CONSTRUCTION OPERATION COST/TIME TRACKING SYSTEM

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Abstract

A properly designed cost and time tracking system for construction operations is needed to watch the progress of any project on a daily basis. Contractors should be able to examine the efficiency and the economical progress of the project. In order to save the contractor's time and finances, this examination must be simple, fast, and accurate.

The objective of this paper is to introduce a software package developed for an earth-moving contractor. This software will help the contractors to have a proper and an immediate control over the cost, the construction operations, the labor tasks, and the equipment tasks of any project. Tracking the time consumed on any construction operation is considered a vital advantage of this software package. Moreover, using this software will help the contractor obtain a more accurate estimate for future contracts.

Introduction

Both contractors and investors are engaged in an enterprise for profit as a goal. The lack of an effective cost and time tracking system will prevent their goal from being achieved. Usually, construction projects are not built exactly according to the original plan. The project progress, the cost trends, and the performance must be known and reported periodically to the contractor. This will assure corrective actions to take place effectively. Unless these reports and trends are pointed out accurately and in line, a cost and a labor will overrun. In this case, the progress of the project will be far behind the original plan. Moreover, it will be very expensive for any corrective action to be effective.

There are some factors that may cause extreme losses such as labor strikes and weather changes. These factors cannot be eliminated. But, an efficient managerial system can play a vital role in assisting the contractor to reduce the cost of these damages. The objective of a construction data analysis system is to provide detailed and accurate information regarding the cost of each operation. More importantly, this process must be done promptly. The cost of the project should be identified during the construction operations. This will enable the contractor to find a solution for any problem in the original plan of the project.

This paper introduces a software developed for an earth-moving contractor. Upon using this software, the contractor will have an immediate control over the cost, the construction operations, the labor tasks, and the equipment task of any project.

The proposed software package shows a promise to relate effectively the cost and the performance of any construction operation. This approach is conducted simply and in a meaningful way. Although this package is developed to meet a specific set of requirements for the earth-moving contractor, it is applicable to a very broad range of construction applications.

Program Operations

Complete correlation between the construction cost and the work performance is required in any approach to build a tracking system. Such an ideal approach will help the contractor to compare the actual time performance of the crew with the original schedule. Moreover, it will help him to compare the actual cost with the planned budget. Without this approach, which is presented here, it is extremely difficult to realize such a comparison.

