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TRANSPORTATION, WATER & URBAN DEVELOPMENT DEPARTMENT

TRANSPORT DIVISION

Report TWU 12

HDM Manager Version 2.1

Rodrigo Archondo-Callao

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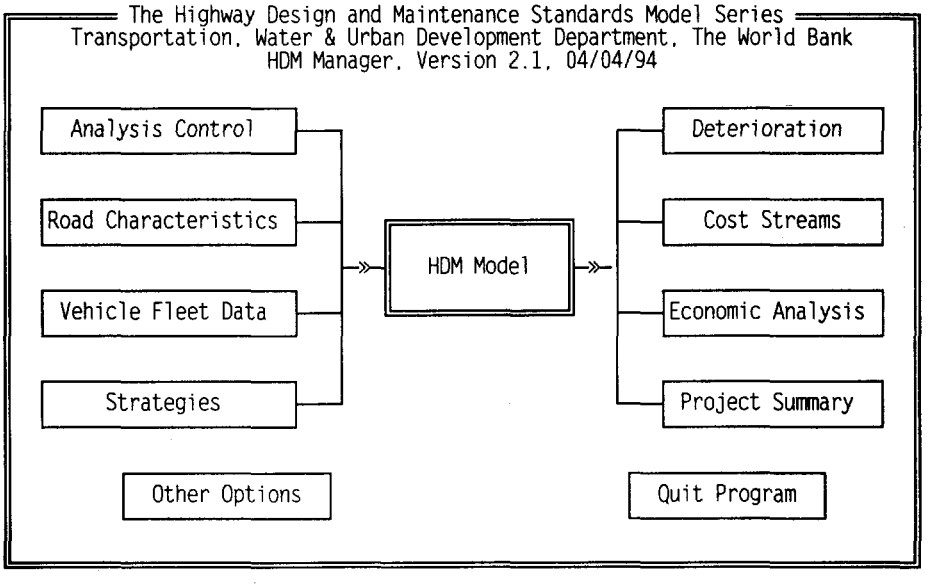
Technical Paper

The Highway Design and Maintenance Standards Series

HDM Manager Version 2.1



Rodrigo Archondo-Callao

Transportation, Water & Urban Development Department
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This report presents the HDM Manager software developed by Rodrigo Archondo-Callao, The Transportation, Water & Urban Development Department, The World Bank. To obtain a copy of the HDM Manager software, contact the following organization:

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The Highway Design and Maintenance Standards Model (HDM) developed by the World Bank (Thawat Watanatada and others) is required to be used in conjunction with the HDM Manager. To obtain a copy of the HDM Model, contact the following organization:

University of Florida
McTrans
Center for Microcomputers in Transportation
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Manufactured in the United States of America
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HDM Manager is designed for use on 286, 386 or 486 personal computers. A hard disk of 20 megabytes and minimum installed memory of 640K is required to run the HDM Manager program, using MS-DOS 3.3 or higher.

The HDM Manager program was written to assist in the operational work of the World Bank. The author, the World Bank, the members of its Board of Executive Directors, and the countries they represent make no representations or warranty with respect to the HDM Manager program other than as specified in the User License Agreement. The User assumes all risk for the installation and use of, and results obtained from, the program. The author and The World Bank shall not be liable for any error contained in the program or in the supporting manual or documentation supplied with the program or for incidental or consequential damage resulting from furnishing, performance, or use of the program.

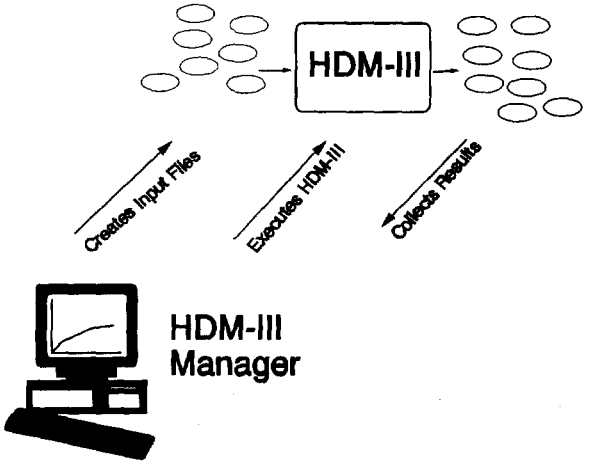
Although every effort has been made to test HDM Manager and ensure its accuracy, the World Bank is not in a position to provide user support.

Table of Contents

Introducing HDM Manager

The Highway Design and Maintenance Standard Model HDM[1] is a computer program for analyzing the total transport costs of alternative road improvement and maintenance strategies. The program provides detailed modeling of pavement deterioration and maintenance effects, and calculates annual costs of road construction, maintenance, and vehicle operation. Accidents and other impacts can be added exogenously to the economic evaluation. It is widely used in the evaluation of specific road proposals, national or regional road investments analysis, and road maintenance policy assessment.

HDM Manager is a user-friendly shell environment for specific customized applications of HDM (see the figure below). It stores the input data efficiently, creates all the required HDM input files, runs the HDM program, collects the results, and presents the results in a practical way. The program is a simple but powerful package for learning and using the major concepts of HDM.



HDM Manager is designed for use with the full HDM software package and documentation, which must be obtained separately. While you can use the HDM Manager software alone for demonstration purposes, it cannot analyze new options or save new data without the presence of the full HDM model.

HDM Manager is designed to evaluate a set of road agency strategies applied to paved and unpaved roads. The program computes the road deterioration, the cost streams (agency costs, vehicle operating costs, and total society costs) for each of the road agency strategies being evaluated, and the economic indicators (net present value of net benefits and the internal rate of return) used to compare the set of road agency strategies.

HDM Manager incorporates most but not all the features of HDM and has some constraints on parameter choices, e.g. must use seven vehicle types. The main HDM features not included in this version are the following: i) Division of links into sections and subdivision of sections into three subsections, ii) Execution of more than one link at a time, iii) Definition of exogenous costs and benefits, and iv) Use of alternative vehicle operating costs relationships.

Installing the Program

To use HDM Manager, you first need to install the HDM program into your hard disk. The steps to install the HDM program, as given by the HDM-PC manual[2], are the following:

STEP 1 - Make a directory called HDM for HDM with the DOS command:

```
MD\HDM
```

STEP 2 - Change to the HDM directory with the following DOS command:

```
CD\HDM
```

STEP 3 - Place the first HDM program disk in drive A: and enter:

```
COPY A:*.*
```

STEP 4 - Repeat step 3 for all the HDM disks supplied.

After installing HDM, install HDM Manager with the following steps:

STEP 1 - Make a directory called HDM-MAN for HDM Manager with the DOS command:

```
MD\HDM-MAN
```

STEP 2 - Change to the HDM-MAN directory with the following DOS command:

```
CD\HDM-MAN
```

STEP 3 - Place the HDM Manager program disk in drive A and enter:

```
COPY A:*.*
```

Program Requirements

To run HDM Manager you need DOS 3.3 or higher and 600 KB of free conventional memory. Also make sure that the following line is included in the CONFIG.SYS file:

FILES = 30

Starting the Program

Start the program following the steps below:

STEP 1 - Change to the HDM-MAN directory with the following DOS command:

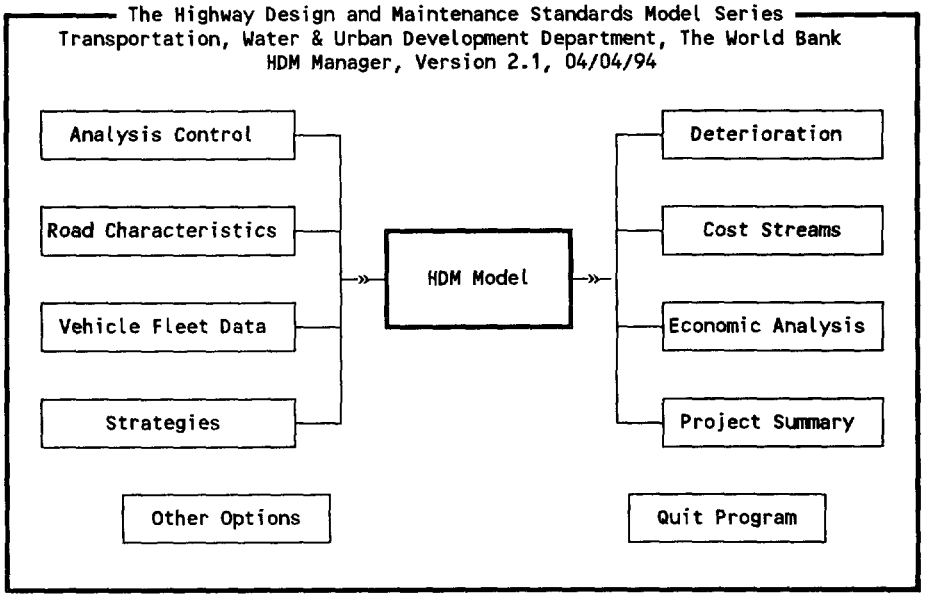
CD\HDM-MAN

STEP 2 - Run the program with the command:

HDM-MAN

The Main Menu

The main menu (shown below) shows you the basic structure of the program and gives you a series of options (Analysis Control, Deterioration, etc.). At this type of menu, select an option by using the cursor keys to highlight the option and pressing the Enter key or by pressing the first letter of the option selected.



