

**A User Manual for CPEP:
The Corn Product Evaluation Program,
a Macro Program in Lotus 1-2-3**

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This manual documents the first release of the CPEP program. Please address comments and suggestions concerning the program and/or manual to the senior author for incorporation into future revisions. Neither the author nor CARD shall be liable for damages arising out of the use of or inability to use the contents of the CPEP program.

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Introduction

The Corn Product Evaluation Program (CPEP) is a Lotus 1-2-3¹ macro program that is intended to facilitate benefit/cost evaluation of alternative corn products. The program is fully menu-driven. The user is guided through the program via typical 1-2-3 menus, from which the user makes selections. A working knowledge of Lotus 1-2-3 is all that is required to use CPEP. A proficient Lotus macro programmer, however, can further modify or customize the program to meet more specialized needs.

Hardware Requirements

CPEP will run on any MS-DOS or PC-DOS microcomputer on which Lotus 1-2-3 can be run. Although the program can be run from a floppy drive, it is more efficient when installed on a fixed disk drive. It is recommended for use in a machine running at a speed of 10 megahertz or faster, as computation of large worksheets in Lotus 1-2-3 is inherently slow. Given the large size of the main program file, a minimum of 640K RAM is required to run the program, because Lotus itself occupies a large share of this memory. If expanded or LIMS (Lotus/Intel Expanded Memory Specification) extended memory of 1 megabyte or more is available, consider setting up a RAM drive and loading the program from this drive. This will speed up updates, subroutine calls, and extraction of computed results.

1. Lotus and 1-2-3 are registered trademarks of Lotus Development Corporation.

The master file (CPEP.WK1) is almost 350K in size, and this grows with the addition of data for permanent storage. The other large file is the Path subroutine file (PATH.WK1), which occupies 47K. Six other DOS (Disk Operating System) format files included on the program disk, with the extension .CLP, are relatively small and provide the subroutines necessary for a menu-sensitive help provision in the program. The supplementary disk contains the file CPEP.DOC (68K), a document file written in WordPerfect² that reproduces this user manual. The appendix for this manual is in a separate WordPerfect document file named CPEP_APP.DOC (400K). These accessory files may be used from any directory or drive.

Software Requirements

CPEP is a Lotus worksheet that incorporates the extensive macro commands provided in Release 2.0 of 1-2-3. As such, it will run only on Lotus 1-2-3 Version 2.0 or later versions, or any other fully compatible spreadsheet programs. Some of these spreadsheet programs contain a utility that converts Lotus files into their own formats. Performance of CPEP after such conversion will depend on the integrity of the conversion process as well as the compatibility of the programs. The major factors involved are the translation and interpretation of the macro commands. Often, after automatic translations, such alternative spreadsheet programs also caution one to make some manual changes in the macro programs. Make sure that such procedures are carefully followed.

2. WordPerfect is a registered trademark of WordPerfect Corporation.

Installation

The CPEP program is provided on two 3½-inch diskettes, formatted 720K. The program disk contains all the files necessary to run the program, and the supplementary disk contains the WordPerfect files that will reproduce this manual. Although CPEP may be run directly from the program disk, copying it onto a hard disk is recommended for two reasons. First, since the main program is large, time taken to retrieve and store will be substantially reduced. Next, because the main program file includes the data storage area, as more and more data are entered for permanent storage, the file size will grow. Keeping it on a floppy disk will limit the amount of data that can be stored.

The recommended installation procedure is as follows:

Make a subdirectory within the directory where the Lotus files reside and copy all the files provided into this. For instance, say Lotus files are in the directory C:\LOTUS\. First issue the command

PROMPT \$PSG³

to customize the prompt to display the current path. Then, starting from the root directory with the prompt C:\>, issue the DOS command

CD C:\LOTUS

to get the prompt C:\LOTUS\> . Issue command

MD CORN

to create a subdirectory named Corn. When the original prompt reappears, issue command

CD C:\LOTUS\CORN

3. The commands to be issued by user are underlined for clarity.

to go to the Corn subdirectory you just created. The resulting prompt will be C:\LOTUS\CORN> .

Now place the CPEP disk in drive A and issue the command

COPY A:*.*,

and all the files will be copied to the Corn subdirectory. Issue another command at the prompt C:\LOTUS\CORN\>

MD DATA

to create a Data subdirectory within the Corn directory. All the computed outputs of the program will be, by default options of the program, channeled to this Data directory.

By default, updates of the program files will be sent to this C:\LOTUS\CORN directory, while computed information will be sent to the Data subdirectory. Also, the program will look for the Help and Path subroutine files in the C:\LOTUS\CORN directory. If your directory structure is different, the program will, at the first occasion needed, ask for the correct path and adjust its default paths automatically. The user may respecify the paths if and when necessary.

CPEP Graphics Driver

To be able to view the CPEP flow diagram, 1-2-3 must be run with a special driver with a modified text display attribute. To do this, invoke the Lotus Install program and its main menu; select "Advanced Options." Then select "Modify Current Driver Set" from the resulting menu and choose "Text Display," followed by "Universal Text Display--ASCII--NOLICS," to override the Lotus international character set option. Escape and save changes to a new driver set named, for instance, Nolics. Exit from Lotus

and then restart it using the new driver set by issuing the command LOTUS
NOLICS or 123 NOLICS.

Program Purpose and Concepts

This microcomputer program was developed as a tool for economic evaluation of manufacturing corn-based products. Starting from corn as the base input, technology exists to produce various outputs such as alcohol, starch, syrups, and sugar, among others. Producing these various outputs requires other inputs, both variable and fixed. Conversely, along with the main product, a number of by-products of economic value are produced as well. Economic evaluation thus requires that both the costs and the benefits be taken into account. Furthermore, different technical processes are available, and new processes, such as converting starch to sugars, will become available for producing a product.

In order to allow for such flexibility, the CPEP program uses the concept of a single, unique "process" as the base unit for evaluation. Understanding this concept and the use of process details in computations will facilitate better use of the program and interpretation of results. The processes concept is best explained using an example, illustrated in Figure 1.