The software presented in this paper is written using the Microsoft FORTRAN. The executable file, TRACK1.EXE, runs on a 386 computer with a math-co-processor and a VGA monitor. The input data are fed to the program in an interactive mode. The program prompts the user for all the required input data. Also, the output results of the program such as the cost and the time per each job, labor, equipment, or truck are obtained in both tabular and graphical formats. The objective of this software is to make it very simple and convenient to the user to insert the input data and/or to examine the output results. On the other hand, the accuracy of the output results is considered a significant issue in this package. Figure 1 shows a general flow chart of the program.
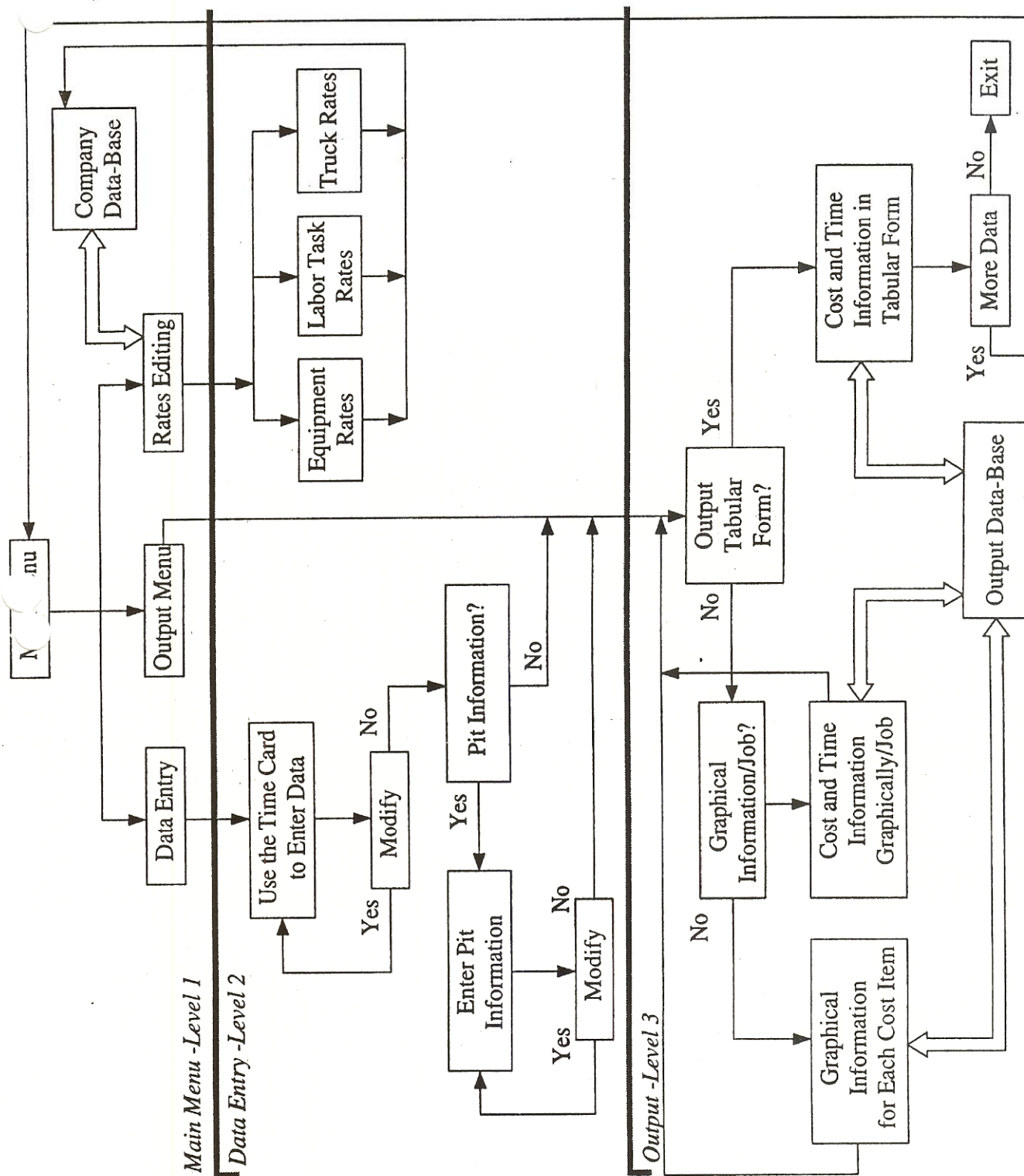
Figure 1. A General Flow Chart of the Proposed Program

Main Menu - Level 1

Data Entry - Level 2

Output - Level 3

For any company to start using this package, minimum adjustments are needed. This software package is designed taking into account the following factors:

1. to reflect the actual flow of information within the company.
2. to use unified codes for all construction operations and resources of any project that can be handled by the company.
3. to be simple and convenient in inserting huge amount of input data.
4. to be fast, accurate, and friendly in displaying the output results.

Numerical Example:

To illustrate the software capabilities, this program is applied to a small earth-moving contractor. This company owns ten different trucks and ten pieces of equipment. Each truck or equipment may be used for ten different tasks. There are ten workers employed in this company for ten different tasks. A coding system is classified for each person, equipment, equipment task, truck, truck task, labor task, and pit operation. Each equipment or truck can be used under a different rate. These rates are fixed for nine pieces of equipment and trucks but are variable for the tenth ones. Each truck has different volume for carrying debris, rocks, dirt, etc. These fixed rates or volumes are assigned to the classified codes. In some cases, it will be needed to replace a certain truck. This means that the volume of that specific truck should be changed, but the code of the truck should be the same. This software gives the user an option to re-enter these fixed rates and/or volumes easily, if needed.

Since this system keeps track of the time consumed on each job, the user will be asked to enter the starting and the ending time of the construction operation. In some cases, subsidiary costs will arise as a result of subcontracts or unexpected financial changes. This package is designed to account for those unexpected events.