Learning the Basics

To do a basic economic analysis of road agency strategies applied to a paved or unpaved road, follow the steps below:

STEP 1 - Define the Analysis Control. Enter the discount rate, the analysis period, the calendar year of the initial year, and the currency to be used.

STEP 2 - Define the Road Characteristics. Enter the road geometry, road structure, road condition, environment, daily traffic, and the traffic growth.

STEP 3 - Define the Vehicle Fleet Data. Enter the vehicle fleet characteristics and the vehicle operation unit costs.

STEP 4 - Define the Strategies. Enter the maintenance operations and construction unit costs, define a data bank of possible road agency maintenance and construction policies, and define the road agency strategies being evaluated. Each strategy should include one or more road agency policies.

STEP 5 - Execute the HDM Model. Run the HDM model from within the shell environment. Note that after the HDM run is completed, the HDM Manager program collects the HDM results from the HDM output files.

STEP 6 - View the Deterioration. Examine the road deterioration behavior of each of the road agency strategies being evaluated.

STEP 7 - View the Cost Streams. Examine the financial and economic cost streams (agency costs, vehicle operating costs, and total society costs) of the road agency strategies being evaluated.

STEP 8 - View the Economic Analysis. Examine the economic comparison of the strategies being evaluated. The comparison is based on the net present value of benefits (NPV) or the internal rate of return (IRR) of each strategy in relation to a base strategy (the first strategy).

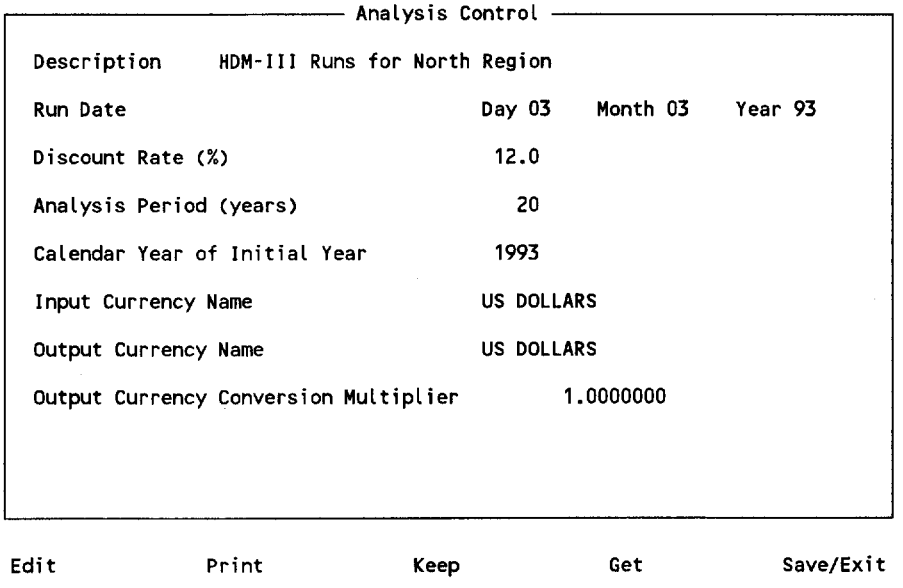
STEP 9 - Produce the Project Summary. Select the optimal road agency strategy among the five strategies being evaluated and create a project summary report for the selected strategy. The project summary report contains all the basic inputs and results for the selected strategy.

STEP 10 - Explore Other Options. For example: export the results to Lotus 1-2-2, view or print the original HDM output files, or manage the input data set files.

For each step described above, select the corresponding option at the main menu.

Defining the Analysis Control

Select the Analysis Control option at the main menu to enter the control data to be used in the HDM run. When you select this option, the Analysis Control screen (shown below) appears.



The screen presents the current information in memory and a menu of options at the bottom of the screen. To modify any of the input variables, use the Edit option and to print the current information, use the Print option. In this type of menu, you should select an option using the arrow keys and the Enter key or by pressing the first letter of the selected option.

When you select the Edit option, the program presents the inputs that you can change. The HDM Manager has three types of inputs: i) Required inputs, ii) Optional inputs, and iii) Lookup table inputs. The required inputs are displayed in Black and should be entered by the user. The optional inputs are displayed in Purple and if the user wants the HDM model to estimate the input as a function of other inputs, the user can leave the input empty (not zero). The lookup table inputs are displayed in Brown and accept only a valid choice from a list of options. Press the F10 key, when the cursor is at the input field, to display the list of valid options and select an option with the Enter key.

The information displayed on this type of screen (Blue background) will be what is used by the HDM model to compute the results. The information on a screen is saved automatically by HDM Manager each time you exit the screen with the Save/Exit option. That is, if you use the Save/Exit option, exit the program and later you load the program and go back to the screen, the information previously on the screen will be there.

You also have the option of storing the information currently on the screen in a data set file to create a library of information files. If you store the information in a data set file, you can retrieve it later. To store the information currently on the screen, use the Keep option. This option

prompts for the name of the data set file to store the information. Enter up to six characters or digits.

To retrieve the information of a previously stored (with the Keep option) data set file, use the Get option. This option lists the available data sets. Highlight the data set you want and press the Enter key. The program will get the information from the data set file and present it on the screen. Remember that the HDM model uses the current information displayed on the screen (saved automatically with the Save/Exit option) to compute the results.

To return to the main menu use the Save/Exit option. If you press the Escape key, the program will return to the menu but it will not save the latest screen changes. Note that in the HDM Manager at any moment you can press the Escape key to cancel an operation or to go back to a previous menu.

Defining Road Characteristics

Select the Road Characteristics option at the main menu to enter the road information to be used in the HDM run. When you select this option,the Road Characteristics screen (shown below) appears.

```
                    Road Characteristics
                                                          Page 1/3
Description     Gravel Road 1 in North Region

Road Type (Paved/Unpaved)   U

GEOMETRY
  Road Length (km)          100.0     Road Width (m)              6.0
  One Shoulder Width (m)      0.4     Effective Number of Lanes     .
  Rise & Fall (m/km)         40.0     Curvature (deg/km)          100.0
  Superelevation (%)          0.0

ENVIRONMENT
  Altitude (m)                500     Rainfall (m/month)        0.0300

                                                        | Next Page |

Edit          Print          Keep          Get          Save/Exit
```

The Road Characteristics menu is similar to the Analysis Control menu. Use the Edit option to edit the information, the Print option to print the information, the Keep option to store the information into a data set file for future use, the Get option to retrieve a data set information, and the Save/Exit option to save the current information and return to the previous menu.

Note that if you decide to store the current information (Keep option), you can use the same data set name for an Analysis Control, Vehicle Fleet, Maintenance Unit Costs, Road Agency Policies, or a Road Agency Strategies data set. The HDM Manager program treats each set of information (Analysis Control, Road Characteristics, Vehicle Fleet, Maintenance Unit Costs,

Policies and Strategies) as independent of each other. Therefore, you can use the same data set name for all the input sets.

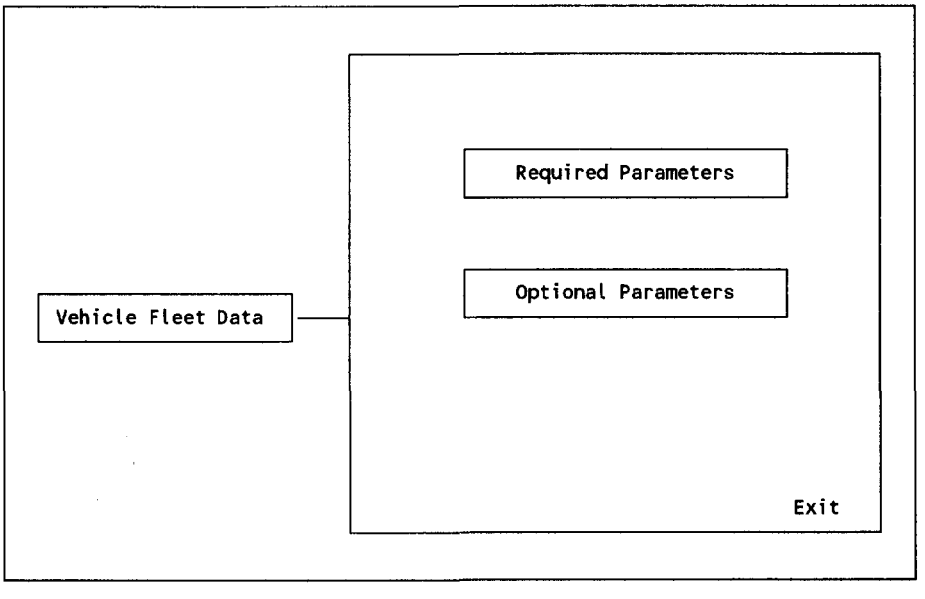
The Road Characteristics data is divided into three screen "pages": i) Page 1 with the road type, road geometry and environment data, ii) Page 2 with the road structure and condition data, and iii) Page 3 with current traffic and expected traffic growth data. Note that the data requested on the second page changes as a function of the road type (paved or unpaved).

