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**A PROJECT MANAGEMENT AND
TIME SCHEDULING PROGRAM**

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ORGANIC SOFTWARE**

**P.O. BOX 2069
Livermore, CA 94550**

**User's Manual
Revision 1C
February 1981**

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NOTICE

Camera ready copy for this manual was prepared using TEXTWRITER by Organic Software, a word processing program for 8080 and Z80 based computer systems. TEXTWRITER is ideal for long documents such as this manual because it automatically generates a Table of Contents and alphabetized index. It also controls micro-spaced letter-quality printers such as Diablo, NEC, and Qume.

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Special Edition Newsletter
ASTORIA A-ONE REPORT
SUBJECT: THE A-ONE CASE
This report will describe
the history of the case
from its beginning to
the present. It will
also discuss the
various aspects of
the case and the
role of the
various parties
involved.

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OVERVIEW

You may remember the terms "critical path" and "PERT/CPM" from your days as a student. Well, those terms are no longer restricted to the realm of the space program and large defense projects. Now you can use "critical path network analysis" on your projects. All you need is a desktop microcomputer and MILESTONE.

With today's concerns about increasing costs and declining productivity it is true more than ever that any project worth doing deserves careful planning. Whether you're planning a construction project or the opening of a new retail store, you must carefully schedule your manpower, dollars and time in order to maximize productivity.

This is a chance to increase your productivity by using the latest developments in computer technology. In the past, PERT/CPM programs cost thousands of dollars and ran only on large expensive computers. Now MILESTONE costs only a few hundred dollars and runs on inexpensive microcomputers.

What is a Critical Path?

Critical-path-network-analysis is a technique originally devised in the late '50s to aid in the planning and development of the Polaris weapon system. The basic technique is to divide a complex project into a series of smaller and more easily understood tasks and then to analyze their timing to see which ones are critical to the overall completion of the project - Critical in the sense that any delay in a job on the critical path results in a delay of the entire project.

Until MILESTONE was made available, there were basically two competing methods of critical path analysis, PERT and CPM.

The acronym PERT stands for Performance Evaluation and Review Technique. It treats a project as a series of events occurring in a time sequence and is considered to be a good tool for reporting the progress of a project.

CPM stands for Critical Path Method (not to be confused with the microcomputer operating system known as CP/M for Control Program/Monitor). In contrast to PERT, CPM treats a project as a series of activities and is generally considered to be useful for planning a project.

Implementations of PERT and CPM have been expensive and cumbersome to use. They typically are very expensive (in the thousands of dollars), require a large mainframe or mini-computer, and operate in a non-interactive batch mode.

What's So Special About MILESTONE?

MILESTONE combines the best features of other critical path techniques into a package that is inexpensive, runs on a desktop computer, and is simple enough for anyone to use. It is designed to expand the application of critical path analysis to areas where, because computers were so expensive, it would never before have been considered. It is not designed to replace some of the more

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sophisticated PERT and CPM implementations with features such as resource leveling and schedule optimization.

MILESTONE's design is a product of many years of experience in the "real world" of small-project management. In such an environment the primary purpose of planning is to help the project leader clarify the task at hand and to help him communicate his ideas to his subordinates and superiors. For these two reasons the designers of MILESTONE stressed its interactivity and comprehensive reporting.

Most of the design effort was put into eliminating unnecessary or redundant operator input and checking all entries for validity. By organizing the project data for you, you can interactively modify your project plan leaving MILESTONE to perform the tedious calculations and to display the results.

Internally, MILESTONE treats your project as a series of activities. Each activity has a name, duration, capital cost, mix of manpower, and an associated list of other activities that must be completed first. The list of associated activities provides a thread that MILESTONE uses to link all jobs together into an overall project schedule. Every time you add a new activity or make a change to an existing one, the entire schedule is recomputed and the results are immediately redisplayed on the screen.

You have to run MILESTONE to appreciate its speed of response. Because interactivity was a major design goal, all project data is kept in memory to allow rapid computation of the project schedule. As you might expect, having all data in memory limits the total number of activities that can be handled. Even so, with MILESTONE it is possible to plan a project with up to three hundred activities on a 64K byte microcomputer. If your application requires more than three hundred activities, you're probably better off to spend \$80,000 and buy a large mini-computer.

How Can I Use It?

For our purposes a project is simply any task made up of steps that must be performed in sequence. After dividing a project into its composite steps, MILESTONE can help you plan, schedule, and control the project.

Specifically here are some of the things you can do,

- o Find out which activities are time critical and can't be delayed
- o Discover which activities have slack time and can be delayed if necessary without delaying the entire project
- o Prepare a detailed cost estimate based upon a summation of each activity's individual equipment and manpower expenses
- o Change an activity and instantly see the impact on the overall project schedule
- o Investigate the tradeoffs between manpower, dollars, and time.

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- o Keep track of your project's progress by periodically updating the schedule to reflect changes in the plan and completed activities
- o Communicate your plan to your subordinates by giving them a clear picture of what is expected of them, and when
- o Use MILESTONE's printed reports to help convince your superiors that your plan is sound

By defeating its critical path option, it can also be used as a sophisticated planning calendar to

- o Create an activity calendar to keep track of your vacation time, business trips, conferences, and special meetings
- o Plan your organization's projected workload for the coming year
- o Allocate the rental or other use of equipment or resources

OVERVIEW

MILESTONE Requirements

If you are not sure whether MILESTONE will run on your computer system, then the following information may help you. If your computer is not listed here, please contact your computer dealer or Organic Software.

COMPUTER - A Z80, 8080, or 8085 running Digital Research's CP/M
An 8086 running Digital Research's CP/M 86
A Z80 running Cromemco's CDOS operating system
An APPLE][computer with a language card and APPLE PASCAL
An APPLE][computer with a language card and Z80 soft card
A TRS-80 Model II running Digital Research's CP/M
Any computer running UCSD PASCAL by SofTech Microsystems

TERMINAL - Any 24 line by 80 column CRT terminal or video display that has a home-and-clear function and absolute-cursor-positioning

MEMORY - 48K or more bytes of RAM, 56K are recommended

DISK DRIVES - One or more drives

MILESTONE Specifications

To save you the trouble of wading through this long manual in search of a few key numbers, the most important ones are listed here.

Speed - Virtually instantaneous

Capacity - Although the actual number of activities is strongly dependent on the operating system overhead (some computers may only have room for 50 fewer activities than shown here), approximate values are:

50 activities in 48K RAM
150 activities in 56K RAM
250 activities in 64K RAM

Skills - Nine manpower categories with different costs per time-unit

Time Units - Can be measured in hours, days, weeks, months, quarters, or fiscal quarters. You can define your normal working hours, working days, and holidays

Duration - Up to 32767 time units

Reports - Three reports including a large time schedule chart made by aligning strips from the printer

It is only fair to list a couple of limitations. MILESTONE does not do resource leveling and schedule optimization. It is our belief that these two features are not necessary for the vast majority of all projects. If you disagree or can suggest other features that are desirable, please let us know in writing.

EXAMPLES

Several examples are included on your diskette. The first one serves as the basis for the screen displays that appear throughout this manual.

A Construction Project

This first example is a simple construction project that exhibits most of the characteristics of a project management plan. The project is to install a new water main in a small town.

Assume for a moment that your name is J. K. Henderson and you are the city engineer in charge of the installing a new water main. Before the project can begin you must come up with a plan and a cost estimate - a perfect job for MILESTONE.

Before you run MILESTONE you think about the project and divide it into several steps.

- o Purchase the pipe - Although this doesn't require any manpower, it will take two weeks for the pipe to be delivered and cost \$50,000.
- o Dig the trench - Since this will take one operating engineer and three laborers four weeks, the digging should be started immediately.
- o Lay the pipe - As soon as the pipe is delivered and the trench is half dug, pipe laying can begin. Two welders and four laborers will take four weeks to complete this job.
- o Test for leaks - Two civil engineers working for one week can test the pipe for leaks after it is completely laid.
- o Fill the trench - As the final step, two operating engineers and two laborers will take two weeks to fill the trench.

There are two types of costs in this project, direct outlays for material and indirect manpower costs. Manpower is expected to cost \$1000 per man-week for an operating engineer, \$500 per man-week for a laborer, \$750 per man-week for a welder, and \$1500 per man-week for a civil engineer,.

The next step in planning is to list all jobs in order, so that each job depends only on other jobs already ahead of it in the list.

JOB	NAME	DURATION	MANPOWER LEVEL	DIRECT COST	PREREQUISITE JOBS
1	Purchase pipe	2	0	50000\$	none
2	Dig first part of trench	3	4		none
3	Dig last part of trench	1	4		2
4	Lay first part of pipe	3	6		1&2
5	Lay last part of pipe	1	6		3&4
6	Test for leaks	1	2		5
7	Fill trench	2	4		6

EXAMPLES

Other Examples

There are at least six examples included on your diskette to help you see how to use MILESTONE. The first one was discussed in detail above, the others are listed in the table below. You can experiment with them by using the "L(oad)" option to bring them into memory.

example1 - **First Street Water Main:** A simple construction project making use of capital and manpower costs.

example2 - **Milestone Development:** Development of a software package

example3 - **Bill's Photo Studio:** A small businessman's plan for opening a retail store

example4 - **New Product Introduction:** The classic problem of timing the marketing of an electronic device with its development

example5 - **Federal Pre-sentence Investigation:** A federal probation officer outlines the steps in conducting an investigation

example6 - **Recreational Vehicle Rental:** By disabling the "F(ind critical path option)" MILESTONE becomes a tool for scheduling the use of a piece of equipment.

If you have an interesting application, please describe it in writing and send it along with a diskette to Organic Software. We will pay cash for items used in our promotional material.

GETTING STARTED

On a CP/M System

STEP 1 - First, make a copy of the MILESTONE diskette and put the original in a safe place. **NEVER USE THE ORIGINAL DISKETTE!** Then load the copy into your second disk drive, log-onto drive B, and list the directory.

```
A>b:
B>dir
B:PRUNZ  COM : PRUNZ20  COM : PRUN8    COM : PRUN820  COM
B:PRUNC  COM : PASLIB  PCO : CONFIG  PCO : ORGANIC  DAT
B:LEARNHOW PCO : MILESTON PCO : EXAMPLE1 DES : EXAMPLE1 JOB
B:EXAMPLE2 DES : EXAMPLE2 JOB : EXAMPLE3 DES : EXAMPLE3 JOB
B:EXAMPLE4 DES : EXAMPLE4 JOB : EXAMPLE5 DES : EXAMPLE5 JOB
B:EXAMPLE6 DES : EXAMPLE6 JOB
```

There are five different files with names like 'prun.com' that are different versions of SORCIM's PASCAL/M interpreter. You may have any one or two of these depending on the type of computer system you specified on your order. The file named 'paslib.pco' is the run-time library. Together these files comprise the PASCAL/M 'run-time package'. Although MILESTONE was written in PASCAL and compiled with PASCAL/M, you still need the run-time package to run MILESTONE.