The user has a wide range of options to evaluate the output data. The cost and the time consumed on each job, task, and working person are given in tables and in graphs. Two different groups of graphs are given in the output screen. The first group is to display the cost per every single item or operation in the company. For example, the cost per person, the cost per job, the cost per equipment, the cost per task (equipment, truck, and labor) can be chosen from the first group of graphs. The second group is to display every single item or operation in the company per job. For example, the time consumed, the labors, the equipments and/or the trucks used, and the different tasks (labor, equipment, and truck) per job. Moreover, any subcontract and or pit operation per job are included in the second group of graphs.

Figure 2 shows the coding system used for the company data-base. The intent of this paper is to show the operation of the software using the given example. The program can be extended easily to handle any project that consists of hundreds of construction operations. Figure 3 shows the main menu of the computer program. The first option on the menu allows the user to enter the project data using the codes shown in Figure 2. A sample of this portion of the program is presented in Figure 4. Once this part of the data entry is completed, the user has the option to view and/or modify the data. This will be done by selecting the first option on the screen shown in Figure 4. Selecting the second option from the same screen, will allow the user to enter the pit information and then view it or modify it as shown in Figure 5.

The cost control aspect of any construction project necessitates adequate response to the changing conditions in its environment. The contractor must be able to compare the time, the cost, and the performance of the project with the originally planned ones. This comparison should be conduced in an integrated manner. Tracking the project budget and the time schedule are significantly useful only if the performance of the project is adequate. This can be achieved by using this software package.

Data Entry	: Enter 1
Output Menu	: Enter 2
Rates Editing	: Enter 3

Please enter your choice ----> 1

Figure 3. Main Menu for TRACK1.EXE.

1- Enter Your ID #	---->	1001
2- Enter Project #	---->	1000
3- Enter Date (03/21/93)	---->	10/28/93
4- Enter Start Time (07 52 am)	---->	08 00 am
5- Enter Quit Time (11 43 pm)	---->	01 30 pm
6- Enter Equipment Task Code	---->	1
7- Enter Equipment Rate Code	---->	2001
8- Enter Truck Task Code	---->	101
9- Enter Truck Rate Code	---->	5001
10- Enter Labor Task Code	---->	11
11- Enter Subcost (if any)	---->	20

(a) Data Entry Screen.

| To Modify Data | : | Enter 1 |
| To Continue | : | Enter 2 |

Please enter your choice ----> 2

(b) Modify Data Screen.

Figure 4. Data Entry Options.

Do you want to enter Pit code (y/n): Y

Pit Code Entry

1. Enter Pit Code	----> 7001
2. Enter Dirt Rate/C.Y	----> 3.0
3. Enter Number of Dirt Loads	----> 4
4. Enter Debris, etc. Rate/C.Y	----> 0
5. Enter Number of Debris Loads	----> 0

(a) Pit Entry Screen.