Assume a producer is planning to derive sugar from corn. Corn is steeped, germ separated, endosperm ground, fiber screened, and gluten separated to arrive at starch (Figure 1). Each step can be identified as a distinct process, or they can all be grouped together as a single process of converting corn to starch with gluten, fiber, and corn germ as by-products. For ease of explanation, let's consider the latter, and call

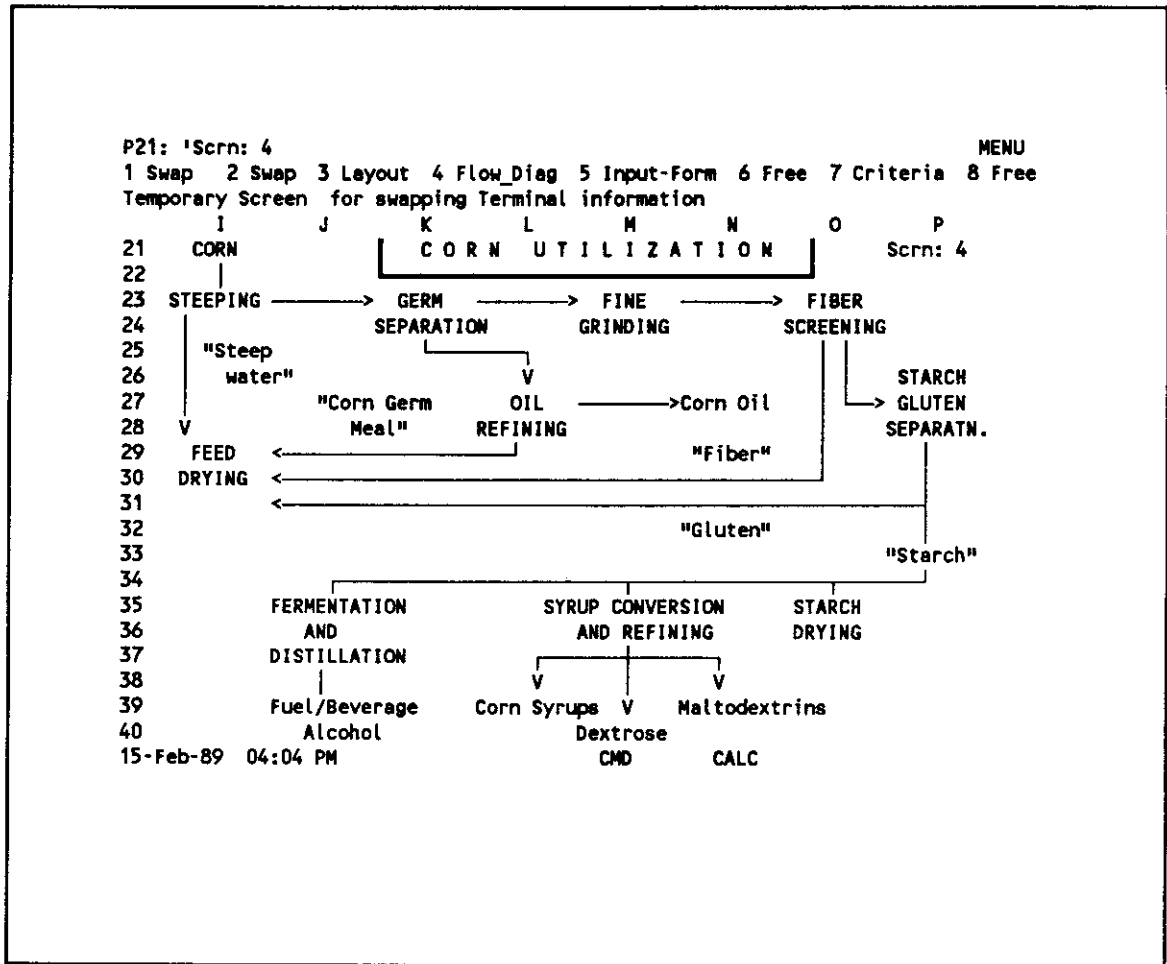


Figure 1. Flow Diagram as Displayed in CPEP.

this Process A. The resulting starch is then converted to sugar by a second process, B, with alcohol as the by-product. Process A is defined by a primary input, corn, and a primary output, starch, along with several other variable and fixed inputs and by-products.

Several optional technical methods and machinery combinations may be available to convert corn to starch. Assume that three such methods are available, namely processes A1, A2, and A3. Similarly, assume three options exist for B, namely B1, B2, and B3. The producer thus needs to

find the most economical combination among the A_i 's and B_i 's ($i = 1,2,3$) to produce sugar from starch. The best combination will depend on the prices of the primary outputs, the by-products, and the inputs. Also, if an alternative process (B4) becomes available, the producer may have to reconsider the optimal combination. CPEP is programmed to assist in such decision making.

The user inputs the necessary technical data of each process, identified by a primary output, a primary input, by-products, and other benefits, inputs, and costs. These details and the corresponding price data are stored permanently in the master file. Such technical data and price data can be updated at any time. All possible combinations (referred to as "paths" in CPEP) of producing any of the primary outputs or by-products, starting from any of the identified primary inputs, will be computed automatically by a subroutine, on request. Once the data is set up, the program will perform the cost/benefit evaluation of up to six individual processes or paths simultaneously. Also, from this evaluation menu, the user could change prices of the master file temporarily to reevaluate the impacts of such changes. To see impacts of different technologies, the user could select different paths or processes and request a reevaluation.

Operating CPEP

Start-up

To run the CPEP program, load the Lotus program (with the optional Nolics graphics driver described under "CPEP Graphics Driver") and select 1-2-3 from the main menu to go to the worksheet environment. The file

directory may be changed (using Lotus commands /FD) to the directory where the CPEP files reside; say, C:\LOTUS\CORN. On retrieving the file named CPEP, the CPEP program will automatically load and run, presenting the opening menu and the program features as shown in Figure 2. From here the user will be guided via menus or instructions in the top panel.

Program Features

Menu Structure. The typical Lotus menu feature is used extensively in the program to assist the user in proceeding step-by-step through the program. This feature is complemented with visible form-type input screens into which the user enters the data. Such screens are only temporary storage areas, from which the program automatically extracts the relevant information and stores them in a more compact manner in a hidden area of the worksheet. This allows for better security of data and more efficient use of space.

Selecting from a Menu. When a menu appears on the top panel, the user selects a choice, either by moving the cursor to the selection and pressing the <RETURN> key or by simply typing the first letter (or number) of the choice.

Moving to the Previous Menu. Some of the menus have explicit quit or return options that will enable retracing to the previous menu. The <ESC> key will do the same in these menus as well as those that lack explicit return facilities. In instances where only browsing of some worksheet areas is allowed and no instructions appear in the top panel, the bottom line of screen will have instructions as to which key will return one to

```

H19:
EVALUATE TECHNICAL COSTS PASS-WORD HELP QUIT
Evaluation Step. " USE ARROWS TO SELECT AND PRESS <RETURN> "
      A      B      C      D      E      F      G      H
1      C o r n   P r o d u c t   E v a l u a t i o n   P r o g r a m
2
3
4
5
6
7
8
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17
18
19 CARD, Dept. of Economics. ISU, Ames, Iowa. Jan. 1989.
20
15-Feb-89 02:46 PM          CMD      CALC

```

M A I N M E N U

- * Evaluate Products
- * Technical Information
- * Price Information
- * Pass-Word Protect
- * Help
- * Quit

Figure 2. CPEP Opening Screen Display.

the previous menu. When in doubt, refer to the relevant menu chart provided in the Appendix.