Organic Software has entered into an agreement with SORCIM to allow the distribution of the PASCAL/M interpreter and run-time library along with each copy of MILESTONE. If you like MILESTONE and would like to write similar programs of your own, we suggest that you purchase a complete SORCIM PASCAL/M package that includes the PASCAL compiler.

In order to make the most efficient use of your computer and CP/M operating system, you must use the proper run-time package. It is the random-access disk file capability of PASCAL/M that necessitates the need for different versions of 'prun.com'. The table below lists the names of each prun and explains the systems on which they run.

File name	System
prunz.com	Z-80 and CP/M version 1.4
prunz20.com	Z-80 and CP/M version 2.0, 2.1, 2.2, etc.
prunc.com	Cromemco CDOS (a variant of CP/M 1.4)
prun8.com	8080 and 8085 computers using CP/M 1.4
prun820.com	8080 and 8085 computers using CP/M 2.0, 2.1, 2.2, etc.

The file named 'prun80.com' should be used only if you have an 8080 or 8085. If you have a Z80, you should use one of the other files, since they run noticeably faster and require less RAM memory.

GETTING STARTED

STEP 2 - Rename one of the files "prun.com"

B>ren prun.com=prunz20.com	If you have a Z80 with CP/M 2.x
B>ren prun.com=prunz.com	If you have a Z80 with CP/M 1.4
B>ren prun.com=prun820.com	If you have an 8080 with CP/M 2.x
B>ren prun.com=prun8.com	If you have an 8080 with CP/M 2.x
B>ren prun.com=prunc.com	If you have a Z80 with CDOS

STEP 3 - Configure the terminal, printer, and data disk by running the program named "CONFIG" (See the chapter titled "Configuring Your Terminal and Printer").

B>prun config

STEP 4 - While running "CONFIG" you will see three different screens and menus. Pick the proper terminal, set your printer width in columns, and make sure the data drive is set to "B".

STEP 5 - Run LEARNHOW and practice entering different types of data.

B>prun learnhow

STEP 6 - Run MILESTONE.

B>prun mileston

STEP 7 - When you see the STARTUP menu, make the following entries,

press T, enter the date, and press TAB
enter your name and press RETURN
press RETURN again

STEP 8 - Now the MAIN OPTIONS should be displayed on the screen. To begin the demo, press L to load a project into memory.

STEP 9 - To load the first example into memory, press F to select the file name and then enter "example1" and press RETURN twice.

STEP 10 - When the file is found, type Y to verify your choice and then you're off and running.

On a UCSD or APPLE PASCAL System

STEP 1 - First, make a copy of the MILESTONE diskette and put the original in a safe place. NEVER USE THE ORIGINAL DISKETTE! Then load the copy into your second disk drive.

STEP 2 - Load a system disk in the first drive and boot your system (NOTE: The system disk must contain the file named "SYSTEM.LIBRARY"). Execute the FILER, set the prefix to the second drive, and list the directory.

```
Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(ssem, D(ebug? F
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate, Q(uit? P
Prefix titles by what vol? #5
Prefix is MSTONE:
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate, Q(uit? L
Dir listing of what vol? :
CONFIG.CODE      43      27-DEC-80
ORGANIC.CODE     13      27-DEC-80
MILESTONE.CODE   106     27-DEC-80
EXAMPLE1.DES     1       27-DEC-80
EXAMPLE1.JOB     2       27-DEC-80
EXAMPLE2.DES     1       27-DEC-80
EXAMPLE2.JOB     3       27-DEC-80
EXAMPLE3.DES     1       27-DEC-80
EXAMPLE3.JOB     5       27-DEC-80
EXAMPLE4.DES     1       27-DEC-80
EXAMPLE4.JOB     3       27-DEC-80
EXAMPLE5.DES     1       27-DEC-80
EXAMPLE5.JOB     3       27-DEC-80
EXAMPLE6.DES     1       27-DEC-80
EXAMPLE6.JOB     2       27-DEC-80
```

STEP 3 - Quit the FILER and then configure the terminal, printer, and data disk by running the program named "CONFIG" (See the chapter titled "Configuring Your Terminal and Printer").

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate, Q(uit? P
Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(ssem, D(ebug? X
Execute what file? config
```

STEP 4 - While running "CONFIG" you will see three different screens and menus. Pick the proper terminal, set your printer width in columns, and make sure the data drive is set to "#5".

STEP 5 - Run LEARNHOW and experiment with entering data.

GETTING STARTED

```
Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(ssem, D(ebug? X
Execute what file? learnhow
```

STEP 6 - Run MILESTONE.

```
Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(ssem, D(ebug? X
Execute what file? milestone
```

STEP 7 - When you see the STARTUP menu, make the following entries,

press T, enter the date, and press TAB
enter your name and press RETURN
press RETURN again

STEP 8 - Now the MAIN OPTIONS should be displayed on the screen. To begin the demo, press L to load a project into memory.

STEP 9 - To load the first example into memory, press F to select the file name and then enter "example1" and press RETURN twice.

STEP 10 - When the file is found, type Y to verify your choice and then you're off and running.

CONFIGURING YOUR TERMINAL & PRINTER

Before you run any Organic Software program, you must first run the program named CONFIG. It creates a special data file named "terminal.dat" that contains all information needed to control your particular terminal and printer.

If, at a later date, you have changed your terminal or printer, you can then rerun CONFIG to change the data file.

Whenever you run an Organic Software program, you must be sure that the file named "terminal.dat" is present on the currently logged disk drive.

Terminal Selection

After running CONFIG, the first screen you see is the terminal selection menu.

CONFIGURE, Revision 1.01

Copyright (c) 1980 by Organic Software, Serial Number 000001

This program is now configured for a

It can be changed to one of the following terminals,

A(ANSI Standard terminal	M(Heath HL9 & H89	Y(Tektronix 4025
B(ADDS Regent 20 & 25	N(HP 2641A & 2645A	Z(Televideo 912 & 920
C(ADDS Regent 40 & 60	O(HP 2621	0(TI 911 VDT
D(Apple II M&R Superterm	P(Intertec Superbrain	1(TRS-80 MOD II FMG
E(Apple II Smarterm	Q(Lear Seigler ADM 3A	2(TRS-80 MOD II LBA
F(Apple II Videx Video	R(Lear Seigler ADM 42	3(TRS-80 MOD II P&T
G(Beehive Micro B 2	S(MicroTerm ACT IV & V	4(Vector MZ Video
H(Data Media Elite 1520	T(Perkin Elmer 550	5(VIO-C Video Driver
I(DEC VT-52	U(Perkin Elmer 1100	6(Zenith WH19
J(DEC VT-100 ANSI Mode	V(Perkin Elmer 1200	7(Zentec Zephyr
K(Hazeltine 1410	W(Soroc IQ 120 & 140	8(
L(Hazeltine 1500 & 1510	X(SSM VB3 ICRT Driver	9(Terminal Not Shown

To change the terminal, press the corresponding letter

To quit, press ESC; to leave as shown, press RETURN

The screen lists some of the most popular terminals used with small computers. If yours is listed, then press its letter. If it is not listed, then press "9" and follow the instructions in Appendix B.

CONFIGURING YOUR TERMINAL & PRINTER

Printer Selection

The printout options govern how output reports are to be printed. Some of them depend upon the physical characteristics of your printer, others depend upon how you want reports to be formatted.

PRINTOUT OPTIONS

```
D(evice name=printer:
W(idth in columns=80
H(eight in lines=66
  T(op margin=3
  B(ottom margin=3
  L(eft margin=1
  R(ight margin=80
  U(se form-feeds=Yes
P(ause at page end=No
```

To change a variable, press its letter, "D" "W" "H" etc.

To quit with no changes, press ESC

To leave as shown, press RETURN

D(evice name

Normally you will direct the printout to your printer (it's called "printer:", not "lst:" on CP/M systems), however, by changing the device name you can redirect the output to a disk file or any other device. Although legal device names on CP/M systems are limited to "printer:", "punch:" and "null:", you can could direct the output to a different device by using the STAT command.

If the output is to a disk file, then you can insert it directly into a report using a text formatting program such as **TEXTWRITER** by Organic Software.

W(idth in columns

You can use a printer of any width. Most printers print a ten characters per inch on paper either eighty or one hundred thirty-two columns wide. Others can print at twelve or sixteen and a half characters per inch. Although most reports use only eighty columns, some can use up to 255 (For example, the MILESTONE time schedule report.

After running MILESTONE for a while, you may wish to rerun this program and

CONFIGURING YOUR TERMINAL & PRINTER

change the printer width. For example, some printers automatically to a linefeed whenever an 80 column line is printed, causing the output to be double spaced. If this is true for you, then change the printer width to 75 columns.

H(eight in lines

The most common page height is sixty-six lines, corresponding to six lines per inch and a paper length of eleven inches. However, some printers can print at eight or more lines per inch producing eighty-eight or more lines per page.

You must specify the page height so that the program can keep track of where it is on the page. If you are using fan-fold paper and a printer that responds to form-feeds, then this number may be less than the actual number of lines per page. If your printer does not do form-feeds, then this number must be exactly equal to the actual number of lines per page.

T(op margin

Any number of lines may be skipped at the top of each page. Normally this should be set at three to leave one-half inch at the top of the page, however, you may make it any value you wish.

B(ottom margin

Any number of lines may also be skipped at the bottom of each page. Normally this should be set at three to leave one-half inch at the bottom of the page, however, you may make it any value you wish.

L(eft and R(ight margin

You can also specify the position of the left margin and right margins for some reports and printouts. The margin value along with the three previous values mentioned above gives you complete control over the position of the printing on your printer paper. (NOTE: All MILESTONE reports ignore these values.)

U(se form-feeds

Set this value to "YES" if your printer is capable of responding to an ASCII form-feed character. It causes the paper to be advanced as fast as possible to the beginning of the next sheet. (NOTE: It will have an effect only if the bottom margin is non zero.)

P(ause at page end

If you intend to use single sheets of paper in your printer, then you must have this option set to "YES", so that the program will stop at the end of each page ready for you to insert another single sheet.

There are two ways to load single sheets into your printer: so that the print element is ready to print on the very first line of the sheet, or rolled up one inch (and held against the platten by the pressure bail) so that the element is ready to print on the seventh line of the sheet. If you intend to roll the paper up one inch, then you must change the top margin to 0 and the paper length to 60 lines.

CONFIGURING YOUR TERMINAL & PRINTER

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Disk Drive Selection

DISK DRIVE OPTIONS

D(ata drive name=A

To change a variable or select an option, press its letter
To quit with no changes, press ESC
To leave as shown, press RETURN

D(ata drive name

This is the name of the disk drive normally holding data files. It is used as a default only and can be overridden at any time. If you have a dual disk system, you should probably keep programs on the first drive and data on the second.

LEARNING HOW TO ENTER DATA

To help you learn how to run programs provided by Organic Software, we have created a special program called "LEARNHOW". It may be a little different from what you have learned running other computer programs, but we think you will find it to be much better.

To get started, first run CONFIG, then run LEARNHOW.