To move among the three pages use Next Page option or press the Page Up or Page Down keys. When you use the Edit option, you edit the page being displayed. To edit another page, you have to display the page and then use the Edit option. When you use the Print, Keep, and Get options, you are working with the data of all three pages. Therefore, when you use the Keep option, you are storing the data of all three pages into a single data set file.

For detailed information on the information requested at the Road Characteristics option, refer to the HDM manuals[3]. This input screens contain the information required by the HDM model to describe the road characteristics and traffic (series A and E in HDM). Note that if you don't want to include a particular vehicle type, you should enter 0 (zero) in the corresponding average daily traffic (ADT) field. Note also that as in the HDM Model you have the option of entering both the Structural Number and the Benkelman Beam deflection or just either one of these variables leaving the other as blank.

Defining Vehicle Fleet Data

Select the Vehicle Fleet Data option at the main menu to enter the vehicle fleet characteristics to be used in the HDM run. When you select this option, the Vehicle Fleet Data menu (shown below) appears.



You have three options: i) Enter the Required Parameters, ii) Enter the Optional Parameters, or iii) Exit the menu. Select an option using the arrow keys and the Enter key or by pressing the first letter of the selected option. When you select the Required Parameters option , the Vehicle Fleet Data - Required Parameters screen (shown below) appears.

Vehicle Fleet Data - Required Parameters

Page 1/2

Description Required Data for North Region

BASIC CHARACTERISTICS	Car	Pickup	Bus	Light Truck	Medium Truck	Heavy Truck	Artic. Truck
Gross Vehicle Weight (t)	1.200	1.800	10.900	5.600	11.300	20.800	27.000
ESAl Factor per Veh.(E4)	0.000	0.010	0.500	0.100	1.000	3.000	5.000
Number of Axles	2	2	2	2	2	3	5
Number of Tires	4	4	6	6	6	10	18
Number of Passengers	1.00	1.00	1.00	1.00	1.00	1.00	1.00
VEHICLE UTILIZATION DATA							
Service Life (yr)	10.0	8.0	8.0	8.0	8.0	8.0	8.0
Hours Driven per Year	450	1300	2000	1300	2100	2000	1900
Km Driven per Year	18000	30000	80000	50000	65000	67500	80000
Depreciation Code	2	2	2	2	2	2	2
Utilization Code	1	3	3	3	3	3	3
Annual Interest Rate (%)	12.00	12.00	12.00	12.00	12.00	12.00	12.00

Next Page

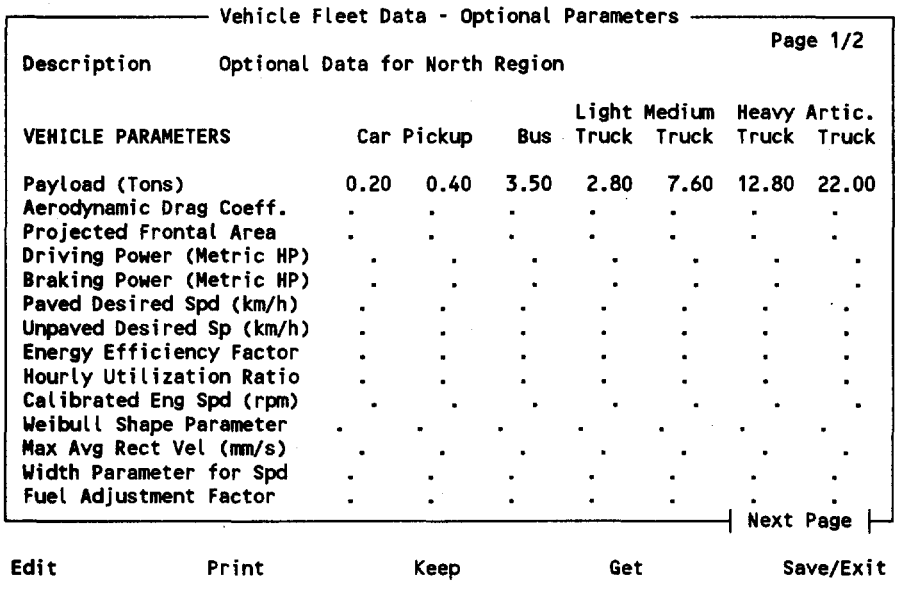
Edit Print Keep Get Save/Exit

The Required Parameters menu is similar to the Analysis Control and Road Characteristics menus. Use the Edit option to edit the information, the Print option to print the information, the Keep option to store the information into a data set file for future use, the Get option to retrieve a data set information, and the Save/Exit option to save the current information and return to the previous menu.

The Required Parameters are defined in two pages of information. Use the Next Page option to move among pages. Remember that the Edit option acts on the current page while the Print, Keep, and Get options act on all the pages.

The Required Parameters (all inputs in Black) option contains the basic vehicle characteristics, the vehicle utilization, and the vehicle unit costs data. The HDM model uses this information to compute the vehicle operating cost of the vehicle fleet as a function of the road geometry and the road roughness.

When you select the Optional Parameters option at the Vehicle Fleet Data menu, the Vehicle Fleet Data - Optional Parameters screen (shown below) appears.



The Optional Parameters menu is similar to the Analysis Control and Road Characteristics menus. Use the Edit option to edit the information, the Print option to print the information, the Keep option to store the information into a data set file for future use, the Get option to retrieve a data set information, and the Save/Exit option to save the current information and return to the previous menu.

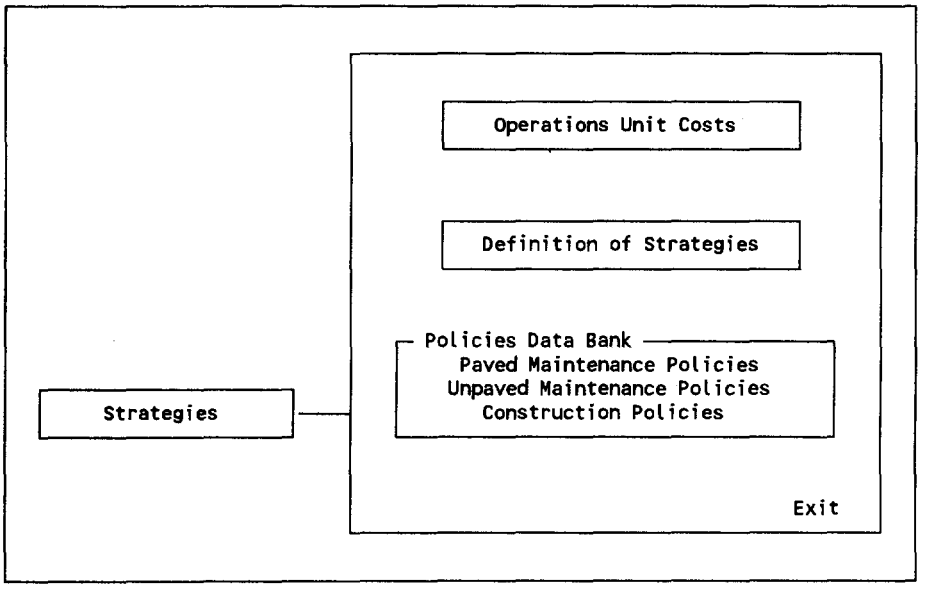
The Optional Parameters option (all inputs in Purple) is used to enter the data required to calibrate the vehicle operating costs model. Remember that if you want to change any of the default values supplied by the HDM model, you should enter the new values, otherwise leave the fields blank (not zero).

For detailed information on the information requested at the Vehicle Fleet Data option, refer to the HDM manuals. The HDM manuals describe each input item, the units used, and the valid range. This option contains the vehicle fleet characteristics required by HDM (series D in HDM). Note that the currency used to enter the unit costs is defined in the Analysis Control screen.

The HDM Manager program adopts the Brazil vehicle operating costs relationships of HDM and defines seven types of vehicles. The number of vehicle types defined is fixed by the HDM Manager program. Therefore, while the full HDM program allows you to change the number of vehicle types and their names, these cannot be changed through the HDM Manager. The HDM Manager allows you to change the characteristics of each of the seven vehicle types defined and if in your analysis you don't want to include a particular vehicle type, enter 0 (zero) in the corresponding average daily traffic (ADT) field at the Road Characteristics option. Note also that HDM Manager does not present the computed vehicle operating costs and vehicle speed by vehicle type, which is available in the full HDM.

Working with Strategies

Select the Strategies option at the main menu to define the road agency strategies to be evaluated in the HDM run. This option displays the Strategies Menu screen (shown below). You have five options: i) Enter the maintenance and construction operations unit costs, ii) Define the road agency strategies, iii) Define a library of possible paved road maintenance policies, iv) Define a library of possible unpaved road maintenance policies, v) Define a library of possible construction policies.