| To Modify Pit Data | : Enter 1 |
| To Continue | : Enter 2 |

Please enter your choice ----->

(b) Modify Pit Data Screen

Figure 5. Pit Information Options

```
                    ┌──────────────────┐
                    │ Project Codes    │
                    │ 1000 . . .10,000 │
                    └──────────────────┘
        ┌──────────┬──────────┴──────────┬──────────┐
        │          │                     │          │
┌──────────────┐ ┌───────────────┐ ┌──────────┐ ┌──────────┐ ┌──────────┐
│ Labor Codes  │ │Equipment Codes│ │Truck Codes│ │Pit Codes │ │Other Cost│
└──────────────┘ └───────────────┘ └──────────┘ └──────────┘ └──────────┘
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Labor Codes

● Operator ID
   1001. . .1010

● Labor Task
   11. . .20

Equipment Codes

● Equipment Rate
   ■ Fixed 2001. . .2009
   ■ Variable 3001

● Equipment Task
   1. . .10

Truck Codes

● Truck Rate
   ■ Fixed 5001. . .5009
   ■ Variable 6001

● Truck Task
   101. . .110

Pit Codes

● Pit Rate
   7001. . .7010

Other Cost
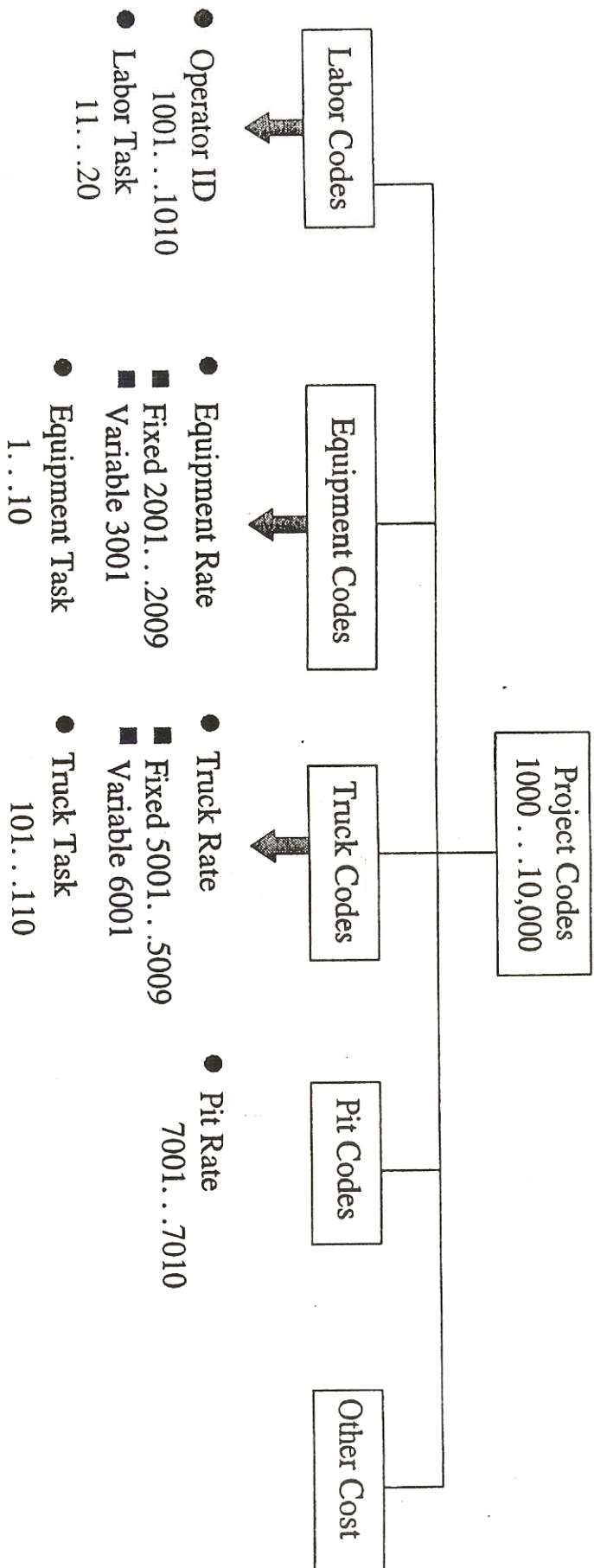
Figure 2. The Coding System for the company data-base.

Data Entry :Enter 1

Output Menu :Enter 2

Rates Editing :Enter 3

(a) Main Output Menu

To Obtain Total Cost/ID	:Enter 1
To Obtain Total Cost/Job	:Enter 2
To Obtain Total Cost/Equip. Task	:Enter 3
To Obtain Total Cost /Truck Task	:Enter 4
To Obtain Total Cost /Labor Task	:Enter 5
To Obtain Grand Cost/Job	:Enter 6
To Obtain Total Cost/Pit #	:Enter 7
To Obtain Total Cost/Equipment #	:Enter 8
To Obtain Total Cost/Truck #	:Enter 9
To Obtain Menu for All Plots	:Enter P
To Obtain Menu for Plots	:Enter J
To Return to Data Entry	:Enter R
Exit	:Enter 0

(b) All Plots Submenu

Plot for Cost/Job	:Enter 1
Plot for Cost/ID	:Enter 2
Plot for Cost/Labor Task	:Enter 3
Plot for Cost/Equipment Task	:Enter 4
Plot for Cost/Truck Task	:Enter 5
Plot for Cost/Pit	:Enter 6
Plot for Cost/Truck Code	:Enter 7
Plot for Cost/Equipment Code	:Enter 8
Back to Previous Output Menu	:Enter 9