```
LEARNHOW, Revision 1.02
Copyright (c) 1980 by Organic Software
Learn how to enter data and to select options
```

DATA FIELDS:

```
I(nteger variable=101
S(tring variable=Hello
  C(lock time=12:00
D(ay of the year=1/1/80
```

OPTIONS:

```
A(dd one day to the date shown above
Q(uit this program
```

To change a variable or select an option, press it letter

All programs created by Organic Software use screen displays in the same general format. At the top left-hand corner is the title of the display. (Display titles are always listed in the manual index for quick reference.)

Next is a list of data fields. You can tell they are data fields because they are denoted by a noun-phrase followed by an equals-sign and a value. (The value is highlighted, if possible on your terminal.) To change a data-field, press the corresponding letter (It's capitalized and followed by a left parenthesis).

After the data fields is a list of options usually denoted by verb phrases. In the example above, "A(dd one day" means to increment the date shown in the data field. Whenever you press an option letter, the option is performed immediately - you need not press RETURN.

At the very bottom of the screen, you will usually find a prompt message. It is typically a series of sentences listing likely actions you will want to make followed by a reminder on how to proceed. Sometimes when you change a data

field, this prompt message will change and give you specific instructions about the data-field you selected.

When the program you are running displays a special screen of data, then the data-fields and options are packed into a few lines at the bottom of the screen, to save space. You still should be able to recognize your choices by looking for capital letters followed by left parenthesis.

Special Keys

Although the American National Standards Institute (ANSI) has published a standard for computer terminals, very few manufacturers follow it. As a result, most computer keyboards are slightly different.

Below are listed several actions you will wish to perform along with the keys you will need to press. Each action has several possible keys; use the one that you can find on your keyboard.

To backup the cursor one position,

BACKSPACE, DELETE, DEL, RUBOUT, RUB, or CTRL-H (ASCII BS or DEL)
Don't try to use the back-arrow key, unless you are sure that it generates an ASCII BS.

To quit entering data and ignore changes that have been made,

ESCAPE or ESC (ASCII ESC)

To quit entering data and leave all values as shown on the screen,

RETURN or ENTER (ASCII CR)

To skip forward to the next data field,

TAB or CTRL-I (ASCII HT)

To skip backward to the previous data field,

BACKSPACE, DELETE, DEL, RUBOUT, RUB, or CTRL-H (ASCII BS or DEL)
Skip back only works from the first position in a data field.

General Rules

RULE #1 - Always read the prompt message at the bottom of the screen for special instructions.

RULE #2 - You don't need to press RETURN (or ENTER on some computers) when selecting a data field or option, because the key is accepted as soon as you press it.

RULE #3 - To quit and return to the previous menu, or end the program, press "Q".

LEARNING HOW TO ENTER DATA

RULE #4 - Once you have selected a data field, you may press ESC if you have changed your mind. Regardless of what data you may have entered, it will be ignored and the data-field will be restored to its previous value.

RULE #5 - After you have entered a new data field, you may press:

RETURN if the data is correct and you want to stop entering data.

TAB (or CTRL-I on some keyboards) to skip to the next data field (The order is from left to right across the screen and then top to bottom).

BACKSPACE to backup one character position. If the cursor is at the very beginning of a data field, it will skip to the beginning of the previous data field. If your terminal does not have a BACKSPACE key, then try RUBOUT, DELETE, or CTRL-H (i.e. hold down the key labeled CTRL and simultaneously press H). One of these combinations will backup the cursor.

ESC to erase the data you have entered and quit data entry.

RULE #6 - If you type an illegal character, it will be ignored and you will hear a bell ring. You may also see an error message displayed at the bottom of the screen.

RULE #7 - To terminate data entry, you must press RETURN, TAB, or ESC; otherwise, a bell will ring.

Entering Integers

Integers are the easiest data values to enter because it is virtually impossible to make a mistake. Only legal digits are accepted; all other key presses are ignored.

To change the integer variable to a value of 99, for example, press the letter "I". The cursor will jump up to the first position of the integer variable.

```
I(nteger variable=101
```

Next, press the "9" on your keyboard.

```
I(nteger variable=9...
```

The number 9 is then displayed followed by three dots indicating that at most three more digits can be entered. The number of allowable digits is controlled by the program depending upon the range of integers that are allowed for the particular variable. This is a form of error checking that prevents you from

entering a number that is too big for the program to handle.

Since you want the new value to be 99, you should press "9" again.

```
I(nteger variable=99_.
```

Now that the integer appears that way you want it, you can press RETURN.

Try entering some other integers. If you get confused, then read the general rules listed earlier in this chapter.

Entering Strings of Characters

Names or other words are usually input as strings of characters.

To change a string variable, press the first letter of its name and the cursor will jump up to the first character position.

```
S(tring variable=Hello
```

For example, lets change "Hello" to "Hi". First press the letter "H".

```
S(tring variable=H_.....
```

The first letter is immediately displayed followed by a series of dots indicating the maximum allowable length of the string. When you have finished entering the string, press TAB or RETURN depending on the message displayed at the bottom of the screen.

Here is an example of how you would change the name John Smith to Jane Doe.

```
S(tring variable=John Smith      (the data field showing the initial name)
S(tring variable=J.....         (after you have pressed "J")
S(tring variable=Jane Doe.....   (after you have completed the name)
S(tring variable=Jane Doe        (after you have pressed RETURN)
```

If you make a mistake, you can backup as describe in RULE #5 above.

LEARNING HOW TO ENTER DATA

Entering Dates

Dates are always entered in the format "mm/dd/yy" where "mm" stands for the month number, "dd" stands for the day number, and "yy" stands for the year.

When you are asked to enter a date, it is shown with some default value. You press a series of keys to change the date to the one you want. Once it is displayed the way you want it, you press either TAB or RETURN depending on the instruction at the bottom of the screen.

If the cursor is positioned at the month field and the month already has the value you want, then press "/" to skip over to the day field. Likewise, pressing "/" again will skip to the year field.

Each key you press is checked for validity and ignored if it would produce an impossible date. For example, trying to enter the 29th of February in a non-leap year causes the bell to ring. In a very rare circumstance it may be necessary to first change the year and then backup to the date.

To illustrate date entry, assume that the date were initially set to the first of June 1980. The following key sequences could change it to other dates.

New date	Key sequence
May 15, 1981	"5/15/81"
July 1, 1980	"7/1/80" or just "7"
June 2, 1980	"/2"
July 4, 1980	"7/4"
June 1, 1981	"//81"

Table 1: Key sequence require to change "D(ate=6/1/80" to a new date.

There is also a quick way to compute a new date. Say for example, you want to change the date shown to a new date forty-five days later - just type in "+45d" and the new date is computed and displayed. Here's what you would see,

```
D(ay of the year=1/1/80
D(ay of the year=+45d
D(ay of the year=2/15/80
```

You can go forward or back in time by entering either "+" or "-", followed by up to three digits, and then "d" for days, "w" for weeks, "m" for months, and "y" for years.

For example,

+60d	adds sixty days
-180d	subtracts one hundred eighty days
+3w	adds three weeks
-2w	subtracts two weeks
+6m	adds six months
-1y	subtracts one year

Entering Times

Times are always entered in the format "hh:mm" where "hh" stands for the hour and "mm" stands for the minutes. As with entering dates you need only press the keys required to change the displayed time to the time that you want.

For example, if a time were initially set to noon, the following key sequences could change it to other times.

New time	Key sequence
3:45	"3:45"
1:00	"1"
0:30	":30" or ":3"
12:30	"12:3"

Table 2: Key sequence require to change "T(ime=12:00" to a new time.

OPERATION

Running MILESTONE on CP/M

To run MILESTONE on a CP/M system, first boot CP/M, log-on to the disk drive with MILESTONE.PCO and TERMINAL.DAT, type the following line, and then press RETURN.

```
A>prun mileston
```

Don't forget to leave the "e" off of the end of the word "milestone" - CP/M file names are limited to eight characters.

Running MILESTONE on UCSD or APPLE PASCAL

Boot your system, run the FILER to set the prefix to the drive containing MILESTONE.CODE and TERMINAL.DAT, and then press "X" for X(ecute).

```
Execute what file?milestone
```

MENUS AND DISPLAYS

This chapter describes each screen display and option menu in detail. The information in each display is from the first example project discussed in the Overview chapter.

Startup Menu

When MILESTONE is started, the terminal screen is cleared and the startup menu is displayed. It gives you the chance to enter new values for two data fields, the date and your name.

At the top of the Startup Display is the title of the program, the revision number, a copyright notice, and a serial number. To receive verbal or written help from your software distributor or from Organic Software, you must always state your serial number and revision level so that we can check it against our file of signed Registration Cards.

As clearly stated in the Purchaser-Licensee Agreement in the beginning of this manual, use of this program is restricted to one computer system. To guard against copyright infringement each copy of the program is serialized and registered to the purchaser. If the copyright notice and serial number are altered in any way, the program will cease to function.

