factors, beneath a scale running from zero to 100. The best factor is assigned a weight of 100 and all other assessments are made in relation to this. This procedure for obtaining weights is depicted below.

	1 US ACTN/ REACTION	2 DEPND ON OTH CMDS	3 DEPND ON SUPR/DCV	4 UNEXPCTD WEATHER
BEST	L HI	C LO	L HI	R HI
WRST	C HI	L HI	L LO	L LO

ENTER RELATIVE WEIGHT FOR FACTORS 4 1 2 3
 0 20 40 60 80 100



THE NORMALIZED WEIGHTS FOR (4 1 2 3) ARE: ' 11 23 30 35
 ARE THESE CORRECT: N

examining scores and weights

After you enter the weights, ENCOA displays the normalized weights and asks whether they are correct. In the example on the preceding page, the weights were rejected, which led to the following display:

	1 US ACTN/ REACTION	2 DEPND ON OTH CMDS	3 DEPND ON SUPR/DCV	4 UNEXPCTD WEATHER
BEST	L HI	C LO	L HI	R HI
WRST	C HI	L HI	L LO	L LO

ENTER THE RELATIVE WEIGHTS FOR FACTORS 4 1 2 3

THE NORMALIZED WEIGHTS FOR (4 1 2 3) ARE: 12 23 29 36

ARE THESE CORRECT:

Here, ENCOA offers a second chance to weight the factors, but the procedure is more streamlined. This time the weights are entered directly.

Once one set of weights is completed, ENCOA prompts for the weights of the next factor category. ENCOA continues until all factors within a category are weighted and the categories themselves are weighted. Then ENCOA returns to the main menu.

At this point it is advisable to SAVE the model as soon as possible. This is done by selecting option 6 on the main menu:

- 1) DISPLAY
 - 2) SENSITIVITY
 - 3) EDIT SELECTED ITEMS
 - 4) PRINT
 - 5) LOAD MODEL
 - 6) SAVE MODEL
 - 7) ENTER ALL VALUES
 - 8) CREATE NEW MODEL
 - 9) ERASE A MODEL
 - 0) TERMINATE (Apple only)
- ENTER THE NUMBER OF THE DESIRED OPTION:

When this is done, ENCOA produces the following type of display:

THE MODELS CURRENTLY ON THE DISC ARE:

OPFOR TACVAL (5 CA'S)

5 CA DEMOCEDITED]

JAYHAWK BKW

JAYHAWK DL

JAYHAWK PJD

*VACANT

*VACANT

ENTER THE NAME OF THE MODEL THAT IS TO BE SAVED: EXAMPLE

Enter the name of the model you have just supplied data for to save the model and return ENCOA to the main menu.

Now that the model has been created and scores have been entered, all that remains during this session is to review the scores and weights and correct any errors that might not have been caught earlier. The values can be reviewed by selecting DISPLAY option 1 on the main menu. Once this option is selected, ENCOA displays a menu of DISPLAY suboptions:

- 1) SCORES
- 2) RANK BY CUMWT
- 3) RANK BY SELECTED PAIR
- 4) RETURN TO MAIN MENU (Apple only)

ENTER THE NUMBER OF THE DESIRED OPTION: 1

To review a model, the SCORES suboption is best. The SCORES suboption first produces a display of the cumulative scores for each CA:

SUMMARY OF SCORES:

	AVE	RATIO TO BEST
CA1:	61.6	1.0
CA2:	62.0	1.0
CA3:	29.6	.5
CA4:	51.3	.8
CA5:	42.8	.7

PRESS RETURN TO CONTINUE...

reviewing the model (continued)

When you choose to continue, ENCOA requests a node number. Enter the number of whichever factor category you intend to review. The resulting display shows the scores and weights within the designated category:

CA1: FROM THE RIGHT, HIGH
CA2: FROM THE LEFT, HIGH
CA3: FROM THE LEFT, LOW
CA4: THROUGH THE CENTER, HIGH
CA5: THROUGH THE CENTER, LOW

1 TERRAIN	FACTOR	WT	CA1	CA2	CA3	CA4	CA5	CUMWT
	1) FIELD OF FIRE	*(25)	80	100	0	90	10	3.52
	2) COVER & CONCEAL	*(9)	60	90	0	100	20	1.23
	3) MOBILITY	*(17)	20	0	100	40	50	2.37
	4) S/D KEY TERRAIN	*(4)	100	80	0	90	10	.62
	5) OBSRVATN	*(14)	80	100	0	70	30	1.94
	6) NAT/ART OBSTACLE	*(31)	100	80	0	60	20	4.40
	TOTAL		75	75	17	70	23	14.07

ENTER NODE NUMBER:

After displaying the information, ENCOA requests another node number, thereby letting you examine an indefinite number of nodes. When review of the scores is complete, you can return to the menu of DISPLAY suboptions by pressing RETURN (Apple) or EXECUTE (IBM) without a node number. Return to the main menu from the menu of DISPLAY suboptions is accomplished by selecting option 4 (Apple) or by pressing EXECUTE without selecting a DISPLAY suboption (IBM).