Menu Codes. The menus are organized in a tree structure: any choice made in a given menu takes the user to a different branch; a choice there leads to one of its sub-branches, and so on. It is possible to create several layers of such branching. For ease of reference to any position in any branch, this user manual uses the following notation:

The opening menu is referred to as menu [M], for main menu. This menu has six options: evaluate, technical, costs, password, help, and quit. Pressing "E" at the opening menu takes the user to the evaluate menu. This second menu is coded [ME] to indicate that it is obtained by entering "E" from the menu [M]. Similarly, [MT] is the menu obtained by selecting "T" (for technical), and [MH] is the menu obtained by selecting "H" (for help). Following this technique, the notation [MEO] refers to the selection of "E" from the [M] menu, and then "O" from the resulting [ME] menu. The whole system of menus is coded using this principle, as shown in the Appendix.

Data Entry

The entry of technical and price data is facilitated through an on-screen form. To get to this, select "Technical" (press T) from the main menu. This option is password protected for the security of the permanent data in the master file. The user will be prompted for the password the first time in each session this option (Technical) is chosen.

TECHNICAL Entering and revising of technical and price data is controlled via this selection. Once the password is entered and verified, the user is taken to the input form (Figure 3) and prompted by the [MT] menu for the following choices:

REVISE Revises the last set of technical data entered at the previous session. The relevant data is presented in an input form.

```

R27: U 'Syrup
UN-CHANGED COEFFICIENT SELECT NEW-ITEM HELP
Leave Un-Changed & Move to Next Line
Q      R      S      T      U      V      W      X
21 Go to COMMODITY list on right to select 21 List of OUTPUTS in Master
22 =====22 No. of Items: 10
23 Process: 14 Label: syrup 23 Commodity Units Price $
24 =====24 Alcohol gal 1.40
25 ITEM UNITS QUANTITY 25 Corn # 0.10
26 Name Sugar syrup from corn 26 Cornoil lit 0.86
27 Pr.Input Syrup gal 25 27 Ethanol lit 0.89
28 Pr.OutputSugar kg 23 28 Gluten # 0.12
29 By.pdt01 Oil # 10 29 Starch # 0.24
30 By.pdt02 Yeast2 # 20 30 Sugar kg 0.35
31 By.pdt03 Alcohol gal 12 31 Sweetner1 # 0.64
32 AFI01 Distiller $ 8.53 32 Syrup gal 3.89
33 AFI02 Fraction $ 35.03 33 Yeast # 6.00
34 34
35 35
36 36
37 37
38 38
39 39
40 40
15-Feb-89 03:42 PM CMD NUM

```

Figure 3. Input Form and Side Window.

NEW Presents a blank form and automatically sets the process number to one more than the number of processes already entered in the master file.

LIST Provides a list of all processes available in the master file by way of a side window. The user could select a process and view its technical details via the submenu choices Select and View. The data can be imported into the form for revision.

Details of data entry to the input screen:

Label: Mandatory. Enter a string of up to eight alphanumeric characters for the process.

Process Name: Mandatory. Give a more descriptive name for the process. Accepts up to 35 alphanumeric characters.

Pr.Input: Stands for primary input for the process. Mandatory. User may select from the list on the side window or enter a new item. If New-Item is chosen, the user is prompted for units and per unit price. If selection is made from the list, the units and unit price are set in accordance with the master file. Thus, before entering a commodity as a new item, make sure that the commodity is not already available in the master list (the list is in alphabetic order). Following this, the user is prompted for the

Coefficient: The numeric figure entered here will be the basis for the coefficients to be entered for all other categories below. For example, if the user enters 56 pounds of corn, then the primary output, the by-products, and all costs and benefits must be entered on the basis of using 56 pounds of corn.

Pr.Output: Represents the primary output for the process. Entry is mandatory and is similar to Pr.Input.

By.pdt.: By-product. Optional. Allows for up to 99 by-products, numbered By.pdt01 to By.pdt99. By pressing <ENTER>, the user selects the current category and is prompted for details, as in the Pr.Input category above. Selecting <NEXT> moves the user on to the next category.

- VI: Variable inputs of up to 99. Similar to the by-product category.
- AFI: Stands for average fixed input cost. Units are automatically set to U.S. dollars. Up to 99 entries allowed. The basis for averaging is the number of units of primary input or output reported above. Estimating average cost is facilitated through an FC (fixed cost compute) subroutine in the menu. See the FC subroutine for details.
- OVC: Other variable costs. A provision to enter any other variable costs directly in U.S. dollars, on the basis of the primary input/output volumes.
- OFC: Other fixed costs. Entry basis is the same as in OVC.
- O.B.: Other benefits such as subsidies may be entered here. Entry basis is the same as in OVC.
- O.C.: Any other costs, such as taxes, transportation, etc., not included in the earlier categories. Entry basis is similar to OVC.

FC Subroutine

It must be emphasized that the CPEP program is not intended to determine process optimization. That is, one cannot find the optimal level of production given variable and fixed costs and commodity prices. Rather, an optimal production level of each process is assumed. Evaluation therefore is limited to comparison among optimal processes. Hence, the variable and fixed input distinction does not play the conventional economizing role. The distinction is of accounting interest only. Say,

for instance, a particular piece of equipment is used that costs \$1,500 and lasts one year, after which it has no salvage value. It uses \$25 worth of electricity, and 5,600 pounds of corn is processed during this period. If the reporting basis is 56 pounds of corn as primary input, \$0.25 of electricity will be reported as variable input VI-x and \$15 will be reported as average fixed input AFI-x, representing the appropriated cost of this equipment for the base 56 pounds of corn.

The FC subroutine allows the user to specify whether the fixed input is costed as a purchased input or is rented. If it is a purchased input, the user is prompted for capital cost, salvage value, life of capital, and annual rate of output. From this, the appropriated cost of capital for the reported input/output volume is calculated and transferred to the corresponding column. Rented input costs are similarly computed based on whether the rental rate is on an annual, monthly, or daily basis. The user is prompted for the necessary information.

Evaluation

Processes vs. Products

The program allows for simultaneously evaluating up to six individual processes defined in the master file, or for selecting up to six different combinations of processes for evaluation (Figure 4). The latter method is referred to as the commodity- or product-based evaluation, for the user specifies the commodity of choice and the program evaluates the possible paths that contain the chosen commodity.

For instance, say the user opts for commodity-based evaluation, then selects output as the basis and sugar as the commodity. The program then

will list all possible combinations of the processes in the master file that can lead to sugar as the final product. Similarly, the user may select input as the basis and corn as the commodity to get a listing of all possible paths that use corn as the primary input. As a third alternative, the user may ask for all paths that use a given commodity as primary input and another commodity as output, thereby restricting the process combinations to those that satisfy both criteria.

```

H20:
PROCESS COMMODITY REDO-PATHS OLD_COMPUTATIONS HELP QUIT          MENU
Process-based Evaluation
  A      B      C      D      E      F      G      H
1      C o r n   P r o d u c t   E v a l u a t i o n   P r o g r a m
2
3
4      EVALUATION : Options
5
6
7      * PROCESS: Allows selecting up to 6 Processes
8      from the Master List of Processes
9
10     * COMMODITY: Evaluation based on given
11     Input-Output combination.
12
13     * PATH: Re-Do PATH Computations
14
15     * OLD_: Retain Current Computations
16
17     * H e l p           * Q u i t
18
19 CARD, Dept. of Economics. ISU, Ames, Iowa.          Jan.1989.
20
15-Feb-89 04:59 PM                                CMD

```

Figure 4. Evaluation Menu Screen Display.