```
MILESTONE, Revision 1.01, Room for 150 jobs in memory  
Copyright (c) 1980 by Organic Software, Serial Number 000001
```

STARTUP DATA:

```
T(oday's date=1/1/80  
Y(our name=
```

```
To change "T(oday's date", press "T"  
To change "Y(our name" press "Y"  
To quit MILESTONE, press "Q"; to continue, press RETURN
```

If the data is correct as shown, then press "RETURN" and MILESTONE will

MENUS AND DISPLAYS

continue. If you have changed your mind and want to quit, press "Q". But, if you want to change either of the two data fields, follow the instructions below.

T(oday's date

When MILESTONE is first started, it reads the file named "mileston.wrk" to find the date when the it was last run. If the date is no longer correct, press the letter "T" and enter a new date (rules for entering dates are listed the chapter titled "Learning How To Enter Data").

Y(our name

The second item of startup data is your name. Eventhough you are preparing this project plan, you may not be the project leader. If this is true, you should enter your name here so that it will appear on all printed reports, giving y proper credit for your work.

Main Option Menu After Startup

After the startup data has been entered, the MAIN OPTIONS are displayed. They are called the "Main Options" because they are the first options displayed and because all other options return to them upon completion.

MILESTONE MAIN OPTIONS

There is no project in memory at this time

C(reate a new project

L(oad a different project into memory

Q(uit MILESTONE and return to the operating system

To begin work, press "C" or "L" to create or load a project

To end MILESTONE, press "Q"

Look on the third line of the display and you can see a message indicating that there is no project in memory. Before you can do anything else, you must first either create a new project or load one in from disk.

C(reate a new project

Select this option if you want to start from scratch and completely describe a new project. All of the project data is initialized to a standard set of default values, and then the project description is displayed, ready for changes.

L(oad a different project into memory

As mentioned earlier, all project data is stored in two associated disk files. The "L(oad" option reads these disk files into memory so that you can display your project on the screen, make changes to it, or print one or more reports on the printer.

MENUS AND DISPLAYS

Main Option Menu After Loading

After a project has been loaded into memory, the MAIN OPTIONS look different. First, you will notice that the name of the project is listed on the third line of the display. You will also notice that there are six other options available.

MILESTONE MAIN OPTIONS

The current project in memory is "First Street Water Main"

C(reate a new project

L(oad a different project into memory

A(Alter or display the current project's description

E(edit or display the current project's skill categories

D(efine or display the current project's working days, hours & holidays

M(odify or display the current project's schedule

P(rint one of the project summary reports

S(ave the current project on disk

Q(uit MILESTONE and return to the operating system

To select a different project, press either "C" or "L"

To make changes to the current project, press either "A", "E", "D", or "M"

To print a project summary report, press "P"

To end MILESTONE, first save your work with "S" and then press "Q"

C(reate new project

Select this option if you are finished working on the project in memory and wish to start from scratch with another. After first checking to make sure you have saved your work, all of the project data in memory is erased and re-initialized to a standard set of default values. Then the project description is displayed, ready for changes. This is the same as selecting the "A(Alter description" option, except that all project data is initialized first.

Don't worry, if a project has been loaded and changed, you will be warned before the data is erased.

L(oad a different project into memory

First a reminder about disk files. As mentioned earlier, all project data is stored in two associated disk files. The "L(oad" option reads these two files into memory so that you can work with them.

By providing the load option and the save option, you are given explicit control

over your project files. However, along with this control comes the responsibility to manage the files intelligently. Although MILESTONE always gives you fair warning before erasing any information, it is up to you to save your own work and to periodically make backup copies of your important project files.

A(fter the description

The description is a collection of data about the project including its name, the name of the project leader, the start date, etc. To learn more about it, read the section titled "Project Description".

E(dit the skill categories

If you want to keep track of manpower for you project, then you should make use of the skill categories. They are up to nine different manpower classifications and their corresponding rates of pay. To learn more about them, read the section titled "Skill Categories".

D(efine the working hours, days, and holidays

If your project uses a time scale of HOURS or DAYS then you should make use of this option. It gives you the opportunity to define your normal working hours, working days, and holidays. To learn more about them, read the section titled "Project Description".

M(odify the project schedule

This is probably the most frequently selected option because you must use it every time you wish to change any of the many jobs that make up a project. When it is selected, it causes the "Project Schedule" display to appear on the screen. You may then modify any of the jobs and see the resulting effect on the schedule. (See the section titled "Job Description" for a complete explanation of all job data.)

P(rint summary reports

Choose this option whenever you want to make a printout of the project schedule or any other project report on your printer. The printout is a permanent record of your work that you can hang on your office wall, show to others, or include in your project documentation.

If you want the printout to go to a disk file for direct inclusion into a report using your word processing program, rerun the program named "CONFIG" and set the printer device to a file name, rather than "printer:".

See a complete discussion of the "P(rintout reports" later in this manual.

S(ave the project on disk

As mentioned above, all project data is stored in two associated disk files. The "S(ave" option writes from memory into the disk file so that you can save your work.

MENUS AND DISPLAYS

Be careful! The old project files are destroyed in the process of saving the new ones.

Q(uit MILESTONE

To end a MILESTONE session, press the letter "Q". If you have not saved your work, you will be warned.

Create a New Project

There are four parts to the project information, the project description, the skill categories, the working hours, and the job descriptions. The first three are data items that apply to the entire project, whereas, the job descriptions are details that describe each step.

Since the four sets of data are distinct, you are given access to them through different options.

The project description is made up of six data fields, normally the first data that you enter when creating a new project. The most important one is the "Time scale" and you should consider it carefully.

CREATE A NEW PROJECT

N(ame of project=	
L(eader of project=	
T(ime scale=Weeks	(Hours, Days, Weeks, Months, Quarters, Fiscal)
S tart date=1/1/80	(Tue Jan 1)
D(irect cost units=K\$	(Either \$, K\$, or M\$)
M(anpower cost units=\$	(Either \$, K\$, or M\$)
F(ind critical path=yes	

To change a project description data-field, press its letter
To quit making alterations, press "Q"

The data fields listed here are exactly the same as for the option titled "Alter the Project Description". Please see that section of this manual for a detailed explanation of each field.

MENUS AND DISPLAYS

Load a different project into memory

Use this option to retrieve a project you have previously saved. It is up to you to remember the file name and the disk drive for each of your projects.

```
LOAD A DIFFERENT PROJECT
-----
DISK FILE DATA:
      F(file name=example1
      D(isk drive=B

To change the file name or disk drive, press "F" or "D"
To quit and return to the MAIN OPTIONS, press "Q"
To load the project, press "RETURN"
```

F(file name

To work on a different project, change the file name by pressing the letter "F" and entering a new file name. After the file is loaded, its name and a short summary is displayed for you to verify.

D(isk drive

To change the disk drive, press "D". Besides choosing a file name, you must to keep track of the disk drive where the file is stored. As shown in the screen above, the file named "example1" contains data for the water main project and resides on the "B" disk drive. (On UCSD PASCAL system, files are named with numbers like #4 and #5 or with seven character names.)

Alter the Project Description

The alter option is exactly the same as the create option with the exception that the project information is not initialized.

ALTER THE PROJECT DESCRIPTION

N(ame of project=First Street Water Main
L(eader of project=J. K. Henderson
 T(ime scale=Weeks (Hours, Days, Weeks, Months, Quarters, Fiscal)
 S tart date=1/1/81 (Thu Jan 1)
D(irect cost units=K\$ (Either \$, K\$, or M\$)
I(mpower cost units=\$ (Either \$, K\$, or M\$)
F(ind critical path=yes

To change a project description data-field, press its letter
To quit making alterations, press "Q"

N(ame of project

The project name appears on all printouts generated by MILESTONE and is the primary means of identifying a project. You may enter any string of forty or fewer characters.

L(eader of project

Every project has a leader and, as you know, they tend to be rather conceited types and never miss an opportunity to see their name in print. So here it is; you can use up to twenty-four characters; make sure you spell his/her name correctly.

If you are preparing the plan for someone else, don't worry, your name will still appear on all of the reports so that you get credit for your work.

MENUS AND DISPLAYS

Time scale

As shown to the right of the display, the time scale may take on several different values: hours, days, weeks, months, quarters, or fiscal quarters.

One time unit is the shortest possible job duration, so think about how "closely" you are going to manage the project. If you plan to check its progress every week, then WEEKS is the proper time scale. Don't select a short time scale unless you really need to.

Your choice also determines how the time line is displayed across the time schedule graph. The table below illustrates each of the options.

TIME SCALE	TIME SCHEDULE EXAMPLE
HOURS	<pre> Thu Jan 1 8 9 10 11 12 1 2 3 4 Fri Jan 0 1 2 3 4 5 6 7 8 8 9 9 10 </pre>
DAYS	<pre> Jan 1 2 3 4 5 6 7 8 9 10 11 0 1 2 3 4 5 6 7 8 9 10 </pre>
WEEKS	<pre> Jan Feb Mar 6 13 20 27 3 10 17 24 2 9 16 0 1 2 3 4 5 6 7 8 9 10 </pre>
MONTHS	<pre> 1980 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov 0 1 2 3 4 5 6 7 8 9 10 </pre>
QUARTERS	<pre> 1980 1981 1982 Jan Apr Jul Oct Jan Apr Jul Oct Jan Apr Jul 0 1 2 3 4 5 6 7 8 9 10 </pre>
FISCAL QUARTERS	<pre> FY80 FY81 FY82 Oct Jan Apr Jul Oct Jan Apr Jul Oct Jan Apr 0 1 2 3 4 5 6 7 8 9 10 </pre>

Although the screen display is limited to eleven units of time, the entire duration of the project appears on the printed time schedule graph. This is done by printing the schedule in several vertical strips which you can attach to form a complete chart. See the section titled "Print summary reports".

The time scale is the most crucial data item - choose it carefully. If you

change the time scale, you will have to use the MODIFY option to change the durations of each job accordingly. MILESTONE does not automatically change the durations because there is no unambiguous transformation between all possible time scales.

S(tart date

The start date is the date when you expect the project to begin. It can be changed at any time since all jobs are scheduled relative to it.

D(irect cost units

Each job may have an associated direct cost. This is a one time capital or expense outlay that is independent of the duration of the job. For example, in the "First Street Water Main" project, "purchase the pipe" has a direct cost of 50K\$.

As is common practice when dealing with cost estimates, figures are expressed in units of thousands or millions with only a few significant digits. This data field specifies which units will be used.

Only four significant digits are printed by MILESTONE. This saves space in memory allowing room for a large number of jobs. In almost all project plans, four significant digits is adequate.

If you select K\$, then direct costs can have values from 1K\$ to 9999K\$. This means that direct cost of less than 1K\$ must either be ignored or rounded up to 1K\$. Likewise, direct costs of more than 9999K\$ must be spread over more than one job.

Use the table shown below to choose the cost units depending on the range of job costs you foresee.

COST RANGE	COST UNITS
Dollars	\$
Thousands	K\$
Millions	M\$

Don't worry about cost totals exceeding the range of the units you have selected, MILESTONE automatically adjusts the cost units when totals are printed.

If you change the cost units, you will have to change the job costs that you have already entered.

MENUS AND DISPLAYS

M(anpower cost units

Each skill category has an associated manpower cost expressed as "cost units/work unit" where the work unit is determined from the time scale. So, choose the manpower cost units based upon the time scale that you have already chosen.

For example, a time scale of weeks results in a work unit of man-weeks. The work units are summarized in the table below.

Time scale	Work units
Hours	Man-Hours
Days	Man-Days
Weeks	Man-Weeks
Months	Man-Months
Quarters	Man-Years
Fiscal	Man-Years

Later, when you enter the details for each skill category, you will be asked to specify the corresponding manpower costs.

If you change the cost units, you will have to change the skill category costs that you have already entered.

F(ind critical path

Although MILESTONE is based upon critical path analysis, it is sometimes useful to disable this feature and just consider direct scheduling of jobs. If that's what you want, then set this data field to "no".

Edit the Skill Categories

Each job description includes a capital cost and a manpower level. By specifying the unit cost for different classifications of manpower here, the total project cost can be computed.

<u>EDIT THE SKILL CATEGORIES</u>	
Description	Cost in \$/Man-Week
1(st=Operating engineer	1000
2(nd=Laborer	500
3(rd=Welder	750
4(th=Civil Engineer	1500
5(th=	
6(th=	
7(th=	
8(th=	
9(th=	

To change a skill description, press its number
To change a skill cost, press its number and then press TAB
To quit editing the skill categories, press "Q"

To change a skill category, press its number. The cursor will jump to the first character of the description. To skip over to the cost, press TAB.

Manpower costs can be subdivided into as many as nine skill categories. Each category has a twenty-four character name and a cost per unit of time.

The manpower cost is entered as "cost units/work unit" where the work unit is determined from the time scale. See the section titled "Altering the project description" for a complete explanation of the time scale and corresponding work units).

MENUS AND DISPLAYS

Define Working Hours, Days, and Holidays

These data-fields are used only if the time scale is set to HOURS or DAYS. For other time scales, they are ignored.

DEFINE WORKING HOURS, DAYS, AND HOLIDAYS

WORKING HOURS:

```
B(egin work=8
S(tart lunch=12
F(inish lunch=12
E(nd work=17
```

WORKING DAYS:

```
D(ays of the week=MTuWThF
```

HOLIDAYS:

```
H(oliday list=1/1/81 5/25/81 7/4/81 9/7/81 11/26/81 12/25/81
```

To change the working hours, press "B", "S", "F", or "E"
To change the working days, press "D"
To add or remove a holiday, press "H"
To quit and return to the MAIN OPTIONS, press "Q"

B(egin and E(nd work

These two values define when the normal working day begins and ends. They must be even hours as defined on a 24 hour clock. Follow the rules for entering integers rather than times.

S(tart and F(inish lunch

These two values define when the lunch time begins and ends. If you don't want to consider time off for lunch, then set them both equal. As with normal working hours, they must be even hours as defined on a 24 hour clock

D(ays of the week

Not everyone is fortunate enough to work only five days a week. If you are one of the unlucky ones, you can use this option to redefine your working days.

To change these days, press "D" and follow the new instructions that are displayed at the bottom of the screen.

H(oliday list

You can define up to twelve holidays. When the project is first created, six of the most commonly observed holidays are listed: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day. You can customize this list by pressing the letter "H" and following the instructions on the screen.

MENUS AND DISPLAYS

Modify the Project Schedule

The Project Schedule display is the most important part of MILESTONE since it graphically illustrates the progress of your project as a function of time.

The screen display shown below is for the first example originally discussed in the chapter titled "Overview".

PROJECT SCHEDULE	Keys are ==/critical, :::/done, —/normal, .../slack											
	Jan				Feb				Mar			
Revision 1, 1/1/80	5	12	19	26	2	9	16	23	2	9	16	
Job (Room for 200 more)	0	1	2	3	4	5	6	7	8	9	10	
1 Purchase the pipe	>----->....>											
2 Dig 1st part of trench	>=====>											
3 Dig 2nd part of trench	>----->.....>											
4 Lay 1st part of pipe	>=====>											
5 Lay 2nd part of pipe	>=====>											
6 Test for leaks	>=====>											
7 Fill trench	>=====>											

A(dd E(rase or I(nsert a job move U(p D(own L(eft R(ight or H(ome
M(odify or C(omplete a job O(ther options Q(uit
To select an option, press its letter; numbers can prefix a move

Interpreting the schedule

The project name is at the top of the display, followed by the revision number of this report and the date.

Next comes the time line mentioned earlier in the discussion on "Time scales". It shows time progressing from left to right across the screen with specific dates marked in every fifth column. In the example the time line begins with the first week, January 5th, and extends to the end of the tenth week, March 16th.

There is room for sixteen jobs to be listed - seven are shown in the example. Although many more jobs may be included in a project, the size of the terminal screen limits your view to only sixteen at a time. However, by choosing the "move" options, you can view all parts of the schedule.

Immediately you can see that the "First Street water main" project is made up of

seven different jobs, beginning January 6th and ending March 16th.

The first job, "Purchase the pipe", takes two weeks and can be started immediately. The line of dots ('.....') shows that it may be delayed for one week without affecting the project schedule. This allowable delay is called the 'slack time' or 'float'.

The second job, "Dig 1st part of trench", takes three weeks. The equals signs ('====') indicate that this job is on the critical path and cannot be delayed without affecting the entire project schedule.

The critical path is apparent by looking for jobs that are marked by equals signs. It is called the critical path because delays in any of the critical jobs will delay the project.

Manpower and cost information can also be displayed by choosing options listed under "O(ther options)".

A(dd a job

The "A(dd" option initializes the job data fields and displays the "Job Description" ready for entry of new data. After the data is entered, the new job added to the schedule at the very end of the list chronological order. See the section of this chapter titled "Job Description" for the data items that must be entered.

E(rase a job

If you select the "E(rase" option, then you are asked to enter the number of the job you wish to erase. The project schedule is then readjusted after the job is removed.

I(nsert a job

The "I(nsert" option is exactly like the "A(dd" option except that the job is inserted into the schedule immediately after all of its prerequisites, rather than at the very end of the list.

Use "I(nsert", instead of "A(dd" to place a step into the middle of a project rather than at the end.

M(odify a job

If you want to change any of a job's data fields, then you must select the "M(odify" option. You are asked to enter the number of the job and then that job's data fields are displayed as described in the section titled "Job Description".

move U(p, D(own, L(ef, R(ight, or H(ome

As mentioned earlier in this chapter, a project may have many jobs, but only sixteen can be displayed on the screen at one time. These five options (up, down, left, right, and home) permit you to move around on the project schedule and view any sixteen consecutive jobs.

MENUS AND DISPLAYS

The screen display is like a window. Imagine that there is a "little man" inside your terminal holding a large piece of paper for you to see. You can view any part of that imaginary paper by commanding that "little man" to move the paper in a specific direction. By moving it up, down, left or right you can see any part of the schedule.

To move the window up or down one job, press the letter "U" or "D". If you want to move more than one job, type a number before you press "U" or "D". For example, to move down five jobs, press "5D".

To move the window left or right one time unit (i.e. one week if the time scale is in weeks), press "L" or "R". If you want to move more than one time unit, press a number before you press "L" or "R". For example, to move right twelve weeks, press "12R".

To view a specific job, enter its number and then press "H" for home. For example, to redisplay the schedule with job number one at the top, press the digit "1" and then press RETURN.

O(ther options

There are several other options that affect how the project schedule is displayed. Rather than listing them all at the bottom of the screen, they are displayed only if you press "O".

R(enumerate all jobs	show E(ffort summary	O(ther options
S(ort jobs into time order	show C(ost summary	Q(uit
To select an option, press its letter; to see other options, press "O"		

show E(ffort summary

If the effort summary option is selected, then an extra line appears at the bottom of the screen showing the effort level versus time.

Manpower level=5	5	4	10	6	6	6	2	4	4	0
------------------	---	---	----	---	---	---	---	---	---	---

If your project is short on manpower, you may wish to have the manpower level displayed along with the schedule while you are entering or modifying job data. By glancing at the summary you can see immediately if you have exceeded your project's manpower allocation. You can then readjust the job sequence or effort level so as not to exceed your allocation.

This option changes depending on whether or not the summary is in effect. If you have previously turned on the effort summary, then the option is displayed as "don't show E(ffort summary".

MENUS AND DISPLAYS

show C(ost summary

Selection of the cost summary option adds one more line to the bottom of the display showing the total direct cost for all jobs beginning at the corresponding time.

Direct cost in K\$=50	0	0	0	0	0	0	0	0	0	0
-----------------------	---	---	---	---	---	---	---	---	---	---

As mentioned under "Project Description", two types of cost are involved in any project, direct costs (i.e. capital/expense) and manpower costs. The cost summary displays the direct cost as they are incurred at the beginning of a each job.

Here's how the project schedule would look if both the effort and cost summaries were selected. Notice in the example below that the first digit of each amount is aligned with the first digit of a time number and date. This alignment shows the cost/time correspondence.

PROJECT SCHEDULE	First Street water main										
	Jan			Feb				Mar			
Revision 1, 1/1/80	5	12	19	26	2	9	16	23	2	9	16
Job (Room for 200 more)	0	1	2	3	4	5	6	7	8	9	10
1 Purchase the pipe	>----->....>										
2 Dig 1st part of trench	>=====>										
3 Dig 2nd part of trench	>----->.....>										
4 Lay 1st part of pipe	>=====>										
5 Lay 2nd part of pipe	>=====>										
6 Test for leaks	>=====>										
7 Fill trench	>=====>										
Manpower level=5	5	4	10	6	6	6	2	4	4	0	0
Direct cost in K\$=50	0	0	0	0	0	0	0	0	0	0	0
R(enumerate all jobs	show E(ffort summary O(ther options										
S(ort jobs into time order	show C(ost summary Q(uit										
To select an option, press its letter; to see other options, press "O"											

MENUS AND DISPLAYS

R(enumerate all jobs

The job numbers appearing to the left of the job name are assigned by MILESTONE. After a long session of erasing, adding, and inserting these numbers may no longer be in ascending order. For cosmetic reasons you may wish to renumber them.

S(ort jobs into time order

This is another cosmetic option that may improve the appearance of the display. It sorts all jobs into increasing order of latest finish time. If two jobs have the same latest finish, then they are listed in order of decreasing slack time.

Job Description

A fundamental premise of MILESTONE is that a project can be thought of as a collection of jobs (or activities) that must be completed in a specified sequence. This is the only rational way to plan a complex project; it's too difficult to grasp the intricacies of a complex project without breaking it down into smaller easily understood jobs.

A job should be a well defined activity for which you can devise confident duration, cost, and effort estimates. If you have a high confidence each each job estimate, then you will have a high confidence in the complete project schedule.

The project schedule is determined by linking jobs together in time according to how you they depend upon each other. This dependence is determined by specifying which other jobs must be completed before any one job may be started. These other jobs are called "prerequisites".

A prerequisite is another job that must be done first. In the water main example project the trench shouldn't be filled until after the pipe has been tested for leaks; therefore testing for leaks is a prerequisite to filling the trench. On the other hand, purchasing the pipe has no prerequisites and can begin as soon as the project is given the go-ahead.

Whenever you select "A(dd, I(nsert, or M(odify" a job, a job description menu is displayed at the bottom of the screen. This menu lists all of the data fields necessary to completely define a job.

Look below at the two sample menus to see the job descriptions for the two parts of "digging the trench" in the water main project. "Digging the first part" has no prerequisites and can begin immediately. However, "digging the last part" can only begin after digging the first part is completed.