(c) Plot for Cost/Job Submenu

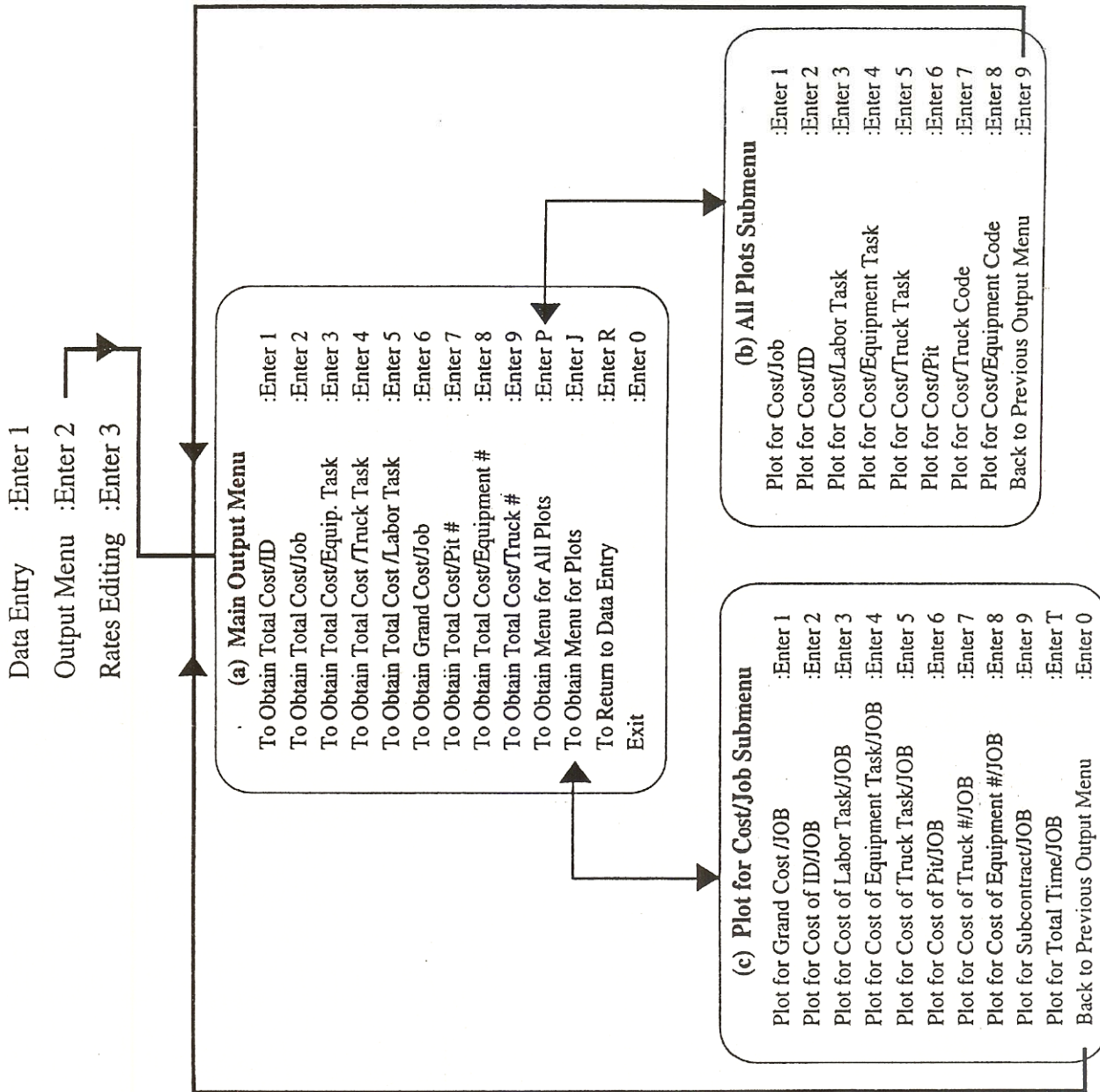|	
Plot for Grand Cost /JOB	:Enter 1
Plot for Cost of ID/JOB	:Enter 2
Plot for Cost of Labor Task/JOB	:Enter 3
Plot for Cost of Equipment Task/JOB	:Enter 4
Plot for Cost of Truck Task/JOB	:Enter 5
Plot for Cost of Pit/JOB	:Enter 6
Plot for Cost of Truck #/JOB	:Enter 7
Plot for Cost of Equipment #/JOB	:Enter 8
Plot for Subcontract/JOB	:Enter 9
Plot for Total Time/JOB	:Enter T
Back to Previous Output Menu	:Enter 0

Figure 6. The Output Data-Base Structure

The second option in the main menu allows the contractor to access the [inp]ut database of the software. The program will then allow the user to obtain information regarding the time, the cost and the performance for any construction operation, equipment, or project. Figure 6 shows the structure and the options available to the contractor on the output database.

As previously stated, the contractor can use the software to evaluate different cost categories for a specific project. Also, he can compare between the total cost, to date, for all active projects. The resulting analysis of such evaluation is presented in Figure 7 and Figure 8. Having these reports available for the contractor during the decision-making steps will allow the contractor to:

1.   identify any major deviations from the planned budget or time schedule.
2.   establish and implement contingency plans early enough such that the cost and/or the time requirements can be adjusted appropriately.
3.   maintain the control over a number of progressing projects simultaneously.

To control the cost of a construction operation, it is important to have the flexibility to modify any of the company database. This option is provided by this system and is considered a vital advantage of using this package. The software provides a mechanism that will allow the contractor to modify the rates of any equipment, labor task, or truck. Moreover, the truck volume can be modified for the purpose of replacement. All this information is stored in the company database and can be accessed from the third option on the main menu.