To define the road agency strategies to be evaluated, follow the steps below:

STEP 1 - Define Operations Unit Costs

Define the maintenance and construction operations unit costs. The Operations Unit Costs menu is similar to the Analysis Control menu (see below). Use the Edit option to edit the information, the Print option to print the information, the Keep option to store the information into a data set file for future use, the Get option to retrieve a data set information, and the Save/Exit option to save the current information and return to the previous menu.

The unit costs entered are the costs for a particular (user defined) operation. For example, in the screen below: the financial unit cost for an overlay is equal to 8.00 $/km, the thickness and the material being defined by the user. This cost, for example, may be based on a 40 mm asphalt concrete overlay, but these details are not shown in the input screen. The cost for a particular operation can be adjusted by a cost factor to consider variations on the defined operation (for example to consider different thicknesses or materials) in each policy to be defined in step 2.

The maintenance and construction unit costs can be in any currency (defined in the Analysis Control screen) and will be used by all the road agency

policies to be defined in Step 2. Note that the unit cost for the construction operation is in thousands of the currency defined in the Analysis Control screen.

Strategies - Operations Unit Costs

Description Unit Costs for North Region

Operation	Financial Unit Cost	Economic Unit Cost
Grading (Currency per km of road graded)	85.0	70.0
Spot Regraveling (Currency per cu m)	7.20	6.00
Gravel Resurfacing (Currency per cu m)	17.80	12.50
Unpaved Routine Maintenance (Currency per km per yr)	100	85
Patching (Currency per sq m)	8.00	6.80
Resealing (Currency per sq m)	3.20	2.70
Overlay (Currency per sq m)	8.00	6.80
Reconstruction (Currency per sq m)	40.00	34.00
Paved Routine Maintenance (Currency per km per yr)	500	425
Construction (Thousands currency per km)	120.0	86.0

Note: The input currency is defined in the Analysis Control Data

Edit Print Keep Get Save/Exit

STEP 2 - Define Policies Data Bank

The HDM Manager evaluates road agency strategies. Each road agency strategy is composed of one or more than one paved maintenance policy, unpaved maintenance policy, or construction policy. Therefore, you have to create a Data Bank of road agency policies before defining the strategies to be evaluated.

For example:

Strategy X	Policy 1:	- Grading every 90 days, plus gravel resurfacing (from 1993 to 2011)
Strategy Y	Policy 1:	- Reseals every 5 years (from 1993 to 2002)
	Policy 2:	- Overlays every 9 years (from 2003 to 2011)
Strategy Z	Policy 1:	- Grading every 90 days (from 1993 to 1994)
	Policy 2:	- Paving the road (in 1995)
	Policy 3:	- Overlays when roughness > 4.5 (from 1996 to 2011)

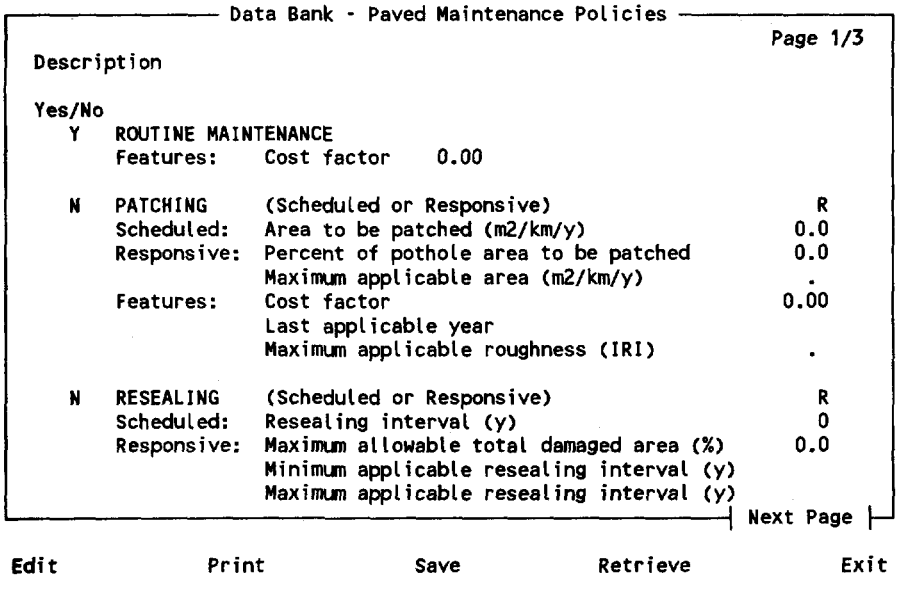
Note that strategies are the road agency alternatives (with the first being the base case) being evaluated. Policies within a strategy are not alternatives, but

a sequence, with only one being applicable in a given year. Note also that a policy can include a number of actions which may be scheduled or condition responsive.

You define the paved maintenance policies, unpaved maintenance policies, and construction policies that should belong to your Data Bank. These policies are stored in data set files with unique file names and should have unique and clear descriptions to identify the policies at the Definition of Strategies phase.

Paved Maintenance Policies

When you select the Paved Maintenance Policies option at the Strategies menu, the screen below appears.



The Paved Maintenance Policies menu is different from the Analysis Control menu or the other previous input data menus described so far. To show that, the screen background is Green while at the previous input data screens the background is Blue. On the Blue input screens, after you select the Save/Exit option, the program saves and retains in memory the information displayed on the screen. This information is then used by the HDM program. The Green input screens are managing a Data Bank of policies stored on files. Therefore, the information is not retained in memory when you select the Exit option. To save the information related to a policy, you have to explicitly use the Save option and supply a file name.

Use the Edit option to edit the information, the Print option to print the information, the Save option to save the information in a file, the Retrieve option to retrieve previously saved information for editing or viewing

purposes, and the Exit option to return to the previous menu. When you use the Save option, you are requested to enter a six digit/character file name and when you use the Retrieve option, the program displays a list of previously saved policies.

Remember that in this step you are not deciding which policies to include in the strategies to be evaluated. You are managing a series of road agency policies stored in files that could or could not be used by the HDM program. You define the policies to be included in each strategy and the timing of these policies in the Definition of Strategies option (see Step 3).

The Paved Maintenance Policies information is composed of three screen "pages". In these pages, you define the maintenance operations included in the policy and the characteristics of the operations. A paved maintenance policy is composed of Routine Maintenance and if wanted other maintenance operations (Patching, Reseal, Overlay or Reconstruction). Each maintenance operation can be scheduled at a certain time interval or activated in response to the condition of the road. Note that the Routine Maintenance operation is always included and that you can have more than one operation in a policy.

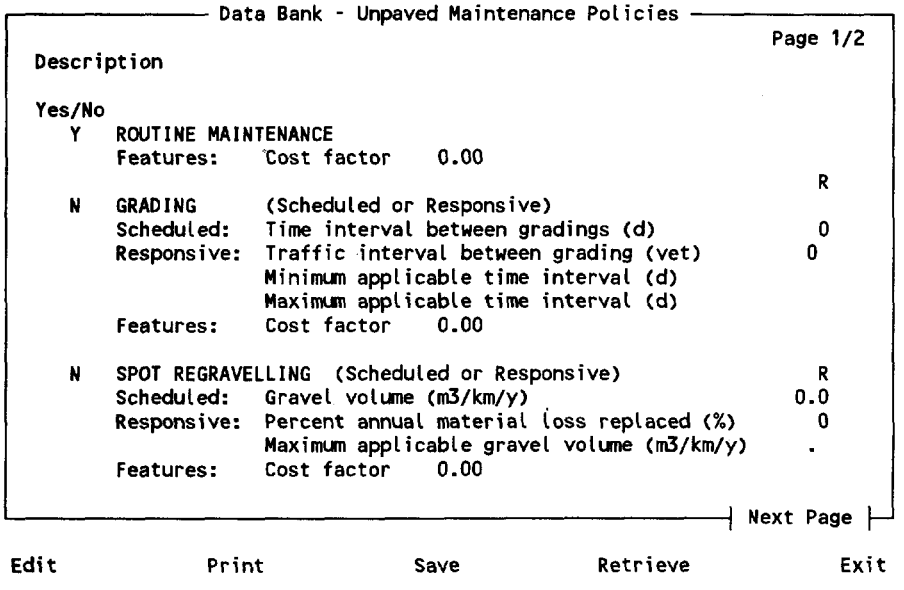
To show that a certain operation should be included on the policy being defined, enter a "Y" at the left column of the screen at the corresponding operation. Otherwise, enter "N" or leave it blank. To select the type of operation (Scheduled or Responsive) place an "R" or "S" at right of the "Scheduled or Responsive" line. If you select the Scheduled option, enter the information at the Scheduled line (lines) and disregard the information on the Responsive line (lines). If you select the Responsive option, enter the information at the Responsive line (lines), and disregard the Scheduled line (lines). In both cases, Scheduled or Responsive options, you should define the Features of the operation.