```
N(ame=Dig first part of trench                D(uration=3
P(rerequisites=0  E(arliest start date=0      C(ost=0
Skills 1(=0    2(=0    3(=0    4(=0    5(=0    6(=0    7(=0    8(=0    9(=0
To change a data field, press its letter; to leave as shown, press RETURN
```

The menu above shows the data fields necessary to completely describe a job that has no prerequisites. Since the number of prerequisites is zero, the start date is shown as a data field. If number of prerequisites listed is not zero, then a slightly different display is shown.

```
N(ame=Dig last part of trench                D(uration=1
P(rerequisites=2                            C(ost=0
Skills 1(=0    2(=0    3(=0    4(=0    5(=0    6(=0    7(=0    8(=0    9(=0
To change a data field, press its letter; to leave as shown, press RETURN
```

MENUS AND DISPLAYS

N(ame

A job name can be up to thirty characters long and should accurately describe the activity. Looking back at the project schedule you can see that there is only room for twenty characters. Only as much of the name as will fit is actually displayed.

D(uration

The duration is the number of time units necessary to complete the job.

For some jobs the duration may be related to the effort level, i.e. more workers can do the job in a shorter time. It is up to you to choose a combination of duration and effort best suited to your working conditions. At a later time you may change the combination and see the resulting effect on the overall project schedule.

Other jobs may have a duration that is completely independent of the effort level. For example, after pouring structural concrete twenty-eight days must elapse before it reaches full strength. Such a job could be shown as a four week duration and zero effort.

P(rerequisites

A job "with no prerequisites" is defined by setting the number of prerequisites to zero and then specifying a time for the earliest possible start. For example, "Dig 1st part of trench" has no prerequisites and can begin as soon as the project begins.

A job "with prerequisites" is defined by entering the numbers of the jobs which must be completed first. In the water main example, "Dig 2nd part of trench" cannot begin until after "Dig 1st part of trench" is completed.

A job cannot have more than nine prerequisites. If a job depends on more than nine others, consider creating two other fictitious jobs of zero duration. Each of these fictitious jobs could depend on up to nine others and one job depending on both of them could, in effect, depend on up to eighteen.

E(arliest start date

You must enter this date only if you have specified zero prerequisites.

When you add a new job, the start date is automatically set to the project start date (i.e. the 0th time unit). If the project start date is ever changed, then all jobs with no prerequisites are automatically rescheduled.

Skills 1(to 9(

Each job can draw manpower from any combination of the nine different skills. In the "water main" example, three laborers (skill category number 2) and one operating engineer (skill category number 1) are needed to dig the trench.

Each skill is indicated by the skill number, "1(=", and a manpower level. To change the manpower for a given skill, press the key for the corresponding skill

MENUS AND DISPLAYS

number and then enter the manpower level. Levels are restricted to a four digit integers.

After you have entered the manpower level, press TAB to go to the next skill category or press RETURN to leave the remaining categories as they are shown.

Don't confuse the manpower level with the total effort. The manpower level level is the number of people working on a job; the total effort is the product of the manpower level and duration. For example an manpower level of four men working for a duration of four weeks results in sixteen man-weeks of total effort.

PROCEED TO THE NEXT CATEGORY BY PRESSING TAB
OR RETURN TO LEAVE THE REMAINING CATEGORIES AS THEY ARE SHOWN.

ENTER THE MANPOWER LEVEL (1-9999)
PRESS TAB TO GO TO THE NEXT CATEGORY
OR RETURN TO LEAVE THE REMAINING CATEGORIES AS THEY ARE SHOWN.

ENTER THE DURATION (1-9999)
PRESS TAB TO GO TO THE NEXT CATEGORY
OR RETURN TO LEAVE THE REMAINING CATEGORIES AS THEY ARE SHOWN.

ENTER THE COST PER HOUR (1-9999)
PRESS TAB TO GO TO THE NEXT CATEGORY
OR RETURN TO LEAVE THE REMAINING CATEGORIES AS THEY ARE SHOWN.

ENTER THE COST PER WEEK (1-9999)
PRESS TAB TO GO TO THE NEXT CATEGORY
OR RETURN TO LEAVE THE REMAINING CATEGORIES AS THEY ARE SHOWN.

ENTER THE COST PER MONTH (1-9999)
PRESS TAB TO GO TO THE NEXT CATEGORY
OR RETURN TO LEAVE THE REMAINING CATEGORIES AS THEY ARE SHOWN.

ENTER THE COST PER YEAR (1-9999)
PRESS TAB TO GO TO THE NEXT CATEGORY
OR RETURN TO LEAVE THE REMAINING CATEGORIES AS THEY ARE SHOWN.

ENTER THE COST PER QUARTER (1-9999)
PRESS TAB TO GO TO THE NEXT CATEGORY
OR RETURN TO LEAVE THE REMAINING CATEGORIES AS THEY ARE SHOWN.

ENTER THE COST PER DAY (1-9999)
PRESS TAB TO GO TO THE NEXT CATEGORY
OR RETURN TO LEAVE THE REMAINING CATEGORIES AS THEY ARE SHOWN.

MENUS AND DISPLAYS

Print a Summary Report

MILESTONE provides several different report formats, each one designed to give you quick access to information about your project. Subsequent revisions of MILESTONE may have more reports than are listed here.

PRINT A SUMMARY REPORT

REPORTS THAT CAN BE PREVIEWED ON THE TERMINAL:

P(roject description report
J(ob description report

REPORTS THAT ARE SENT DIRECTLY TO THE PRINTER:

T(ime schedule report
A(ll of the above reports

To printout a report, press its letter, "P", "J" etc.
To return to the main menu, press "Q"

A report can be preview by displaying it directly on the scree rather than sending it to the printer. If you select one of the "previewable" reports, you will be asked if you want to see it on the screen first.

P(roject and J(ob description report

Rather than delving into a complicated discussion of these reports, you are simply referred to Appendix B where the reports for the first example are listed.

T(ime schedule graph

This reports deserves some explanation. As you know by now, a project may consist of one hundred or more jobs over a long time span. The problem is "How can you print such a big schedule on such a narrow strip of printer paper".

We think we have come up with a unique solution. The time schedule is printed in a series of strips. To make a large chart, you can simply tape the strips together. For example, looking at the schedule in Appendix B, you see that it is on two sheets of paper that can be aligned to form one larger sheet.

MENUS AND DISPLAYS

There is no practical limit to the size chart that can be produced by printing separate strips in this manner.

If you have a wide printer, then be sure to set its width when running the program named "config". With some of the newer printers it is possible to get as many 200 or more columns on one sheet of paper.

A(11 of the above reports

This option is provided for those of you who don't like to sit around watching printers clunk away. Just press the letter "A" and go out for a cup of coffee. When you return, you will have a neat little stack of paper with all of the pertinent reports (barring some unforeseen printer hangup).

MENUS AND DISPLAYS

Save a Project on Disk

After you have create a new project or modified an old one, use this option to save your work.

SAVE THE CURRENT PROJECT

DISK FILE DATA:

F(file name=example1
D(disk drive=B

To change the file name or disk drive, press "F" or "D"
To quit and return to the MAIN OPTIONS, press "Q"
To save the project, press "RETURN"

F(file name

All project data is kept in two disk files. It is up to you to choose a file name and to keep track of the disk drive. As shown in the screen above, the file named "example1" contains data for the water main project.

If you create a new project, then before you save it on disk you will have to invent a new file name. It is good practice to invent a name that has a meaning relative to the project so that you can remember what it contains. But be careful of duplicate file names you may get confused and accidently destroy a file.

D(disk drive

Besides choosing a file name, you must to keep track of the disk drive where the file is stored. As shown in the screen above, the file named "example1" contains data for the water main project and resides on the "B" disk drive. (On UCSD PASCAL system, files are named with numbers like #4 and #5 or with seven chracter names.)

ERROR EXPLANATIONS

Error Messages

Although MILESTONE contains a comprehensive set of checks on each individual key that you press (bad keys causing a bell), some errors are impossible to detect until after you have made a complete data entry. These errors are listed below with some remarks that may help you.

ERROR # 1 - The time scale is limited to: Hours, Days, Weeks, Months, Quarters, and Fiscal Quarters. If you try to enter some other value, it will cause an error.

ERROR # 2 - The cost units are limited to one of the following values: \$, K\$, and M\$. Thousands are denoted by "K" and millions by "M".

ERROR # 3 - You must enter either "Yes" or "No". All other entries will cause an error.

ERROR # 4 - You cannot enter the number of a job that does not exist. Perhaps you have either renumbered the jobs or have erased one.

ERROR # 5 - A fundamental requirement is that a job's prerequisites must precede it. This also implies that a job cannot name itself as a prerequisite. It would create a paradox, if a job could not start until it finished.

ERROR # 6 - As mentioned in number 5 above, a job's prerequisites must precede it. If this error is preventing you from modifying a job's prerequisites, first erase it and then use the I(nsert option to back into the list where it belongs.

ERROR # 7 - You cannot modify or display a job unless it is first loaded into memory.

ERROR # 8 - Another fundamental requirement is that no job can have more than nine prerequisites. If you encounter this error, you have tried to erase a job and MILESTONE's attempt to correct all jobs that depend upon it would result in the named job having more than nine prerequisites. The solution to this dilemma is to manually modify the prerequisites of the named job.

ERROR # 9 - Before you run MILESTONE, you must first run the program named CONFIG in order to create the file named "terminal.dat". This file contains all information needed to control your terminal and printer. If you have already run CONFIG, then check to make sure that you are logged on to the disk drive with the file "terminal.dat". On CP/M system you log onto a disk drive by entering its letter and then pressing RETURN. On UCSD PASCAL and APPLE PASCAL systems you log onto a disk by executing the FILER and setting the PREFIX the the disk's name or number.

ERROR #10 - This error occurs if you try to enter a time that is out of order. For example, the time that you end work must be after the time that you start work.

ERROR #11 - When defining your normal working days, you must have at least one.

ERROR EXPLANATIONS

Hey, if you don't work at least one day a week, why are you running this program.

ERROR #12 - The working day must be at least one hour long. We have yet to find a place of business that works less than one hour per working day. If you do, please send us a stack of job applications.

ERROR #13 - The number of holidays is limited to twelve. This arbitrary limitation is necessary in order to conserve memory space. If you think you need more than twelve perhaps you can get by by defining the twelve that immediately follow the project start date. If you want to block off a period of time for vacation, then simply define a job that has no prerequisites and begins when your vacation begins. Then you can have other jobs name your vacation as a prerequisite.

ERROR #14 - There is not enough room in memory to hold another job. Solution, buy more memory. If you only need a couple of more jobs, consider reducing the number by combining several together. If you need a lot more, then divide you project into phases and treat them as separate projects.

ERROR #15 - A prerequisite list must be made up of up to nine numbers separated by commas. Each number can be up to three digits long.

Warning Messages

Warnings are not really errors, but rather messages to alert you that the action you are about to take may cause loss of data. A bell rings, the warning message is displayed, and you are asked to confirm you action.

WARNING # 1 - Since you have not yet saved the project that is in memory, the action you are about to take will cause it to be erased. If you want to save it first, answer "NO". If you want to create a new project anyway, then answer "YES".

WARNING # 2 - There is no need to save the project since it has not been changed. This warning might appear if you are confused about what you are doing.

WARNING # 3 - Since you have not yet saved the project that is in memory, the action you are about to take will cause it to be erased. If you want to save it first, answer "NO". If you want to load a different new project anyway, then answer "YES".

WARNING # 4 - Since you have not yet saved the project that is in memory, quitting MILESTONE take will cause it to be erased. If you want to save it first, answer "NO". If you want to quit anyway, then answer "YES".

ERROR EXPLANATIONS

System Error Messages