Using the Evaluation Menu

Choosing "Evaluate" from main menu [M] will take the user to submenu [ME]. Options available in this submenu:

PROCESS Allows selection of up to six processes from the master file for evaluation. On confirming the selections, benefit/cost evaluation occurs automatically, concluding with the [MEO] menu.

COMMODITY Allows for evaluating up to six of the possible paths available in the master file. Make sure that if any new technical data is entered, the Redo-Paths option is invoked before attempting this commodity option, so that a recomputed list of all possible paths is available in the master file. The commodity option allows the user to call for a list of all paths or to restrict it to those with a user-selected input, output, or input/output combination. Selection of paths for evaluation is also guided, and no more than six selections can be made for any single evaluation. Once the selections are confirmed, benefit/cost evaluation is automatic, ending with the [MEO] menu.

REDO-PATHS This is a subprogram that computes all possible paths of producing any output or by-product from any primary input. The subroutine is performed by the program in the file PATH.WK1. If CPEP does not find the default directory or the above file in the directory, it will prompt for a different directory/file.

Prior to executing the subroutine, CPEP first stores the current worksheet in the default directory and loads the path file.

OLD-COMPUTATIONS Allows one to view, change, print, and save the last performed computations via menu [MEO], which has the following options:

COMPARE Allows one to view, print, or graph the comparison of the processes or paths selected. Printing can be directed either to a hard copy on the default printer or to a print file that can be saved in the default or any other directory of choice. A file so saved can be retrieved by any word processor that translates Lotus .PRN files for use in reports. Note, however, that these files are saved with the extension .CRN instead of the Lotus default extension .PRN.

SELECTIONS Allows user to view, print, or graph the benefit/cost details or technical details of each of the processes or paths selected from the [ME] menu. On selecting this option, the user is prompted with a menu choice of "Benefit/Cost," to see the summary costs and benefits, and "Technical," to see the technical details as well as detailed cost and benefits involved. The default option "View," can be changed to "Print," or "Graph." The required details can be either printed or stored as files (see previous section on Compare).

- PRICE** Prepares a table of the commodity prices, and the submenu appears with the following choices:
- PRINT** Prints a hard copy of the price data on the default printer.
- CHANGE** Allows the user to change one or more of the prices. On making this choice, a new column of prices appears along the side to remind the user of original prices. The cursor moves to the top of the price list and can be moved down the price column using arrow keys. Make the necessary changes in price and press <RETURN> when finished. After prompting for confirmation, the program recomputes benefits and costs and returns to the [MEO] menu.
- BASIS** The default computation of benefits/costs is on the basis of per unit input in all cases except when output-based paths are selected from the [ME] menu. In this case, per unit output is the basis. This basis option in [MEO] allows the user to change the basis for computation. Options available here depend on the type of evaluation requested from the [ME] menu, as shown in Figure 5.
- TEMP-SAVE** Allows user to save a copy of the master file, along with the current computations, as a file named TEMP_CRN.WK1 in the default directory.

	Unit Input	Unit Output	Original Input	Original Output	Change Input	Change Output
	U.I	U.O	O.I	O.O	C.I	C.O
Process Evaluation:	X	X	X	X	X	X
Commodity Evaluation Based on						
---Input	X		X		X	
--Output		X		X		X
---Both	X	X	X	X	X	X

Figure 5. Different Suboptions Available within Basis Option.

XTRACT Extracts the computed details of the selected processes/paths into a Lotus 1-2-3 worksheet file. This can be retrieved outside the CPEP environment and used like any other regular worksheet file (see "Printing and Graphing").

DIRECTORY Allows user to respecify the default directory for file storage.

Path Subroutine

Once the Path subroutine is loaded, a menu gives an opportunity to change the default directory and file name of the master file from which the necessary technical data is to be extracted. Make the necessary changes only if default options are not correct. Selecting "Go" will initiate the path computation, which may take from five to ten minutes to

complete. At completion, select "Save" from the menu to feed back the computed paths to the master file. The program will save the information and automatically retrieve the CPEP program and return to the [ME] menu.

File Security

Access to Data in the Master File

Technical and price data are saved in a hidden area of the worksheet for security. Updates and revisions of this data are password protected. Temporary changes in prices, for evaluation under different price scenarios, can be made via the evaluation menu without affecting the master file data.

Password

The program comes with the default password "CPEP." The password option provides for the user to change the password at will and thereby to protect the data from casual users. Only the data entry ("Technical"), cost revising ("Cost"), and password ("Password") options of the main menu are password protected, so that modification of the main data base can be restricted to one or few users, while use of the program for evaluation can be open to all.

Resetting the Password

By choosing the password option, the user can go to the password resetting menu. To reset, the user needs to know the current password. The program checks the entered password, and if cleared, it prompts for a new password, confirms the new entry, and saves it. Make sure that the password is reset at regular intervals and do not forget the new password.

Write it down and store it in a secure place. If you are unable to recall the password, you may contact the author of this manual or the CARD publications clerk for instructions on how to reset the password.

Help Features

The CPEP program provides for context-sensitive help from most of the menus. (See Figure 6 for illustration of one help screen.) Some details of help are available in hidden areas of the worksheet, from which they will be retrieved and made visible to the user on request. Most of the help details, however, are available via subroutines that read information

```

H20:
PROGRAM GENERAL ADD/REVISE LAYOUT QUIT
Program Features
A B C D E F G H
1 Corn Product Evaluation Program
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19 CARD, Dept. of Economics. ISU, Ames, Iowa. Jan. 1989.
20
15-Feb-89 04:01 PM CMD CALC
  
```

HELP MENU

- * Program Information
- * General Help
- * How to Add/Revise Data
- * Layout of Work Sheet
- * Quit Help

Figure 6. Help Screen from the Main Menu.

from the accessory files with the file extension .CLP. Thus, make sure these files are in place in the default directory, or specify the proper directory path when prompted.

Printing and Graphing

Printing Computed Results

The first three options of the menu [MEO], compare, selections, and price, provide for printing. The default printer has to be preset for uninterrupted printing from these menus. Therefore, before you retrieve the CPEP program, be sure to select the correct printer from the Lotus 1-2-3 menu options.

The compare option allows for printing the summary comparison of the benefit/cost analysis of selected processes or paths. The selections option can be used to print either the technical details or the benefit/cost details of individual paths or processes. The price option can be used to print the commodity list from the master file.