Unpaved Maintenance Policies

When you select the Unpaved Maintenance Policies option at the Strategies menu, the screen below appears.

The Unpaved Maintenance Policies menu is equal to the Paved Maintenance Policies menu. Use the Edit option to edit the information, the Print option to print the information, the Save option to save the information in a file, the Retrieve option to retrieve previously saved information for editing or viewing purposes, and the Exit option to return to the previous menu. When you use the Save option, you are requested to enter a six digit/character file name and when you use the Retrieve option, the program displays a list of previously saved policies.

Remember that the inputs in Black are required, the inputs in Purple are optional (you can leave them blank, not zero), and the inputs in Brown are obtained from a list of valid options (press F10).



The Unpaved Maintenance Policies structure is similar to the Paved Maintenance Policies structure. The only difference is the type of operations included (Grading, Spot Regravelling, and Gravel Resurfacing). Remember that you select an operations by placing a "Y" at the left of the operation line and you decide between a Scheduled or Responsive operation by placing an "R" or "S" at right of the corresponding line.

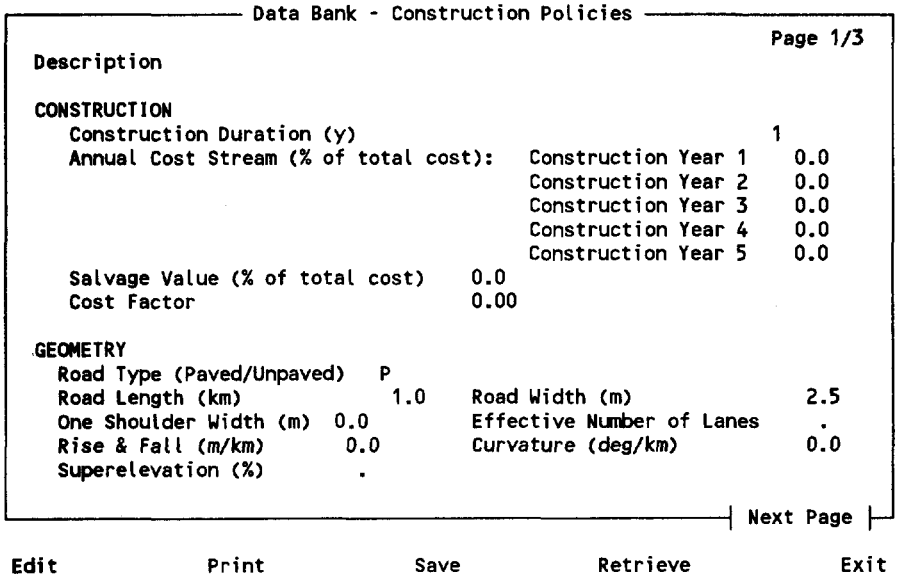
Construction Policies

When you select the Construction Policies option at the Strategy menu, the screen below appears. The Construction Policies menu is equal to the Paved Maintenance Policies menu.

Use the Edit option to edit the information, the Print option to print the information, the Save option to save the information in a file, the Retrieve option to retrieve previously saved information for editing or viewing purposes, and the Exit option to return to the previous menu. When you use the Save option, you are requested to enter a six digit/character file name and when you use the Retrieve option, the program displays a list of previously saved policies.

Remember that each policy should have a unique file name and a unique description. While defining the strategies in Step 3, you will identify the policies that are part of a strategy through the policy description.

The Construction Policies option requests the characteristics of a construction policy. That is, the construction duration and costs, the new road characteristics, and an optional generated traffic.



For detailed information on the information requested at the Paved Maintenance Policies, Unpaved Maintenance, and Construction Policies options, refer to the HDM manuals. The HDM manuals describe each input item, the units used, and the valid range.

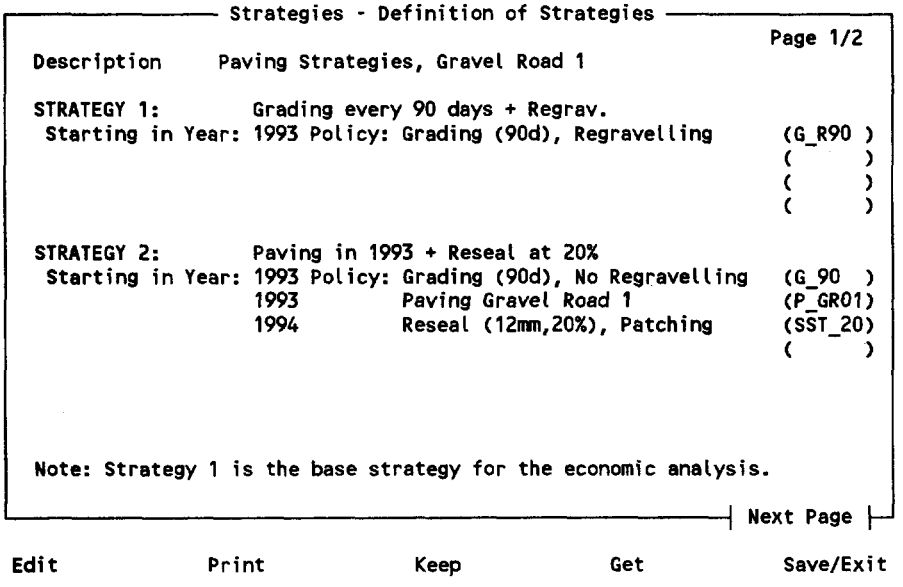
STEP 3 - Define Strategies

The HDM Manager evaluates and compares five road agency strategies at a time. Each strategy is composed of one or more than one road agency policy that is valid for a certain period. The program always analyzes five strategies. Therefore, you always have to define five strategies even if you are interested in the results of only one or two strategies. You could use the other strategies to do some sensitivity analysis.

When you select the Define Strategies option, the screen below appears. The Definition of Strategies menu is similar to the Analysis Control menu. Use the Edit option to edit the information, the Print option to print the information, the Keep option to store the information into a data set file for future use, the Get option to retrieve a data set information, and the Save/Exit option to save the current information and return to the previous menu.

To define the strategies enter the description of the set of strategies and for each strategy defines the policies that compose the strategy. For each strategy, define at least the following information:

- The description of the strategy
- The starting year of the first policy
- The description of the first policy



Each strategy should have at least one policy and the first policy should start at the calendar year of the beginning of the analysis period. Each strategy can have a maximum of four policies. For example:

	Starting in year	Policy Description (Paved Maint., Unpaved Maint., or Construction)
STRATEGY 1	1992	Grading every 90 days
STRATEGY 2	1992	Grading every 90 days
	1993	Paving the road
	1994	Reseal when damage > 30%
	2004	Overlays when IRI > 4.5

A policy will be active from the starting year up to the end of the analysis period, unless a new policy starts. If a new policy starts, the previous policy will be stopped.

Enter the starting calendar year for each policy and to enter the policy description press the F10 key while the cursor positioned at the description field. When you press the F10 key at a policy description field, the program lists all the available policies (stored in your Data Bank and managed in Step 2). Select a policy by highlighting it and pressing the enter key.

Note that the first strategy is the strategy defined by the HDM Manager as the base strategy (do minimum case). The HDM Manager computes the economic benefits of implementing the other strategies in relation to implementing the first strategy.

Running the HDM Model

After defining all the input data, run the HDM model with the "HDM Model" option. This option creates all the input data files required by HDM, runs the HDM program automatically, and after the HDM run is completed, collects the HDM results. Note that you need 3.5 Mb of empty hard disk to store the temporary files created by the HDM program. These temporary files are erased automatically when you exit the HDM Manager program.

If there is an input data or system error detected by the HDM program, the HDM program will not generate the results. The HDM Manager program shows this fact by giving you a warning message. If there is an input data error, you should locate it by viewing the output HDM scan files. Use the "Other Options" option at the main menu. View the SCAN 1 file to locate errors on the Analysis Control and Road Characteristics Data. View the SCAN 2 file to locate errors on the Vehicle Fleet Data and Road Agency Policies. View the SCAN 3 file to locate errors on the Road Agency Strategies and the structure of the run and to obtain a summary table of errors and warnings. View the SCAN 4 file to locate execution errors. After locating the errors, you should fix them and run the HDM model again. If HDM is not installed on your hard disk, the HDM Manager presents a warning message and doesn't compute the results.

Viewing the Road Deterioration

Select the Deterioration option at the main menu to view the road deterioration under the five standards being evaluated. When you select this option, the periodic operations table appears and if you select the Next Table option, the following deterioration (Roughness) table appears.