The phrase "System Error Messages" refers to those errors that are outside of MILESTONE's control. If you encounter one of these errors, it is probably due to an electronic hardware error, a problem with your disk media, or simply confusion on your part about disk drives and file names. The following paragraphs attempt to help you fix the problem.

BDOS ERROR ON x SELECT - The disk drive has either been turned off or the disk has been removed. There is no recovery from this error.

SYSTEM ERROR # 1 - Hardware error when reading. Probably a bad disk.

SYSTEM ERROR # 2 - Unknown device specified. Probably an incorrect disk drive name when loading or saving a file.

SYSTEM ERROR # 3 - Illegal operation. You should not get this error.

SYSTEM ERROR # 4 - Undefined hardware error. Call your computer dealer, there is something wrong with your disk controller.

SYSTEM ERROR # 5 - Device referenced is not on line. Most likely an incorrect disk drive name when loading or saving a file. It could also be due to an incorrect name for the printer device - Try running CONFIG again.

SYSTEM ERROR # 6 - File is no longer in directory. You probably put a new disk in a drive while running MILESTONE. That is a NO-NO.

SYSTEM ERROR # 7 - Illegal file name. Most likely an invalid character imbedded inside a file name. Consult your system manual for rules about file names.

SYSTEM ERROR # 8 - Insufficient space on disk. Try saving your file on a different drive that may have some space left.

SYSTEM ERROR # 9 - No such volume on line. Most likely a bad disk name.

SYSTEM ERROR #10 - File not found on device specified. Double check the file name and disk drive. The project description report, if you have printed one, has this information.

SYSTEM ERROR #11 - Duplicate file. The named file already exists.

SYSTEM ERROR #12 - File already open. You should not encounter this error.

SYSTEM ERROR #13 - File is not open. You should not encounter this error.

SYSTEM ERROR #14 - Error in reading real or integer. Most likely you are trying to read a file that was not created by MILESTONE.

SYSTEM ERROR #15 - File position error. You should not get this error.

SYSTEM ERROR #16 - End of file found when reading. Probably trying to read a file not created by MILESTONE.

ERROR EXPLANATIONS

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APPENDIX A: SAMPLE REPORTS

PROJECT DESCRIPTION REPORT

First Street Water Main
Prepared by J. K. Henderson
Revision 8, 1/1/81

DESCRIPTION DATA FIELDS:

Name of project=First Street Water Main
Leader of project=J. K. Henderson
Time scale=Weeks
Start date=1/1/81
Direct cost units=K\$
Manpower cost units=\$
Find critical path=yes
File drive and name=a:example1

SKILL CATEGORIES:

	Description	Cost in \$/Man-Week
1st skill category=	Operating Engineer	1000
2nd skill category=	Laborer	500
3rd skill category=	Welder	750
4th skill category=	Civil Engineer	1500
5th skill category=		0
6th skill category=		0
7th skill category=		0
8th skill category=		0
9th skill category=		0

WORKING HOURS:

Begin work=8
Start lunch=12
Finish lunch=12
End work=17

WORKING DAYS:

Days of the week=MTuWThF

HOLIDAYS:

Holiday list=1/1/81 5/25/81 7/4/81 9/7/81 11/26/81 12/25/81

SCHEDULE SUMMARY:

Completion date=3/12/81
Number of jobs=7
Total manpower=50 Man-Weeks
Manpower cost=33K\$
Direct cost=50K\$
Total cost=83K\$

SAMPLE REPORTS

JOB DESCRIPTION REPORT

First Street Water Main
Prepared by J. K. Henderson
Revision 8, 1/1/81

Job #1, Purchase the pipe

Duration=2 Weeks
Completed=no
On critical path=no
Slack time=1 Week

Earliest start=1/1/81
Earliest finish=1/15/81
Latest start=1/8/81
Latest finish=1/22/81

Prerequisites=none

Manpower skills=none

Total effort=none
Manpower cost=none
Direct cost=50KS

Job #2, Dig 1st part of trench

***** CRITICAL *****

Duration=3 Weeks
Completed=no
On critical path=yes
Slack time=none

Earliest start=1/1/81
Earliest finish=1/22/81
Latest start=1/1/81
Latest finish=1/22/81

Prerequisites=none

Manpower skills=Skill #1, Operating Engineer, 1 @ 1000\$ per Man-Week
Skill #2, Laborer, 3 @ 500\$ per Man-Week

Total effort=12 Man-Weeks
Manpower cost=7500\$
Direct cost=none

Job #3, Dig 2nd part of trench

Duration=1 Week
Completed=no
On critical path=no
Slack time=2 Weeks

Earliest start=1/22/81
Earliest finish=1/29/81
Latest start=2/5/81
Latest finish=2/12/81

Prerequisites=Job #2, Dig 1st part of trench

Manpower skills=Skill #1, Operating Engineer, 1 @ 1000\$ per Man-Week
Skill #2, Laborer, 3 @ 500\$ per Man-Week

Total effort=4 Man-Weeks
Manpower cost=2500\$
Direct cost=none

Job #4, Lay 1st part of pipe

***** CRITICAL *****

Duration=3 Weeks
Completed=no
On critical path=yes
Slack time=none

Earliest start=1/22/81
Earliest finish=2/12/81
Latest start=1/22/81
Latest finish=2/12/81

Prerequisites=Job #1, Purchase the pipe
Job #2, Dig 1st part of trench

Manpower skills=Skill #2, Laborer, 4 @ 500\$ per Man-Week
Skill #3, Welder, 2 @ 750\$ per Man-Week

Total effort=18 Man-Weeks
Manpower cost=10500\$
Direct cost=none

Job #5, Lay 2nd part of pipe

***** CRITICAL *****

Duration=1 Week
Completed=no
On critical path=yes
Slack time=none

Earliest start=2/12/81
Earliest finish=2/19/81
Latest start=2/12/81
Latest finish=2/19/81

Prerequisites=Job #3, Dig 2nd part of trench
Job #4, Lay 1st part of pipe

Manpower skills=Skill #2, Laborer, 4 @ 500\$ per Man-Week
Skill #3, Welder, 2 @ 750\$ per Man-Week

Total effort=6 Man-Weeks
Manpower cost=3500\$
Direct cost=none

Job #6, Test for leaks

***** CRITICAL *****

Duration=1 Week
Completed=no
On critical path=yes
Slack time=none

Earliest start=2/23/81
Earliest finish=3/2/81
Latest start=2/23/81
Latest finish=3/2/81

Prerequisites=Job #5, Lay 2nd part of pipe

Manpower skills=Skill #4, Civin Engineer, 2 @ 1500\$ per Man-Week

Total effort=2 Man-Weeks
Manpower cost=3000\$
Direct cost=none

SAMPLE REPORTS

Job #7, Fill Trench

***** CRITICAL *****

Duration=2 Weeks
Completed=no
On critical path=yes
Slack time=none

Earliest start=3/9/81
Earliest finish=3/23/81
Latest start=3/9/81
Latest finish=3/23/81

Prerequisites=Job #6, Test for leaks

Manpower skills=Skill #1, Operating Engineer, 2 @ 1000\$ per Man-Week
Skill #2, Laborer, 2 @ 500\$ per Man-Week

Total effort=8 Man-Weeks
Manpower cost=6000\$
Direct cost=none

SAMPLE REPORTS

First Street Water Main, Revision 8, 1/1/81
 Prepared by J. K. Henderson

Job Description	Jan					Feb			
	1	8	15	22	29	5	12	19	26
	0	1	2	3	4	5	6	7	8
1 Purchase the pipe	>.....>					.	.	.	.
2 Dig 1st part of trench	>====>					.	.	.	.
3 Dig 2nd part of trench	.	.	.	>.....>					.
4 Lay 1st part of pipe	.	.	.	>====>					.
5 Lay 2nd part of pipe	.	.	.	.	.	.	>====>
6 Test for leaks	.	.	.	.	.	.	.	>====>
7 Fill trench	.	.	.	.	.	.	.	.	>====>
Manpower level=4	4	4	10	6	6	6	2	4	
Direct cost in K\$=50	0	0	0	0	0	0	0	0	

- Symbol - Explanation
- >.....> Duration of a normal job
 - >.....> Slack time for a normal job
 - >====> Duration of a critical path job
 - >::::> Duration of a completed job
 - * Job with zero duration

SAMPLE REPORTS

Mar				Apr					May				Jun			
5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	
9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
.	
.	
.	
.	
.	
.	
<u>4</u>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

APPENDIX B: TERMINAL CONTROL CODES

If your terminal does not appear in the "TERMINAL SELECTION" list, then you must manually enter its control codes. This will certainly require that you read and understand the technical manual for your terminal and may require the assistance of a programmer.

If you cannot find a programmer to help you, consult your computer dealer or software distributor.

After selecting the "terminal not shown" option in the "TERMINAL SELECTION" list, the following display appears.

TERMINAL SELECTION

Since your terminal is not shown on the menu, you must specify its control codes for cursor positioning, clearing the screen, and other functions. Please consult your terminal manual before continuing.

The mandatory control codes are,

- * Clear the screen and home the cursor
- * Position the cursor to a specific row and column

Optional control codes are,

- * Erase from the cursor to the end of the screen
- * Erase from the cursor to the end of the line
- * Turn on screen highlighting
- * Turn off screen highlighting

You will be asked a series of questions. To answer, enter a decimal number and then press RETURN.

To continue, press RETURN

To quit, press ESC

This display is intended to remind you of the complexity of the information that is required. The following sections of this appendix discuss each of these six control code functions in more detail.

There is a blank control code form at the end of this Appendix. You should read your terminal manual along with this Appendix and record each of the control sequences as you discover them. After you have installed your program and tested the codes, we would appreciate receiving a copy of the completed form so that we can include your terminal in the TERMINAL SELECTION menu and thereby eliminate this chore for others in the future.

APPENDIX B: TERMINAL CONTROL CODES

Clear Screen and Home Cursor

This is a mandatory function that is used very frequently.

CLEAR THE SCREEN AND HOME THE CURSOR (mandatory)

This character, or sequence of characters, should entirely blank the screen and leave the cursor in the upper left hand corner.

For example, an ADM3A terminal requires,

Number of characters in the sequence = 1
first character = 26 (an ASCII Control/Z)

To answer each question, enter a decimal number followed by RETURN

To quit, press ESC

The sequence that you enter here, and anywhere else for that matter, is limited to seven characters at most. This should be sufficient for any terminal.

The example given above is the ADM3A, a very common terminal. Looking in an ADM3A manual you might see the home and clear function defined in any one of the following ways,

By its ASCII name → SUB
As a hexadecimal number → 1A
As a control character → CONTROL/Z
As an octal number → 32
As a decimal number → 26

Whatever is given in your manual, you must convert it into a decimal number before you can enter it. This should not be a problem, because most terminal manuals have conversion tables in the back.

The home and clear sequence may be a combination of two functions for your terminal (one to clear the screen and one to home the cursor). In that case, just combine the two sequences into one long sequence and enter in the decimal values.

Other terminals list a "lead-in" character that must follow each control code. If yours does, remember to include the lead-in character in the sequence.

As an example, specification of the ADM3A control codes is shown below with operator's entries shown in bold face.

How many characters are in the home and clear sequence? 1
What is the decimal value of character #1? 26

Position the Cursor

Positioning the cursor is probably the most complicated function that your terminal can perform. Because of the obscure way in which most terminal manuals are written, it may take you several tries before you successfully discover the proper control sequence. Don't despair, most people have difficulty with this one.

POSITION THE CURSOR (mandatory)

This is a complex sequence of characters used to move the cursor to a specific row and column of the terminal screen. The sequence required by most terminals can be generalized into five parts.

The general sequence is,

For example, for an ADM3A,

part 1 = a lead-in sequence	2 characters, 27 and 61
part 2 = the row number plus an offset	row number + 32
part 3 = a separator sequence	none required
part 4 = the column number plus an offset	column + 32
part 5 = an ending sequence	none required

By generalizing the sequence into five parts almost all terminals can be controlled. If your terminal's cursor positioning is simple you won't need to use all five parts. But if your terminal is more complicated, all five may be necessary.

There is one complication: some terminals want the column number first, not the row number. Make sure to check your manual for this odd behavior.

The lead-in sequence is a set of characters that tells your terminal to be on the look out for a cursor address.

The row number is sent with an optional offset. It is a conventional practice for computer programs to refer to rows of the terminal screen using the numbers 0 through 23, but some terminals refer to rows using the numbers 32 through 55 (these are just the same numbers but with an offset of 32). They do this so that they won't confuse a row number with some other control code. Because a row offset is so common, you will be asked to enter the offset used by your terminal.

Some terminals require a separator sequence between the row and column, but most terminals don't. If one is required it is probably due to the fact that you can independently position the cursor row and column location.

As with the row number, the column number may require an offset and this offset may be different from the row offset. For example, a Microterm ACT-V terminal uses a row offset of 32 and a column offset of 80 but most programs refer to terminal screen columns with numbers from 0 through 79. If the column offset is 32, then the numbers 32 through 112 are used instead. If a column offset is

APPENDIX B: TERMINAL CONTROL CODES

used that would make the column number greater than 126, then a value the numbers wrap back around to 0.

The fifth part of this general sequence is included for those terminals that require something to follow both the row and column numbers.

As an example, the following entries could be used for an ADM3A,