These outputs also can be directed to files (as opposed to hard copies). On such a request, the user will be prompted for a file name. A file extension of .CRN is automatically attached to these files, and the files are saved in the default directory (C:\LOTUS\CORN\DATA), unless the directory has been otherwise changed (see directory option in "Using the Evaluation Menu"). Such print files can be directly imported into most of the common word-processing programs for inclusion in other reports.

Another alternative available for using the computed results is via the Xtract option. Invoking this option saves the computed results in a file, to be named by the user and with the .EXT extension, in the default

directory (or current directory, if changed). The saved file is a 1-2-3 worksheet file that can be retrieved independently and used as any normal 1-2-3 worksheet. In saving this extracted file, Lotus automatically saves the range names in the master file and positions the cursor at the location corresponding to its location in the master file. With this in mind, when retrieving a file, first delete all range names (by 1-2-3 command /Range Name Reset), then move the cursor to the first cell of the worksheet by pressing the <HOME> key.

Graphs

Only a very basic graphing facility is provided within the CPEP program. Graphs generated within the program can only be viewed, not printed, and options for style, type, and headings are minimal. This restriction is intentional and is a means of saving on program lines and worksheet space. In any case, Lotus graphs cannot be printed from within the 1-2-3 environment in which CPEP operates; Lotus requires exiting from 1-2-3 and entering the PrintGraph environment to print graphs.

However, to get printed graphs of results, the user can extract the computations using the Xtract option, exiting from the CPEP program and retrieving the newly extracted file. The necessary graphs with all the options available can be generated from here, saved as graph files (with the Lotus default option of .PIC file extension), and used for printing.

Saving and Quitting

Always return to the main menu and invoke the quit option to leave the program. On selecting "Quit," a menu appears with the options detailed

below. Options to save any changes, either by replacing the original file or by creating a new file, are included within the submenus of this option.

The menu options:

- RETURN** Allows the user to return to the program without quitting. This is actually a safeguard option, in case the quit option is invoked unintentionally.
- SAVE** Allows the user to save the worksheet, with any changes made in the current session as a file named CPEP.WK1. This will replace the original file. The program prompts for confirmation before saving.
- NEW** Allows the user to save the current worksheet, with any changes made in the current session, as a new file. A list of files available is provided and the user is prompted for a new file name. Optionally, a new path also may be specified.
- QUIT** Allows the user to quit the program without saving any of the changes made in the current session.

An Example

The corn-to-sugar process can be used to demonstrate the workings of the program. Assume four distinct processes (Table 1), two for converting corn to starch and two for producing sugar from starch. See Table 2 for prices of commodities used within the computations for this example.

Table 1. Process Details Used in the Example

Process	1		2		3		4	
Label	ST-1		ST-2		Sug-1		Sug-2	
Pr.Input	Corn	56	Corn	100.00	Starch	100	Starch	32
Pr.Output	Starch	32	Starch	57.14	Sugar	24	Sugar	8
By.pdt01	Germ	4	Germ	7.14	Ethanol	2	Ethanol	0.4
By.pdt02	Gluten	10	Gluten	8.36				
VI-01	Labor	.5	Labor	0.35	Labor	.2	Labor	.3
VI-02	Power	1	Power	2.68	Power	3.5	Power	0.2
VI-03	Acid	3						
AFI01	Rent	0.53	Rent	0.97	Rent	0.26	Rent	0.07
AFI02	Equip.	0.30	Equip.	0.72	Equip.	0.85	Equip.	0.04
OVC	Tax	0.8	Tax	0.7	Tax	1.3	Tax	0.4

To illustrate how AFI01 is computed, say in Process 1, monthly output is 30,000 pounds of starch, and monthly rent is \$500, resulting in an averaged rental cost of \$0.53 per 32 pounds of starch. Similarly, the equipment purchase cost is \$10,000 for equipment that lasts three years and has a salvage value of \$2,000, resulting in an averaged cost of \$0.23 for the same 32 pounds of starch.

Table 2. Commodity Price Data

Name	Units	Price/Unit
Acid	lit	0.35
Corn	#	0.02
Ethanol	lit	0.89
Germ	#	0.28
Gluten	gal	0.12
Labor	hrs	4.35
Power	watts	0.10
Starch	#	0.24
Sugar	#	0.48

The Redo Paths subroutine will trace out all possible paths as follows:

```

1 Corn --> [ 1 ] --> Starch
2 Corn --> [ 2 ] --> Starch
3 Corn --> [ 1 ] --> Germ
4 Corn --> [ 1 ] --> Gluten
5 Corn --> [ 2 ] --> Germ
6 Corn --> [ 2 ] --> Gluten
7 Starch --> [ 3 ] --> Sugar
8 Starch --> [ 4 ] --> Sugar
9 Starch --> [ 3 ] --> Ethanol
10 Starch --> [ 4 ] --> Ethanol
11 Corn --> [ 1 ] --> Starch --> [ 3 ] --> Sugar
12 Corn --> [ 2 ] --> Starch --> [ 3 ] --> Sugar
13 Corn --> [ 1 ] --> Starch --> [ 4 ] --> Sugar
14 Corn --> [ 2 ] --> Starch --> [ 4 ] --> Sugar
15 Corn --> [ 1 ] --> Starch --> [ 3 ] --> Ethanol
16 Corn --> [ 2 ] --> Starch --> [ 3 ] --> Ethanol
17 Corn --> [ 1 ] --> Starch --> [ 4 ] --> Ethanol
18 Corn --> [ 2 ] --> Starch --> [ 4 ] --> Ethanol

```

Suppose paths 12 and 14 are selected. Printouts from the resulting computations are given in Figures 7-9. Note that since the processes have different bases of inputs, the computations are on the basis of unit output. This basis can be changed via the basis option in menu [MEO].

Figure 7 demonstrates how the different items in the process are grouped into different categories such as variable costs and fixed costs. Starch, which is an intermediate output in the process chain, is accounted for as a by-product in the revenue side and as a variable input on the cost side. As can be seen from Figure 9, the program first standardizes the first process on the basis of the primary input to compute the intermediate output. Then the second process details are evaluated on the basis of the computed intermediate product.

Item		REVENUE	COSTS					
Starch Process 2								
Corn	-0.146							
Starch	1.000	Pr. Output	Sugar	0.480	Pr. Input	Corn	0.146	0.146
Germ	0.146	By. pdt.	Starch	1.000	Variable			
Gluten	0.073		Germ	0.146		Starch	1.000	
Labor	-0.111		Gluten	0.073		Labor	0.111	0.036
Power	-0.020		Ethanol	0.074		Power	0.020	0.015
Rent	-0.071					Tax	0.051	0.054
Equip.	-0.053	Sub-Total		1.293				
Tax	-0.051					VAR. Cost	0.182	1.105
Sugar Process 1								
Starch	-1.000				Fixed	Rent	0.071	0.011
Sugar	0.480					Equip	0.053	0.035
Ethanol	0.074							
Labor	-0.036					Fixed.	0.123	0.046
Power	-0.015							0.169
Rent	-0.011							
Equip	-0.035							
Tax	-0.054	Total Revenue		1.773		Total Cost		1.602
Net	0.171					Net Profit		0.171

Figure 7. Details of Computation.