If your review of the score has revealed that changes are needed, you should now select EDIT SELECTED ITEMS, option 3 of the main menu. ENCOA will display the menu of EDIT suboptions:

- 1) EDIT WEIGHTS
- 2) EDIT SCORES
- 3) EDIT CA LABELS
- 4) DELETE CA
- 5) REVIEW SCORES (Apple only)
- 6) RETURN TO MAIN MENU (Apple only)

ENTER THE NUMBER OF THE DESIRED OPTION:

The procedure EDIT WEIGHTS is the same as that used for entering weights presented on p. 51. It is, however, more convenient because it allows you to select the factor category requiring revision.

The procedure EDIT SCORES is the same as that used for PROMPTED entry, which was not discussed earlier. Therefore, it was selected for the purpose of this demonstration.

When you select the EDIT SCORES option, ENCOA requests a node number. Once this is entered, ENCOA will prompt you for a change of scores in the following manner:

1 TERRAIN - 1.2 COVER & CONCEAL

CA1: R HI CA2: LL HI CA3: L LO CA4: C HI CA5: C LO

WHICH CA IS THE BEST IN RESPECT TO COVER & CONCEAL
 WHICH CA IS THE WORST IN RESPECT TO COVER & CONCEAL
 INDICATE THE RELATIVE POSITION OF THE REMAINING CA's.

0 20 40 60 80 100
 |-----|-----|-----|-----|-----|
 3 4
 THE SCORES ASSIGNED ARE 60 90 0 100 20
 ARE THESE CORRECT?

When you have responded to the prompt for the best and worst CAs, ENCOA offers a scale under which you must place the numbers of the remaining CAs. You can, if desired, indicate that all CAs should receive the same score by typing A or ALL when ENCOA requests the best CA. After the new scores are confirmed, ENCOA asks for another node number, thereby permitting an indefinite number of changes.

Changes in the scores often make it necessary to change weights as well. Therefore, when you indicate that editing scores is complete by pressing RETURN or EXECUTE without a node number, ENCOA occasionally requests weight changes before returning to the menu of EDIT suboptions. The procedure for making these changes is identical to that used for entering or editing weights. Once these weight revisions are made, ENCOA returns to the menu of EDIT suboptions.

If further editing is required, this is the time to do it. Besides changing weights and scores, ENCOA also lets you change the CA labels or delete a CA. Once the editing is completed, you can return to the main menu by selecting option 6 (Apple) or pressing EXECUTE without first selecting an EDIT suboption (IBM).

Now that the model has been revised, it must be saved again. This is done by selecting 6, the SAVE MODEL option on the main menu. When ENCOA requests the name of the model to be saved, you should enter the same name and it will simply save the new version "on top" of the old version. Thus, the old version is lost.

ending session

To end an Apple session, select option 0 from the main menu. The ENCOA program is then automatically terminated.

To end an IBM session, press EXECUTE alone while ENCOA is displaying the main menu. This leads to the following display:

DO YOU WISH TO TERMINATE THIS SESSION? Y

A Y confirms your intention. At this point, you should remove the tape cassette or diskette, turn off the computer, and turn off the printer.

EXAMINING AN OLD MODEL

When you wish to examine an old model, the sequence of events is somewhat different. After you start up the system, ENCOA displays the preliminary menu:

SELECT ONE OF THE FOLLOWING:

- 1) CREATE NEW MODEL
- 2) LOAD MODEL

ENTER THE NUMBER OF THE DESIRED OPTION:

Selecting option 2 will lead to the following type of display:

THE FOLLOWING MODELS ARE AVAILABLE ON THIS TAPE:

- 1) OPFOR TACVAL(5 CA's)
- 2) 5 CA DEMOCEDITED)
- 3) JAYHAWK BKW
- 4) JAYHAWK DL
- 5) JAYHAWK PJD
- 6) EXAMPLE
- 7) *VACANT

ENTER THE NUMBER OF THE DESIRED OPTION:

Once the number of the model you want has been entered, ENCOA requests confirmation:

THE MODEL YOU HAVE JUST LOADED IS:

EXAMPLE 1/11/80 PATTERSON

IS THAT CORRECT:

Y confirms the choice and leads you to the main menu.