Roughness (IRI m/km)

	Year	First Strategy	Second Strategy	Third Strategy	Fourth Strategy	Fifth Strategy
1	1993	10.2	10.2	10.2	10.2	10.2
2	1994	10.5	2.7	10.5	10.5	10.5
3	1995	11.2	2.7	2.7	10.7	10.7
4	1996	12.0	2.8	2.7	2.7	10.8
5	1997	12.2	2.9	2.8	2.8	2.7
6	1998	12.3	3.0	2.9	2.8	2.8
7	1999	12.5	3.0	3.0	2.9	2.8
8	2000	11.8	3.1	3.0	3.0	2.9
9	2001	12.8	3.2	3.1	3.0	3.0
10	2002	13.0	3.3	3.2	3.1	3.0
11	2003	13.1	3.4	3.3	3.2	3.1
12	2004	13.3	3.4	3.4	3.3	3.2
13	2005	12.5	3.5	3.4	3.4	3.3
14	2006	13.6	3.6	3.5	3.4	3.4
15	2007	13.8	3.7	3.6	3.5	3.4

Change Years

Next Table Prev. Table Select Table Graph Table Output Table Exit

The Roughness table presents the roughness progression for all five standards and is only one of the following fifteen available tables:

Periodic Operations
Roughness (IRI m/km)
All Cracks (%)
Wide Cracks (%)
Area Ravelled (%)
Pothole Area (%)
Rut Depth (mm)
SD Rut Depth (mm)
Modified Structural Number
Surface Type
Gravel Thickness
Two-Way Average Daily Traffic
Two-Way Annual Equivalent Standard Axles ('000)
First Strategy Deterioration
Second Strategy Deterioration
Third Strategy Deterioration
Fourth Strategy Deterioration
Fifth Strategy Deterioration

To display the next table, select the Next Table option and to display a previous table, select the Previous Table option. To display a particular table, use the Select Table option. Note that the last five tables present all the deterioration characteristics for each strategy (see example below).

First Strategy - Grading every 90 days + Regrav.

	Year	Operations	Roughness IRI	All Crck %	Wide Crck %	Ravelled %	Potholes %	Rut Dpth mm	Mod SN	Surface	Gravel mm	2-Way ADT	Annual 2-Way ESA 000
1	1993		10.2							GRAV	72	200	23.8
2	1994	RESU	10.5							GRAV	193	207	24.5
3	1995		11.2							GRAV	164	215	25.3
4	1996		12.0							GRAV	134	223	26.1
5	1997		12.2							GRAV	103	231	26.9
6	1998		12.3							GRAV	71	240	27.7
7	1999	RESU	12.5							GRAV	189	249	28.6
8	2000		11.8							GRAV	156	259	29.5
9	2001		12.8							GRAV	123	269	30.4
10	2002		13.0							GRAV	89	279	31.4
11	2003		13.1							GRAV	54	289	32.4
12	2004	RESU	13.3							GRAV	168	300	33.4
13	2005		12.5							GRAV	131	312	34.4
14	2006		13.6							GRAV	93	323	35.5
15	2007		13.8							GRAV	55	336	36.6

Change Years

Next Table Prev. Table Select Table Graph Table Output Table Exit

To print, save into an ASCII file or export to Lotus 1-2-3 a particular table, select the Output Table option. If you save or export a table, the program asks for a filename. Enter a legitimate DOS filename including a path and extension if necessary. To graph a particular table, select the Graph Table option.

Viewing the Cost Streams

Select the Cost Streams option at the main menu to view the cost streams for the five strategies being evaluated. When you select this option, the following costs table (Financial Agency Capital Costs) appears.

Financial Agency Capital Costs
(million US DOLLARS)

	Year	First Strategy	Second Strategy	Third Strategy	Fourth Strategy	Fifth Strategy
1	1993	0.000	12.000	0.000	0.000	0.000
2	1994	1.709	0.000	12.000	0.000	0.000
3	1995	0.000	0.000	0.000	12.000	0.000
4	1996	0.000	0.000	0.000	0.000	12.000
5	1997	0.000	0.000	0.000	0.000	0.000
6	1998	0.000	0.000	0.000	0.000	0.000
7	1999	1.709	0.000	0.000	0.000	0.000
8	2000	0.000	0.000	0.000	0.000	0.000
9	2001	0.000	0.000	0.000	0.000	0.000
10	2002	0.000	0.000	0.000	0.000	0.000
11	2003	0.000	0.000	0.000	0.000	0.000
12	2004	1.709	0.000	0.000	0.000	0.000
13	2005	0.000	0.000	0.000	0.000	0.000
14	2006	0.000	2.240	0.000	0.000	0.000
15	2007	0.000	0.000	2.240	0.000	0.000

Change Years

Next Table Prev. Table Select Table Graph Table Output Table Exit

The table presents the financial agency capital cost stream for all five strategies and is only one of the following eleven available tables:

Financial Agency Capital Costs
Financial Agency Recurrent Costs
Economic Agency Capital Costs
Economic Agency Recurrent Costs
Economic Vehicle Operating Costs
Economic Total Society Costs
Net Economic Benefits
First Strategy Costs
Second Strategy Costs
Third Strategy Costs
Fourth Strategy Costs
Fifth Strategy Costs

To display the next table select, the Next Table option and to display a previous table select, the Previous Table option. To display a particular table, use the Select Table option. Note that the last five tables present all the cost streams for each strategy.

To print, save into an ASCII file or export to Lotus 1-2-3 a particular table, select the Output Table option. If you save or export a table, the program asks for a filename. Enter a legitimate DOS filename including a path and extension if necessary. To graph a particular table, select the Graph Table option.

Viewing the Economic Analysis

Select the Economic Analysis option at the main menu to view the economic analysis performed by the HDM model. When you select this option, the following table appears.

Economic Analysis (million US DOLLARS)

Strategy	Constr. Recons. Costs	Periodic Maint. Costs	Recurrent Maint. Costs	Total Agency Costs	Vehicle Operating Costs	Total Society Costs	Net Present Value	Internal Rate of Return (%)
				0.0% Discount Rate				
1	0.00	6.00	0.74	6.74	74.6	81.3	0.0	NONE
2	7.74	1.89	0.84	10.47	45.0	55.5	25.9	17.1
3	7.74	1.89	0.84	10.47	45.8	56.2	25.1	18.7
4	7.74	1.89	0.83	10.46	46.5	57.0	24.3	20.8
5	7.74	1.89	0.83	10.46	47.4	57.9	23.5	MANY
				12.0% Discount Rate				
1	0.00	2.40	0.31	2.71	26.7	29.4	0.0	NONE
2	8.50	0.43	0.35	9.28	16.9	26.2	3.2	17.1
3	7.58	0.39	0.34	8.31	17.7	26.0	3.4	18.7
4	6.76	0.35	0.34	7.44	18.4	25.8	3.6	20.8
5	6.02	0.31	0.34	6.67	19.0	25.7	3.7	MANY

NPV Sensitivity Graph Table Output Table Exit

To print, save into an ASCII file or export the table to Lotus 1-2-3, select the Output Table option. If you save or export the table, the program asks for a filename. Enter a legitimate DOS filename including a path and extension if necessary. Select the NPV Sensitivity option to compute the Net Present Value of all strategies for a range of discount rates. Select the Graph Table option to graph the table.

Producing the Project Summary

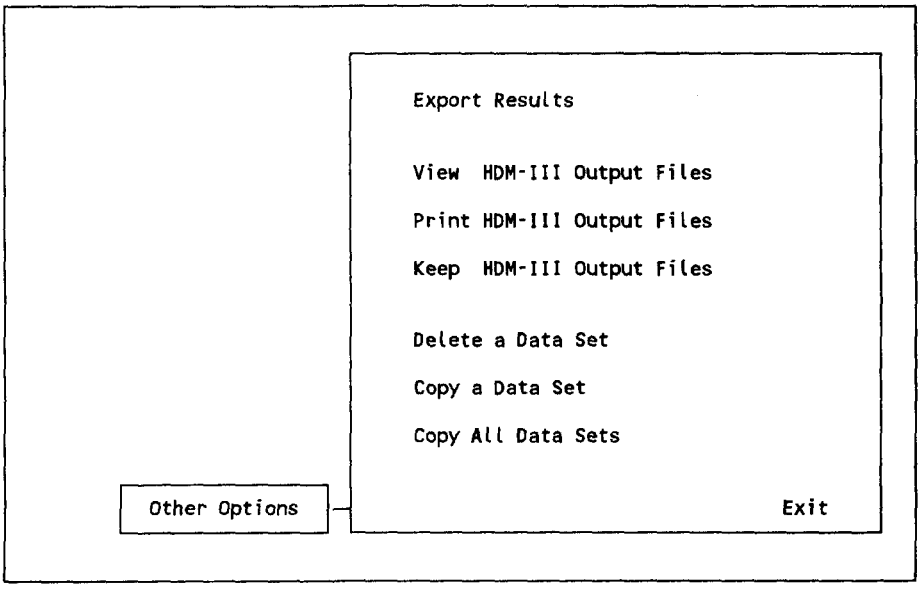
Select the Project Summary option to view, print, or export a summary report for your selected project (see Annex 1). Your selected project should be one of the four strategies being analyzed (second strategy to fifth strategy). Remember that the first strategy is the base strategy (without project case) used to compute the benefits of implementing the other strategies. The summary report prints for the without project case (first strategy) and for the selected project the following information:

- Roughness Progression
- Average Daily Traffic
- Periodic Maintenance Actions
- Financial Road Agency Costs
- Economic Vehicle Operation Costs
- Economic Total Society Costs
- Net Economic Benefits
- Project Net Present Value
- Project Internal Rate of Return

Note that even if the HDM program finds many Internal Rates of Return (MANY is displayed at the Economic Analysis screen) for a particular strategy, the project summary report routine computes the rates of return and presents the appropriate rate of return for the strategy. The appropriate rate of return will be the first rate of return greater than the discount rate if the net present value is positive, and the first rate of return less than the discount rate if the net present value is negative.