C O S T / B E N E F I T C O M P A R I S O N			
Sel. # 1	Corn ->	[2] ->Starch	->[3] ->Sugar
Sel. # 2	Corn ->	[2] ->Starch	->[4] ->Sugar
		1	2

R E V E N U E			
Pr.Output		0.48	0.48
By.Pdt.		1.29	1.21
Other Benefits			
C O S T S			
Pr.Input		-0.15	-0.14
Variable Inputs		-1.29	-1.35
Fixed Costs		-0.17	-0.13
Any Other Costs			
P R O F I T S		0.17	0.07

No. of Steps	Cost Benefits	- Summary	Selectn.
2	=====		1 of 2
Path	Corn ->[2] ->Starch ->[3] ->Sugar		
	Basis	per Unit kg of Sugar	
REVENUE			
Primary Output.....			0.480
By Products.....			1.293
Other Benefits.....			
COSTS			
Primary Input.....		-0.146	
Variable Costs.....		-1.287	
Fixed Costs.....		-0.169	
Any Added Costs.....			
			=====
Profit -	per Unit kg of Sugar		0.171
			=====

No. of Steps	Cost Benefits	- Summary	Selectn.
2	=====		2 of 2
Path	Corn ->[2] ->Starch ->[4] ->Sugar		
	Basis	per Unit kg of Sugar	
REVENUE			
Primary Output.....			0.480
By Products.....			1.215
Other Benefits.....			
COSTS			
Primary Input.....		-0.140	
Variable Costs.....		-1.350	
Fixed Costs.....		-0.132	
Any Added Costs.....			
			=====
Profit -	per Unit kg of Sugar		0.073
			=====

Figure 8. Printout of the Benefit/Cost Analysis.

No.	Rev./Cost	-1 Label	Item	Units	Quantity
2		Name	Starch Process 2		
2	-0.02	-1 Pr.Input	Corn	#	100 -1
2	0.137136	1 Pr.Output	Starch	#	57.14 0.5714
2	0.019992	1 By.pdt01	Germ	#	7.14 0.0714
2	0.010032	1 By.pdt02	Gluten	#	8.36 0.0836
2	-0.01522	-1 VI-01	Labor	hrs	0.35 -0.0035
2	-0.00268	-1 VI-02	Power	watts	2.68 -0.0268
2	-0.0097	-1 AF101	Rent	\$	0.97 -0.0097
2	-0.0072	-1 AF102	Equip.	\$	0.72 -0.0072
2	-0.007	-1 OVC01	Tax	\$	0.7 -0.007
3		Name	Sugar Process 1		
3	-0.13713	-1 Pr.Input	Starch	#	100 -0.5714
3	0.065825	1 Pr.Output	Sugar	kg	24 0.137136
3	0.010170	1 By.pdt01	Ethanol	lit	2 0.011428
3	-0.00497	-1 VI-01	Labor	hrs	0.2 -0.00114
3	-0.00199	-1 VI-02	Power	watts	3.5 -0.01999
3	-0.00148	-1 AF101	Rent	\$	0.26 -0.00148
3	-0.00485	-1 AF102	Equip	\$	0.85 -0.00485
3	-0.00742	-1 OVC01	Tax	\$	1.3 -0.00742
No.	Rev./Cost	-1 Label	Item	Units	Quantity
2		Name	Starch Process 2		
2	-0.02	-1 Pr.Input	Corn	#	100 -1
2	0.137136	1 Pr.Output	Starch	#	57.14 0.5714
2	0.019992	1 By.pdt01	Germ	#	7.14 0.0714
2	0.010032	1 By.pdt02	Gluten	#	8.36 0.0836
2	-0.01522	-1 VI-01	Labor	hrs	0.35 -0.0035
2	-0.00268	-1 VI-02	Power	watts	2.68 -0.0268
2	-0.0097	-1 AF101	Rent	\$	0.97 -0.0097
2	-0.0072	-1 AF102	Equip.	\$	0.72 -0.0072
2	-0.007	-1 OVC01	Tax	\$	0.7 -0.007
4		Name	Sugar Process 2		
4	-0.13713	-1 Pr.Input	Starch	#	32 -0.5714
4	0.068568	1 Pr.Output	Sugar	kg	8 0.14285
4	0.006356	1 By.pdt01	Ethanol	lit	0.4 0.007142
4	-0.02330	-1 VI-01	Labor	hrs	0.3 -0.00535
4	-0.00035	-1 VI-02	Power	watts	0.2 -0.00357
4	-0.00124	-1 AF101	Rent	\$	0.07 -0.00124
4	-0.00071	-1 AF102	Equip	\$	0.04 -0.00071
4	-0.00714	-1 OVC01	Tax	\$	0.4 -0.00714

Figure 9. Technical Details of the Selected Paths.