At this point, you must choose one of the following ways to examine the model:

- o The scores and weights can be examined.
- o All of the low-level factors can be ranked in terms of their CUMWTs. (The CUMWT reflects a factor's importance to the cumulative score.)
- o All low-level factors can be ranked in terms of the extent to which they favor a specified CA over another specified CA.
- o A sensitivity analysis can be performed to reflect what happens when one of the weights is changed.

The first three options are available as both DISPLAY and PRINT suboptions. The sensitivity analysis can be accessed directly from the main menu.

printing all scores and weights, by cumulative weight

If you select 4, the PRINT option, ENCOA will display a menu of suboptions:

- 1) PRINT SCORES
- 2) PRINT RANK
- 3) PRINT DATASHEET

ENTER THE NUMBER OF THE DESIRED OPTION:

The first option prints all scores and weights in the same format as the DISPLAY SCORES (p. 39). The second option displays this menu:

- 1) BY CUMWT
- 2) BY SELECTED PAIR
- 3) PREVIOUS MENU (Apple only)

ENTER THE NUMBER OF THE DESIRED OPTION:

Selection of the BY CUMWT option leads to the following type of printout:

EXAMPLE	1/11/80	PATTERSON							
FACTORS RANK ORDERED BY CUMWT									
FACTOR	R HI	L HI	L LO	C HI	C LO	CMWT	SUM		
2.6 COMMAND& CONTROL	100	70	0	60	10	10.96	10.9		
2.2 STRNGTH& CNDITION	20	0	100	50	90	8.99	19.9		
3.2 STRNGTH& CNDITION	100	10	0	32	70	8.37	28.3		
2.1 DSPOSITN	80	100	0	40	20	8.11	36.4		
4.3 MOBILITY	30	100	20	0	40	8.05	44.4		
3.4 LOGISTIC SUPPORT	70	100	0	30	50	6.70	51.1		
2.3 RESERVES	50	0	70	100	30	5.70	56.8		
4.2 COVER & CONCEAL	20	90	50	0	100	5.48	62.3		
3.3 RESERVES	0	80	70	10	100	4.69	67.0		
1.6 NAT/ART OBSTACLE	100	80	0	60	20	4.40	71.4		
1.1 FIELD OF FIRE	80	100	0	90	10	3.52	74.9		
4.4 EXTREME WX EFFCT	100	0	30	80	50	3.38	78.3		
3.1 DSPOSITN	20	70	0	100	50	3.35	81.6		
1.3 MOBILITY	20	0	100	40	50	2.37	84.0		
2.5 PROB ACT & REACT	80	100	0	50	20	2.19	86.2		
5.3 DEPND ON SUPR/DCV	70	100	0	30	10	2.15	88.3		
1.5 OBSRVATN	80	100	0	70	30	1.94	90.3		
5.2 DEPND ON OTH CMDS	20	0	70	50	100	1.72	92.0		
4.1 OBSRVATN & VSIBLTY	100	0	60	40	20	1.61	93.6		
5.1 US ACTN/ REACTION	50	100	70	0	30	1.37	95.0		
3.5 COMMAND& CONTROL	30	50	100	40	0	1.34	96.3		
1.2 COVER & CONCEAL	60	90	0	100	20	1.23	97.6		
2.4 LOGISTIC SUPPORT	60	80	0	100	50	1.10	98.7		
5.4 UNEXPCD WEATHER	100	50	0	20	90	.69	99.3		
1.4 S/D KEY TERRAIN	100	80	0	90	10	.62	100.0		

... by selected pair

Selection of the BY SELECTED PAIR ranking is slightly more complex. For this option, ENCOA displays the CAs and asks you to select a pair:

CA	AVE
CA1: FROM THE RIGHT, HIGH	61
CA2: FROM THE LEFT, HIGH	61
CA3: FROM THE LEFT, LOW	28
CA4: THROUGH THE CENTER, HIGH	46
CA5: THROUGH THE CENTER, LOW	46

WHICH TWO COURSES DO YOU WANT TO SEE:

A sample printout BY SELECTED PAIR looks like this:

EXAMPLE	1/11/80	PATTERSON			
FACTORS RANK ORDERED BY CA1 VS. CA2					
CA1:	61				
CA2:	61				
CA3:	28				
CA4:	46				
CA5:	46				
FACTOR	CA1	CA2	CUMWT	DIFF	SUM
3.2 STRNGTH& CNDITION	100	10	8.37	7.53	7.53
4.4 EXTREME WX EFFCT	100	0	3.38	3.38	10.92
2.6 COMMAND& CONTROL	100	70	10.96	3.29	14.20
2.3 RESERVES	50	0	5.70	2.85	17.05
2.2 STRNGTH& CNDITION	20	0	8.99	1.80	18.85
4.1 OBSRVATN &VSIBLTY	100	0	1.61	1.61	20.46
1.6 NAT/ART OBSTACLE	100	80	4.40	.88	21.34
1.3 MOBILITY	20	0	2.37	.47	21.81
5.2 DEPND ON OTH CMDS	20	0	1.72	.34	22.16
5.4 UNEXPCTD WEATHER	100	50	.69	.34	22.50
1.4 S/D KEY TERRAIN	100	80	.62	.12	22.62
2.4 LOGISTIC SUPPORT	60	80	1.10	-.22	22.41
3.5 COMMAND& CONTROL	30	50	1.34	-.27	22.14
1.2 COVER & CONCEAL	60	90	1.23	-.37	21.77
1.5 OBSRVATN	80	100	1.94	-.39	21.38
2.5 PROB ACT &REACT	80	100	2.19	-.44	20.94
5.3 DEPND ON SUPR/DCV	70	100	2.15	-.64	20.30
5.1 US ACTN/ REACTION	50	100	1.37	-.69	19.61
1.1 FIELD OF FIRE	80	100	3.52	-.70	18.91
2.1 DSPOSITN	80	100	8.11	-1.62	17.29
3.1 DSPOSITN	20	70	3.35	-1.67	15.61
3.4 LOGISTIC SUPPORT	70	100	6.70	-2.01	13.60
3.3 RESERVES	0	80	4.69	-3.75	9.85
4.2 COVER & CONCEAL	20	90	5.48	-3.83	6.02
4.3 MOBILITY	30	100	8.05	-5.64	.38

sensitivity analysis

At the end of either type of ranking, ENCOA returns to the menu of PRINT RANK suboptions. Selecting option 3 (Apple) or pressing EXECUTE alone (IBM) returns you to the menu of PRINT suboptions. From the PRINT menu, selecting option 4 (Apple) or pressing EXECUTE alone (IBM) returns you to the main menu.

From the main menu, you can choose to do a SENSITIVITY analysis by selecting option 2. This leads to a request for the factor weight that will be varied and a request for the minimum and maximum weights for defining the range of variation:

```
ENTER NODE ID: 5
5 RISK
THE MINIMUM CUMWT IS: 0
THE MAXIMUM CUMWT IS: 20
CURRENT CUMWT: 5.93
```

Completion of this input produces a display of the sensitivity analysis:

```
5 RISK
WT          R HI  L HI  L LO  C HI  C LO
.0          61*  60   28   47   46
2.0         61*  60   28   47   46
4.0         61*  60   28   47   46
6.0         61*  61   28   46   46
8.0         61*  61   29   46   46
10.0        61   61*  29   45   46
12.0        61   61*  29   45   46
14.0        60   61*  29   45   46
16.0        60   61*  29   44   46
18.0        60   61*  29   44   47
20.0        60   61*  30   43   47
CURRENT CUMWT: 5.93
PRESS RETURN TO CONTINUE...
```

In this example, the analysis reveals that the weight assigned to RISK affects the "bottom line" scores for the CAs. In many cases, such an analysis can be critical for determining which factors deserve additional attention.

Having completed the examination of the model's implications, you can exit the system by selecting option 0 (Apple) or pressing EXECUTE alone (IBM). You should remove the tape cartridge or diskette, turn off the computer, and turn off the printer. By now, you should have a good feel for the enemy's options.

TROUBLESHOOTING

Software

Software problems rarely occur. You should, however, avoid two situations:

1. Deleting a CA from an unscored model.
2. Entering A (or All) for the scores on all factors within a category.

Since you are not likely to need to do either of these things, the restrictions against them should not be confining.

In the event of an unanticipated software trap, you should first try using the RESET key (Apple) or RESTART switch (IBM) to reinitialize the system.

Equipment

In the event of equipment failure, first try the RESET key (Apple) or RESTART switch (IBM). If the system still does not work, contact an Apple or IBM representative.