Working with Other Options

Select the Other Options option at the main menu to perform any of the tasks listed in the Other Options menu (shown below).

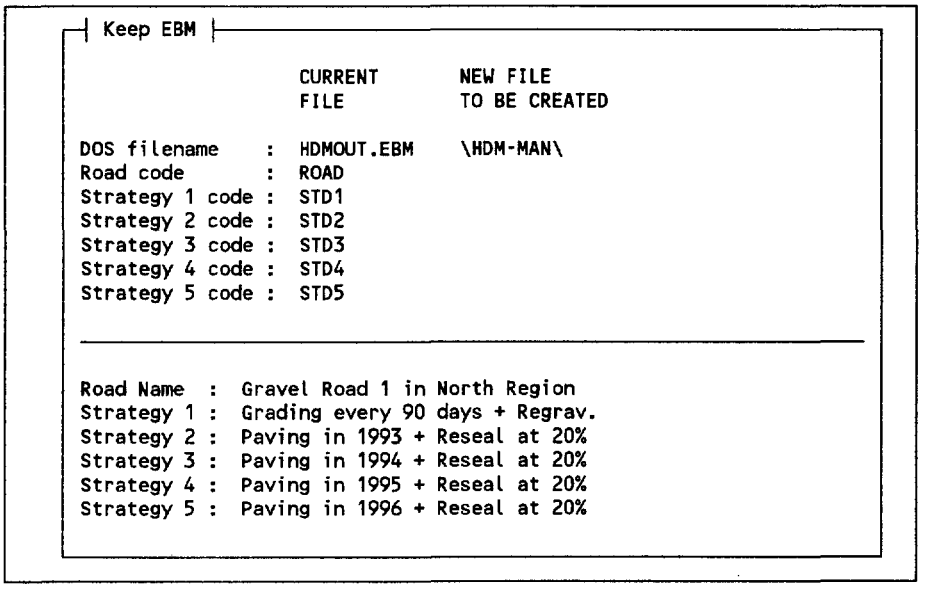


Select the "Export Results " option to export the results to Lotus 1-2-3 or Dbase. You can create a Detailed Lotus 1-2-3 Table (see Annex 2), or a Summary Lotus 1-2-3 Table (see Annex 3). When you select this option, the program asks for a filename. Enter a legitimate DOS filename including a path if necessary. Note that you don't have to include the .WK1 or .DBF extension in the filename. The Lotus 1-2-3 tables can be used to prepare plots or charts, or perform further analysis of the results. The Dbase tables can be used to merge the results of different roads. For this purpose when creating the Dbase Results Table, you can give to each road and strategy an identification code.

Select the "View the HDM Output Files" option to view the output files created by HDM or any text file. When you select this option and the file to view, the file you selected is displayed on the screen. Use the arrow keys to move through the file and press the ESC key to return to the previous menu.

Select the "Print the HDM Output Files" option to print the output files created by HDM. When you select this option, you have to select the file you want to print and a printer from a list of available printers. Note that the HDM output files contain 132 characters per line.

Select the "Keep HDM output files" option to store the HDM output files. Each time you run the HDM program, the previous HDM output files created by the previous HDM run are overwritten. Therefore, use this option to make a copy of these output files for future use before they are overwritten. When you select the file you want to keep, the program asks for the filename (include path and extension) to copy the file. When you select to keep the EBM file, the program requests some additional information (see the screen below).



While you are making a copy of the EBM file, you have the option of changing the road and the strategy codes defined in the current EBM file created by HDM. You may want to change the road and the strategy codes to obtain a unique EBM file for each road.

Select the "Delete a Data Set" option to delete a data set of a particular input module (Analysis Control, Road Characteristics, Vehicle Fleet Data, etc.).

Select the "Copy a Data Set" option to copy a data set of a particular input module (Analysis Control, Road Characteristics, Vehicle Fleet Data, etc.) to a different drive or directory.

Select the "Copy all Data Set" option to copy all data sets to a different drive or directory.

Exiting the Program

Select the Quit Program option at the main menu to exit the program and return to DOS.

Storing the Data Sets in Other Directories

The default setup of the HDM Manager is to store the data sets in the HDM-MAN directory (current directory). If you want to store the data sets in another disk drive or directory, start the program as follows:

HDM-MAN xxxxxxx

replace xxxxxxx by the disk/directory path. For example:

HDM-MAN c:\hdmdata\

Printing the Graphs

To print the graphs, you have the following options::

a) To produce a screen dump to an Epson printer, IBM Proprinter printer, or HP Laserjet printer, press the F7 Key while displaying a graph.

b) To print a high quality graph in a Lasetjet printer, press the F9 Key while displaying a graph.

Note that if you run the HDM Manager under Windows, you can also capture the graphs using the clipboard of Windows.

Monochrome Monitors

HDM Manager detects if you have a color or monochrome board and sets the screen colors accordingly. If you want to force HDM Manager to use the monochrome palette (for example on portable computers), start the program as follows:

HDM-MAN xxxxxxx M

replace xxxxxxx by the disk/directory path. For example:

HDM-MAN c:\hdmdata\ M

HDM Manager and HDM

The HDM program reads a series of input files (ASCII text files) and after it computes the results, it creates another series of output text files. The HDM Manager program stores the input data and the results in Dbase files. Therefore, the HDM input files you created with your word processor or with the HDM Input Data Facility are not compatible with HDM Manager. That means that you cannot import the data stored in HDM input files into HDM Manager.

The HDM Manager creates all the required HDM input files before it runs HDM. These files are named HDMDATA.*. That is, HDMDATA.RUN, HDMDATA.AAA, HDMDATA.BBB, etc. You can view and modify these files with a word processor or the HDM Input Data Facility to run the HDM model directly.

Annex 1 - Project Summary Table

HDM Manager: Project Summary
==========

Project Name : SAMPLE PROJECT SUMMARY

Run Name : HDM-III Runs for North Region

Run Date : 03/03/93

Road Name: Gravel Road 1 in North Region

Road Length: 100.0 km

Currency: Million US DOLLARS

	WITHOUT PROJECT Grading every 90 days + Regrav.					WITH PROJECT Paving in 1996 + Reseal at 20%					
YEAR	ADT	OPER	IRI	FINANCIAL AGENCY COSTS	ECONOMIC V.O.C. COSTS	ECONOMIC TOTAL COSTS	ADT	OPER	IRI	FINANCIAL AGENCY COSTS	ECONOMIC V.O.C. COSTS	ECONOMIC TOTAL COSTS	NET ECONOMIC BENEFITS
1993	200		10.2	0.044	2.309	2.346	200		10.2	0.044	2.309	2.346	0.000
1994	207	RESU	10.5	1.753	2.425	3.662	207		10.5	0.044	2.425	2.462	1.200
1995	215		11.2	0.044	2.594	2.631	215		10.7	0.044	2.532	2.569	0.062
1996	223		12.0	0.044	2.790	2.826	223		10.8	12.044	2.644	11.281	-8.455
1997	231		12.2	0.044	2.913	2.950	231	CONS	2.7	0.050	1.747	1.789	1.161
1998	240		12.3	0.044	3.038	3.075	240		2.8	0.050	1.811	1.853	1.222
1999	249	RESU	12.5	1.753	3.169	4.406	249		2.8	0.050	1.877	1.919	2.487
2000	259		11.8	0.044	3.181	3.218	259		2.9	0.050	1.945	1.988	1.230
2001	269		12.8	0.044	3.445	3.482	269		3.0	0.050	2.016	2.059	1.423
2002	279		13.0	0.044	3.598	3.635	279		3.0	0.050	2.091	2.133	1.502
2003	289		13.1	0.044	3.754	3.791	289		3.1	0.050	2.172	2.215	1.577
2004	300	RESU	13.3	1.753	3.917	5.154	300		3.2	0.050	2.257	2.300	2.855
2005	312		12.5	0.044	3.912	3.949	312		3.3	0.050	2.346	2.388	1.561
2006	323		13.6	0.044	4.261	4.298	323		3.4	0.050	2.438	2.481	1.818
2007	336		13.8	0.044	4.451	4.488	336		3.4	0.050	2.534	2.577	1.911
2008	349	RESU	14.0	1.753	4.645	5.882	349		3.5	0.050	2.634	2.677	3.205
2009	362		13.1	0.044	4.625	4.662	362	RESE	3.6	2.290	2.739	4.671	-0.009
2010	376		14.3	0.044	5.054	5.091	376		3.7	0.050	2.847	2.890	2.201
2011	390	RESU	14.5	1.753	5.279	6.515	390		3.8	0.050	2.961	3.003	3.512
2012	405		13.5	0.044	5.248	5.285	405		3.9	-1.150	3.079	2.262	3.023
Average			12.7						4.7				
Total (undiscounted)				9.425	74.608	81.346				14.016	47.404	57.863	
Total (at 12.00 %)				3.786	26.697	29.406				9.165	19.024	25.691	