Appendix
Selected CPEP Menus

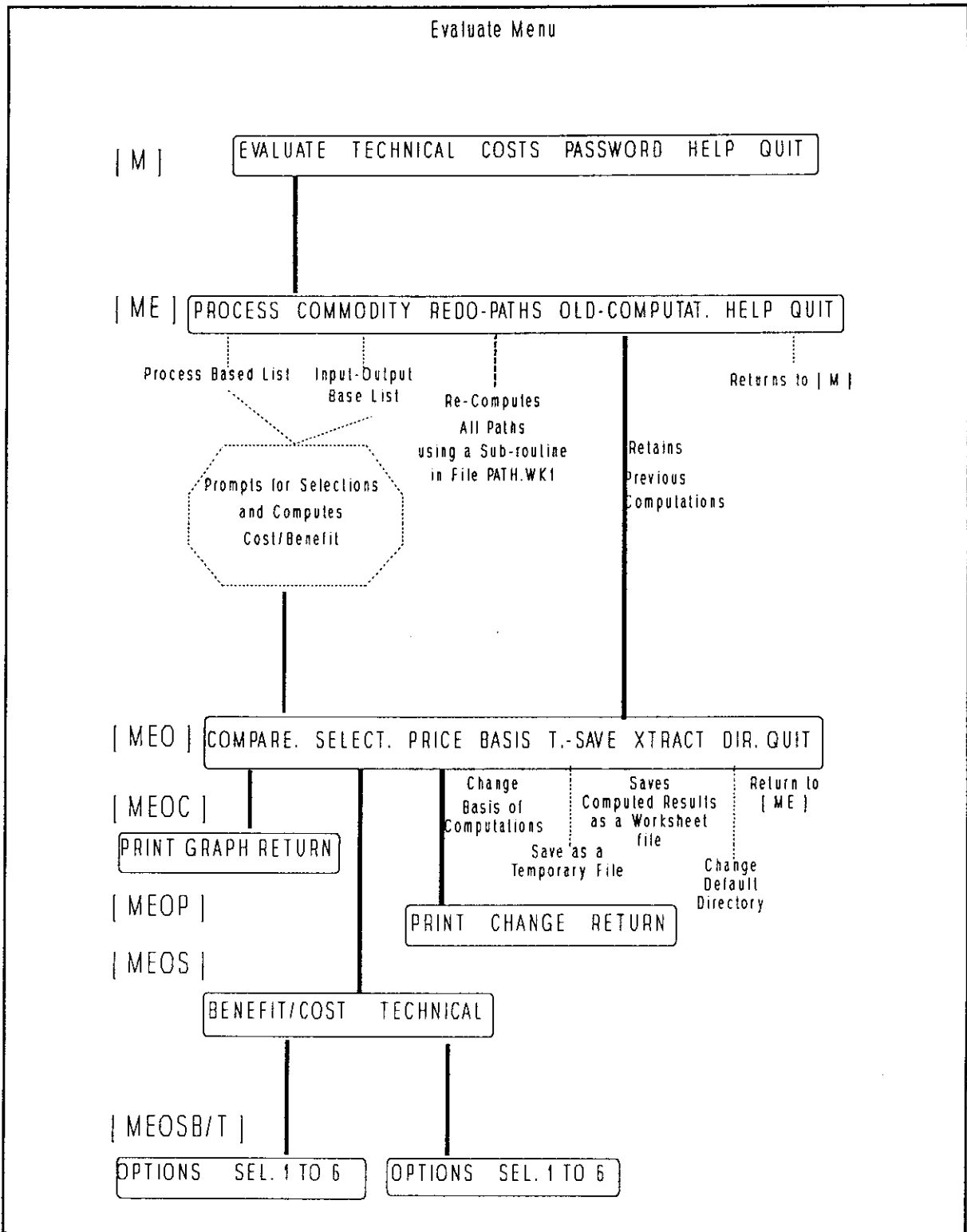


Figure A.1. The Evaluate Menu.

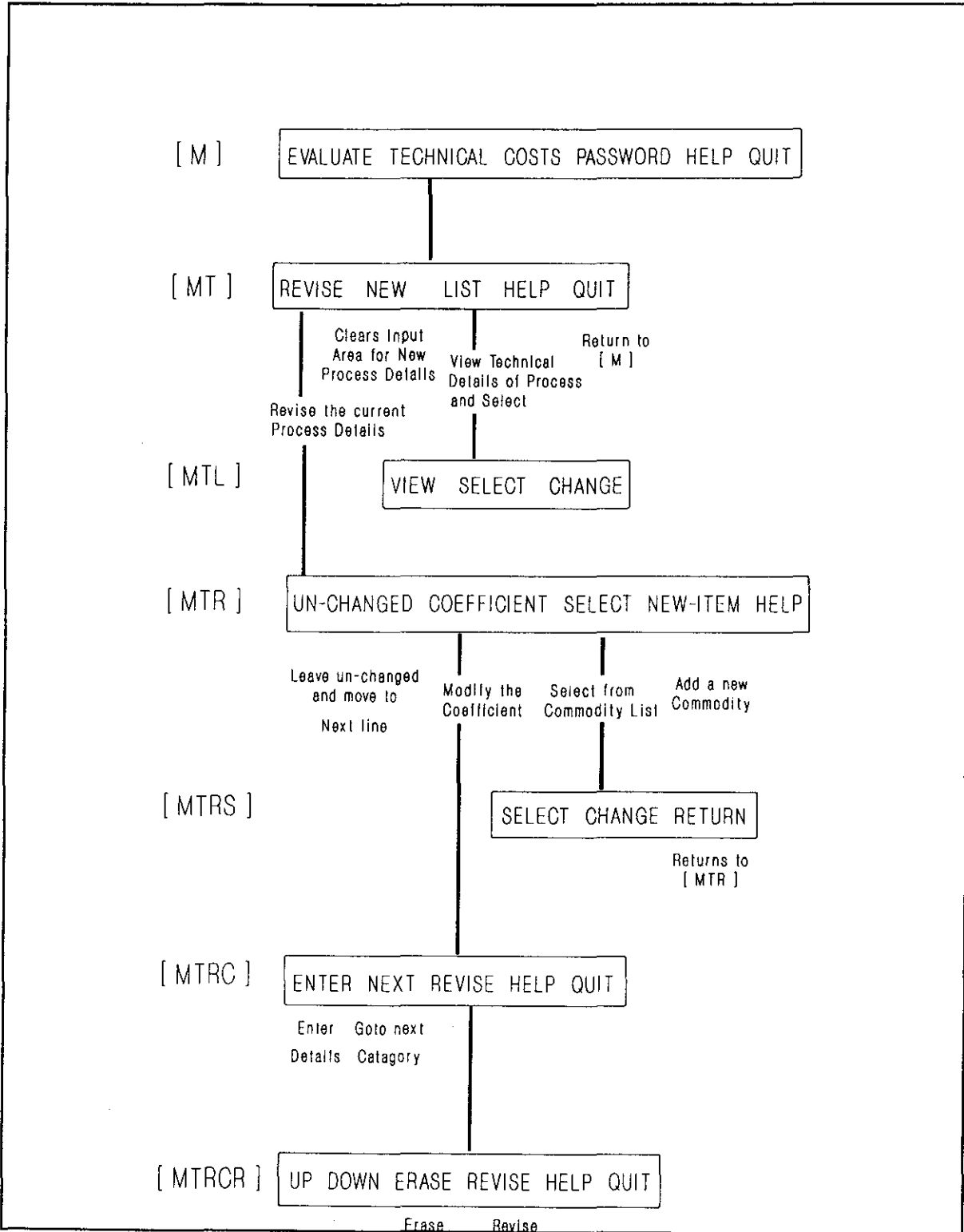


Figure A.2. The Technical Menu.