[Tr]acking the cost and the time of any construction project are equally [i]mportant to all companies, regardless of size. Such tracking systems can [be] used for storing massive quantities of information as well as for analyzing the output data. These processes are very important to make corrective actions within an appropriate period of time. This software package will assist the contractors to have a proper and an immediate control over the cost, the performance of a construction operation, the labor cost, and the equipment cost of any project.

Acknowledgement

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References

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******* JOB #= 1000 *******

ID#     Cost     Equip#   Cost      Truck#    Cost      Pit#    Cost

1001   72.0000   2001   210.0000    5001    180.0000   7001    .0000
1002  128.0000   2002   680.0000    5002    680.0000   7002    .0000
1003  176.0000   2003   160.0000    5003    160.0000   7003    .0000
1004  184.0000   2004   608.0000    5004   1140.0000   7004  200.0000
1005  264.0000   2005   150.0000    5005     80.0000   7005    .0000
1006   24.0000   2006   120.0000    5006    360.0000   7006    .0000
1007  154.0000   2007      .0000    5007     91.0000   7007    .0000
1008     .0000   2008      .0000    5008    120.0000   7008  150.0000
1009     .0000   2009      .0000    5009       .0000   7009    .0000
1010     .0000   2010      .0000    6001       .0000   7010    .0000

Total 1002.0000         1928.0000           2811.0000         350.0000

        Subcontract =   200.0000
    Grand Total = 6291.0000      Time (hrs)/Job/= 64.0000
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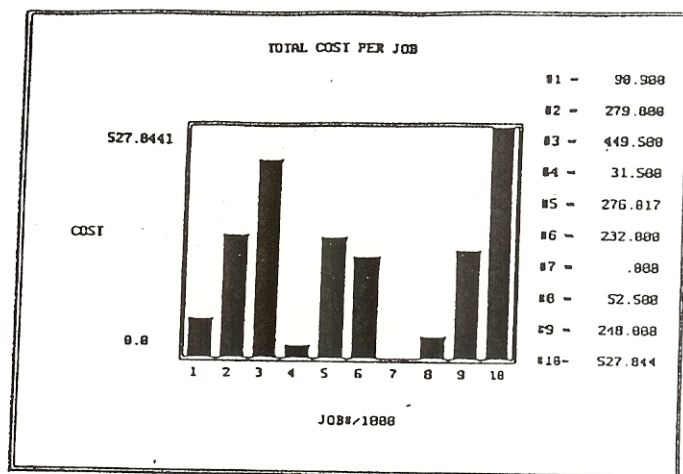
Figure 7. Grand Total Cost Analysis.

Figure 8. Graphical Representation for the Total Cost Per Job.