```
How many characters are in the lead-in sequence? 2
  What is the decimal value of character #1? 27
  What is the decimal value of character #2? 61
Is the row first for your terminal? Enter "Y" or "N"? Y
  What offset, in decimal, is added to the row number? 32
  How many characters are in the separator sequence? 0
  What offset, in decimal, is added to the column number? 32
  How many characters are in the ending sequence? 0
```

Erase to End of Screen

This is the first of the optional control codes. If your terminal does not perform this function, it will be simulated in software. Simulation in software will, of course, be noticeably slower.

```
ERASE TO END OF SCREEN (optional)
```

This sequence blanks the screen from the cursor position to the bottom. If your terminal does not provide this function, it will be simulated in software.

Since this control sequence is used very frequently, it is highly desirable that your terminal have it. Although the ADM3A we have been using does not perform this function, most newer terminals do.

```
Does your terminal provide this function? Enter "Y" or "N"? N
```

Erase to End of Line

This is the second of the optional control codes. If your terminal does not perform this function, it will be simulated in software. Simulation in software will, of course, be noticeably slower.

APPENDIX B: TERMINAL CONTROL CODES

ERASE TO END OF LINE (optional)

This sequence blanks the screen from the cursor position to end of line. If your terminal does not provide this function, it will be simulated in software.

Since this control sequence is used very frequently, it is highly desirable that your terminal have it. Although the ADM3A we have been using does not perform this function, most newer terminals do.

Does your terminal provide this function? Enter "Y" or "N"? N

Turn On Highlighting

Highlighting is intended to be a function such as inverse video, a change in intensity, or any other function that calls attention to some area of the terminal screen. It is normally used by the program to accent one or more data fields in a screen display.

If your terminal is not capable of such a function, the program will not use and there will be no noticeable performance sacrifice.

The highlighting displays and the responses for an ADM3A terminal are shown below.

TURN ON HIGHLIGHTING (optional)

This sequence turns on screen highlighting such as inverse video or a change in screen intensity. If your terminal does not provide this function, it will not be used.

Does your terminal provide this function? Enter "Y" or "N"? N

TURN OFF HIGHLIGHTING (optional)

This sequence turns off screen highlighting such as inverse video or a change in screen intensity. Since you have already specified a sequence to turn on highlighting, you must also enter this sequence.

How many characters are in the turn off screen highlighting sequence?

APPENDIX B: TERMINAL CONTROL CODES

Special Terminal Options

SPECIAL TERMINAL OPTIONS

There are several special options that are required by a few terminals.
Use the normal answer unless you are absolutely sure your
terminal is different

How many NULLS are required after erasing the screen? (Normally 0) 0
Are cursor addresses sent as strings? (Normally NO) Enter "Y" or "N" N
What is the cursor origin? (Normally 0) 0

APPENDIX B: TERMINAL CONTROL CODES

TERMINAL CONTROL CODE FORM

Terminal Manufacturer Televideo 950

Model Number _____

CLEAR SCREEN AND HOME CURSOR

Decimal values of the characters = 2 26 30

POSITION THE CURSOR

Decimal values of lead-in sequence = 2 27 61

Is the row value sent first? (circle one) = Y N

Row offset = 32

Decimal values of separator sequence = 0

Column offset = 32

Decimal values of ending sequence = 0

ERASE TO END OF SCREEN

Decimal values of the characters = 1 21 28

ERASE TO END OF LINE

Decimal values of the characters = 1 23

TURN ON HIGHLIGHTING

Decimal values of the characters = 3 24 40 29 43 42 ^{71 71 72}

TURN OFF HIGHLIGHTING

Decimal values of the characters = 2 27 41 48 ⁷¹

SPECIAL OPTIONS

Number of NULLS after home and clear = 0

Send Cursor Addresses in ASCII (Normally No) = N

Is Zero The Cursor Origin (Normally Yes) = 0

APPENDIX B: TERMINAL CONTROL CODES

TABLE OF ASCII CHARACTERS

Use this table to find the decimal equivalent of ASCII characters used to control your terminal.

CHAR	CTRL	HEX	DEC	CHAR	CTRL	HEX	DEC	CHAR	CTRL	HEX	DEC
NUL		0	0	,		2C	44	X		58	88
SOH	^A	1	1	-		2D	45	Y		59	89
STX	^B	2	2	.		2E	46	Z		5A	90
ETX	^C	3	3	/		2F	47	[		5B	91
EOT	^D	4	4	0		30	48	\		5C	92
ENQ	^E	5	5	1		31	49	]		5D	93
ACK	^F	6	6	2		32	50	^		5E	94
BEL	^G	7	7	3		33	51	~		5F	95
BS	^H	8	8	4		34	52	`		60	96
HT	^I	9	9	5		35	53	a		61	97
LF	^J	A	10	6		36	54	b		62	98
VT	^K	B	11	7		37	55	c		63	99
FF	^L	C	12	8		38	56	d		64	100
CR	^M	D	13	9		39	57	e		65	101
SO	^N	E	14	:		3A	58	f		66	102
SI	^O	F	15	;		3B	59	g		67	103
DLE	^P	10	16	<		3C	60	h		68	104
DC1	^Q	11	17	=		3D	61	i		69	105
DC2	^R	12	18	>		3E	62	j		6A	106
DC3	^S	13	19	?		3F	63	k		6B	107
DC4	^T	14	20	@		40	64	l		6C	108
NAK	^U	15	21	A		41	65	m		6D	109
SYN	^V	16	22	B		42	66	n		6E	110
ETB	^W	17	23	C		43	67	o		6F	111
CAN	^X	18	24	D		44	68	p		70	112
EM	^Y	19	25	E		45	69	q		71	113
SUB	^Z	1A	26	F		46	70	r		72	114
ESC	^[	1B	27	G		47	71	s		73	115
FS	^\	1C	28	H		48	72	t		74	116
GS	^]	1D	29	I		49	73	u		75	117
RS	^^	1E	30	J		4A	74	v		76	118
US	^_	1F	31	K		4B	75	w		77	119
SP		20	32	L		4C	76	x		78	120
!		21	33	M		4D	77	y		79	121
"		22	34	N		4E	78	z		7A	122
#		23	35	O		4F	79	{		7B	123
\$		24	36	P		50	80	|		7C	124
%		25	37	Q		51	81	}		7D	125
&		26	38	R		52	82	~		7E	126
'		27	39	S		53	83	DEL		7F	127
(28	40	T		54	84				
)		29	41	U		55	85				
*		2A	42	V		56	86				
+		2B	43	W		57	87				

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