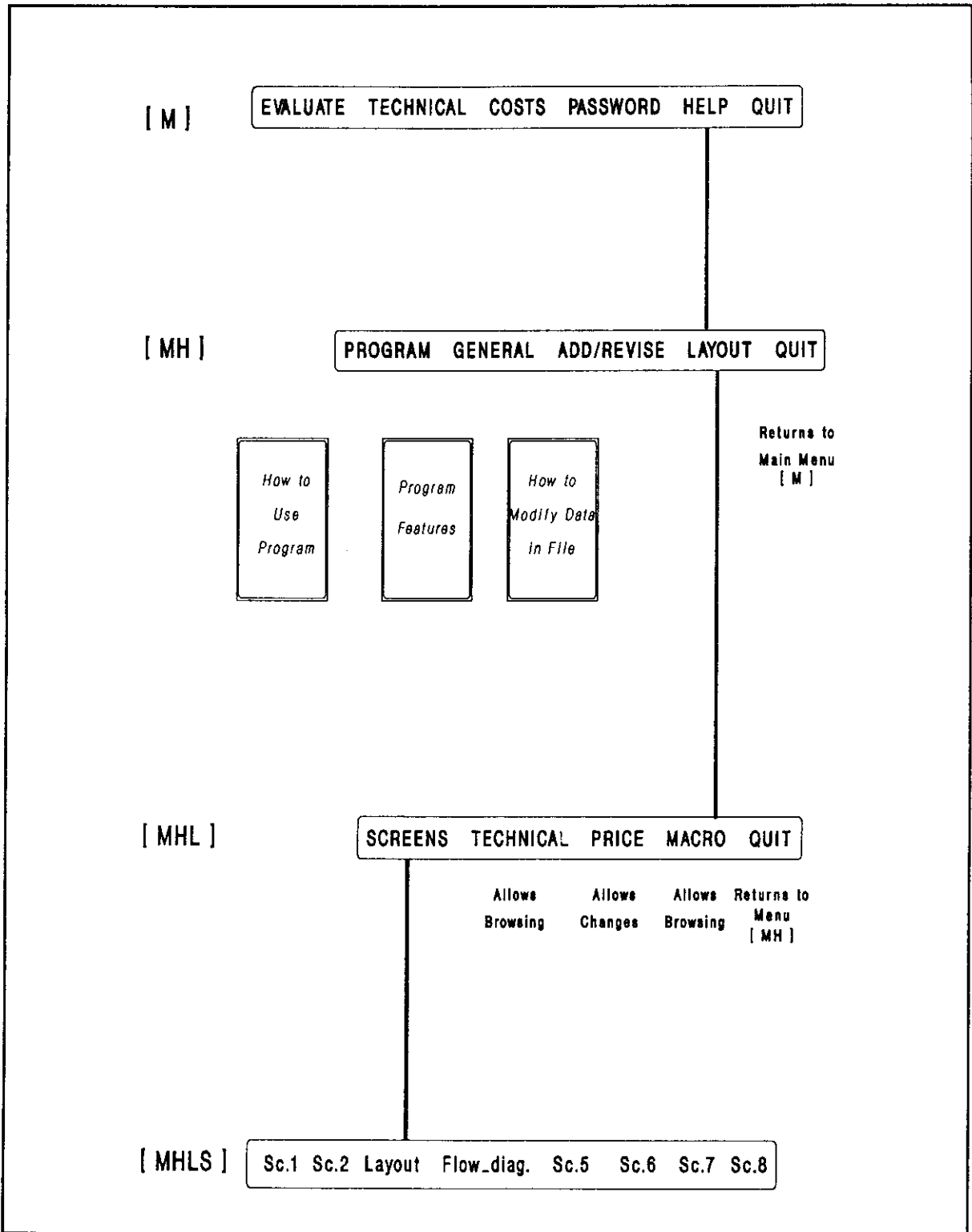


Figure A.3. The Help Menu.

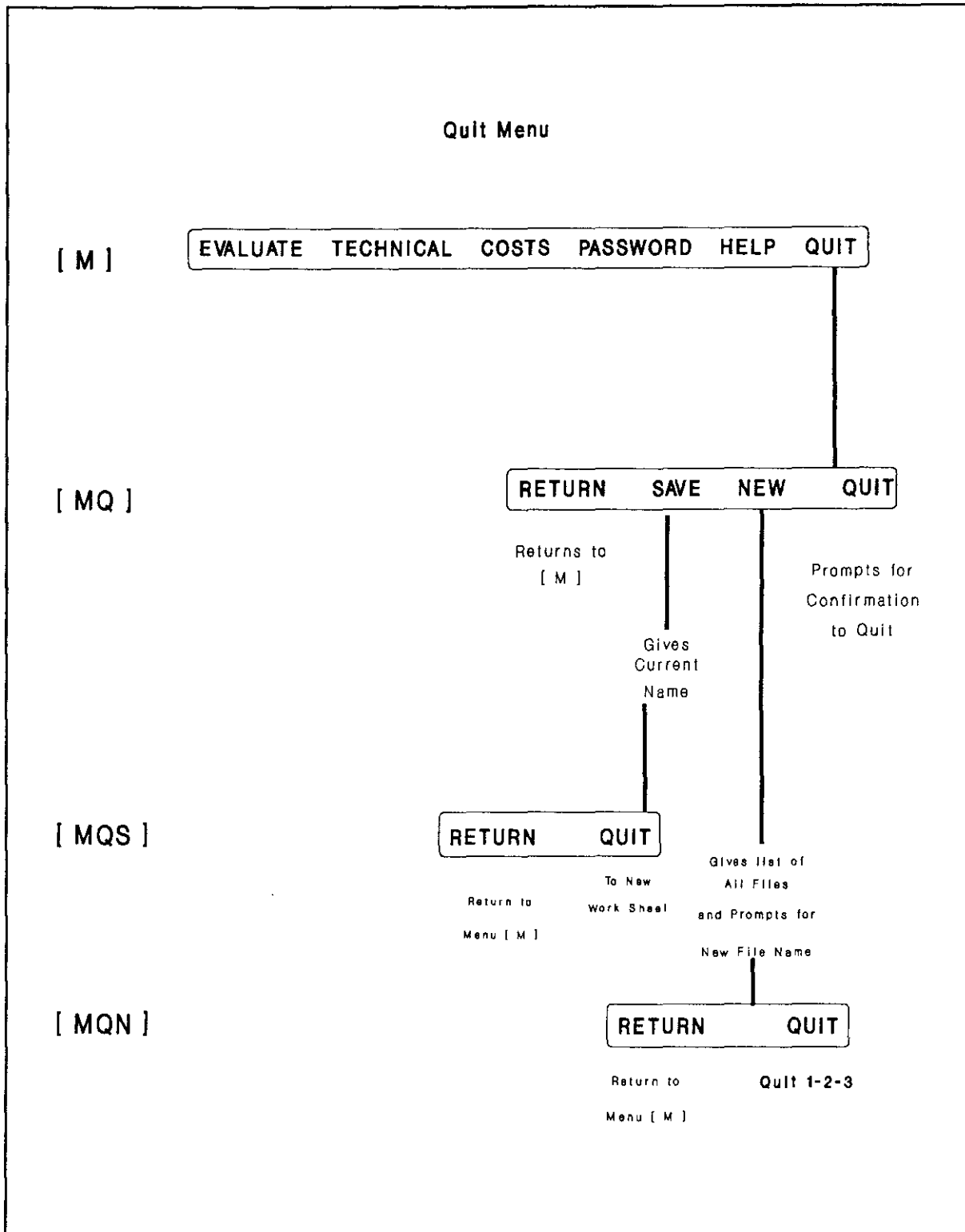


Figure A.4. The Quit Menu.