Project NPV at 12.00 % Discount Rate: 3.7

Project Internal Rate of Return (%): 23.9

HDM Manager: Detailed Table

Run Name: HDM-III Runs for North Region

Run Date: 03/03/93

Road Name: Gravel Road 1 in North Region

Road Length (km): 100.0

(million US DOLLARS)

Strategy	Year	2-Way Daily Traffi (vpd)	2-Way ESA Annua ('000)	Roughn IRI (m/km)	Periodic Maintena Applied	All Cracks (%)	Wide Cracks (%)	Area Ravelled (%)	Pothole Area (%)	Rut Dept (mm	SD Rut Depth (mm)	Modified Structural Number	Surface Type Code	Gravel Thickness (mm)	Financial Agency Capital	Financial Agency Recurren	Economi Agency Capital	Economi Agency Recurren	Economi Vehicle Operatio	Economi Society Total	Net Economi Benefits
1 - Grading every 90 days + Regrav	1993	200.0	23.8	10.2		0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	71.9	0.000	0.044	0.000	0.037	2.309	2.346	0.000
	1994	207.0	24.5	10.5	RESU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	193.2	1.709	0.044	1.200	0.037	2.425	3.662	0.000
	1995	215.0	25.3	11.2		0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	163.6	0.000	0.044	0.000	0.037	2.594	2.631	0.000
	1996	223.0	26.1	12.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	133.5	0.000	0.044	0.000	0.037	2.790	2.826	0.000
	1997	231.0	26.9	12.2		0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	102.7	0.000	0.044	0.000	0.037	2.913	2.950	0.000
	1998	240.0	27.7	12.3		0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	71.3	0.000	0.044	0.000	0.037	3.036	3.075	0.000
	1999	249.0	28.6	12.5	RESU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	189.2	1.709	0.044	1.200	0.037	3.169	4.406	0.000
	2000	259.0	29.5	11.8		0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	156.4	0.000	0.044	0.000	0.037	3.181	3.216	0.000
	2001	269.0	30.4	12.8		0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	122.9	0.000	0.044	0.000	0.037	3.445	3.482	0.000
	2002	279.0	31.4	13.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	88.6	0.000	0.044	0.000	0.037	3.598	3.635	0.000
	2003	289.0	32.4	13.1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	53.5	0.000	0.044	0.000	0.037	3.754	3.791	0.000
	2004	300.0	33.4	13.3	RESU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	167.7	1.709	0.044	1.200	0.037	3.917	5.154	0.000
	2005	312.0	34.4	12.5		0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	131.0	0.000	0.044	0.000	0.037	3.912	3.949	0.000
	2006	323.0	35.5	13.6		0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	93.4	0.000	0.044	0.000	0.037	4.261	4.298	0.000
	2007	336.0	36.6	13.8		0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	55.0	0.000	0.044	0.000	0.037	4.451	4.488	0.000
	2008	349.0	37.7	14.0	RESU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	165.6	1.709	0.044	1.200	0.037	4.645	5.882	0.000
	2009	362.0	38.9	13.1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	125.2	0.000	0.044	0.000	0.037	4.625	4.662	0.000
	2010	376.0	40.1	14.3		0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	83.8	0.000	0.044	0.000	0.037	5.054	5.091	0.000
	2011	390.0	41.4	14.5	RESU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	191.4	1.709	0.044	1.200	0.037	5.279	6.515	0.000
	2012	405.0	42.7	13.5		0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	147.8	0.000	0.044	0.000	0.037	5.248	5.285	0.000
2 - Paving in 1993 + Reseal at 20%	1993	200.0	23.8	10.2		0.0	0.0	0.0	0.0	0.0	0.0	0.0	GRAV	71.9	12.000	0.044	8.600	0.037	2.309	10.946	-8.600
	1994	207.0	24.5	2.7	CONS	0.0	0.0	0.0	0.0	2.2	1.0	2.8	ST	0.0	0.000	0.050	0.000	0.043	1.572	1.614	2.047
	1995	215.0	25.3	2.7		0.0	0.0	0.0	0.0	2.5	1.1	2.8	ST	0.0	0.000	0.050	0.000	0.043	1.630	1.672	0.959
	1996	223.0	26.1	2.8		0.0	0.0	0.0	0.0	2.7	1.2	2.8	ST	0.0	0.000	0.050	0.000	0.043	1.689	1.732	1.095
	1997	231.0	26.9	2.9		0.0	0.0	0.0	0.0	3.0	1.2	2.8	ST	0.0	0.000	0.050	0.000	0.043	1.751	1.793	1.157
	1998	240.0	27.7	3.0		0.0	0.0	0.0	0.0	3.1	1.3	2.8	ST	0.0	0.000	0.050	0.000	0.043	1.814	1.857	1.218
	1999	249.0	28.6	3.0		0.0	0.0	0.0	0.0	3.3	1.3	2.8	ST	0.0	0.000	0.050	0.000	0.043	1.881	1.923	2.483
	2000	259.0	29.5	3.1		0.0	0.0	0.0	0.0	3.4	1.3	2.8	ST	0.0	0.000	0.050	0.000	0.043	1.954	1.997	1.222

Comparison of Strategies

Strategy	Constr Recon Costs	Periodic Maintenan Costs	Recurrent Maintenanc Agency Costs	Total Agency Costs	Vehicle Operatin Costs	Total Societ Costs	Net Presen Value	Internal Rate of Return (%)
Discount Rate:	12.0							
1 - Grading every 90 days + Regrav	0.00	2.40	0.31	2.71	26.70	29.40	0.0	
2 - Paving in 1993 + Reseal at 20%	8.50	0.43	0.35	9.28	16.90	26.20	3.2	17.1
3 - Paving in 1994 + Reseal at 20%	7.59	0.39	0.34	8.31	17.70	26.00	3.4	18.7
4 - Paving in 1995 + Reseal at 20%	6.76	0.35	0.34	7.44	18.40	25.80	3.6	20.6
5 - Paving in 1996 + Reseal at 20%	6.02	0.31	0.34	6.67	19.00	25.70	3.7	

Annex 3 - Summary Lotus Table

HDM Manager: Summary Table

Run Name: HDM-III Runs for North Region

Run Date: 03/03/93

Road Name: Gravel Road 1 in North Region

	Start	End
Calendar Year	1993	2012
Two-Way Daily Traffic (ADT)	200	405
Annual Two-Way ESA ('000)	23.8	42.7
Cummulative ESA (m/lane/yr)	0.01	0.32
Roughness (IRI)	10.2	
Mod Structural No (MSN)	0.0	
Percent All Cracks (ALL)	0.0	
Pavement Age (yrs)	5	

Length (km) 100.0 Currency MILLION US DOLLARS

Strategy	Financial Agency Recurren 0.00%	Financial Agency Total 0.00%	Financial Agency Recurren 12.00%	Financial Agency Total 12.00%	Economic Vehicle Operation 12.00%	Economic Total Society 12.00%	Net Present Value NPV	Internal Rate of Return IRR	Avg IRI	STD IRI	Min IRI	Max IRI	End IRI	End MSN	End ALL	End AGE	Operations				
1 - Grading every 90 days + Regrav.	8.54	9.43	3.42	3.79	26.70	29.40	0.00	NONE	12.7	1.2	10.2	14.5	13.5	0.0	0.0	1.0	1994RESU	1999RESU	2004RESU	2008RESU	2011RESU
2 - Paving in 1993 + Reseal at 20%	13.04	14.03	12.37	12.76	16.90	26.20	3.20	17.10	3.7	1.6	2.7	10.2	4.2	2.9	0.0	6.0	1994CON	2006RESE			
3 - Paving in 1994 + Reseal at 20%	13.04	14.03	11.03	11.44	17.70	26.00	3.40	16.70	4.0	2.2	2.7	10.5	4.1	2.9	0.0	5.0	1995CON	2007RESE			
4 - Paving in 1995 + Reseal at 20%	13.04	14.02	9.84	10.24	16.40	25.80	3.60	20.80	4.4	2.7	2.7	10.7	4.0	2.9	0.0	4.0	1996CON	2008RESE			
5 - Paving in 1996 + Reseal at 20%	13.04	14.02	8.77	9.17	19.00	25.70	3.70	MANY	4.7	3.0	2.7	10.8	3.9	2.9	0.0	3.0	1997CON	2009RESE			

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3. The highway Design and Maintenance Standards Model

- Volume 1. Description of the HDM-III Model

- Volume 2. User's Manual for the HDM-III Model

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