

HDM4 Overview

HDM-4 is a computer software for Highway Development and Maintenance Management System. It is a decision making tool for checking the Engineering and Economic viability of the investments in road projects. The World Bank for the global use has developed it.

Background

HDM-4 is the new windows version after HDM-III with incorporation of many new features so that it can be used in any locality of the world with any environmental and engineering situation.

Sponsors, Coordinators and researchers

The development of HDM-4 has been primarily sponsored by:

- Asian Development Bank (ADB)
- Department for International Development (DFID) UK
- Swedish National Road Administration (SNRA)
- The World Bank

Contributed by:

- Finnish Road Administration (Finnra)
- Inter-American Federation of Cement Products (FICEM)

The study has been Co-ordinated by:

- **Finnra**: Specification of the Strategic and Programme Analysis.
- **FICEM**: Development of deterioration and maintenance relationship for concrete roads.
- **The Highway Research Group (HRG)**, School of Civil Engineering, the University of Birmingham: System design and software development.
- **Road Research Institute (IKRAM)** in Malaysia supported by **N.D. Lea International (NDLI)**: Provided updated relationship for road deterioration and road user costs.
- **Transport Research Laboratory (TRL)**: Responsible for review and update of flexible pavement deterioration relationship.
- **SNRA**: Responsible for developing deterioration relationship for cold climate, road safety, environmental effects and supporting HRG with system design.

Overview of HDM-4 use in Bangladesh

Bangladesh have been using HDM software since long. The previous version HDM-III was in use till 1999 after which the new version HDM-4 is now in use. The Roads and Highways Department (RHD) is the main user of this software.

The first annual Maintenance programme for the year 1999-2000 was done using HDM-III. The next annual Maintenance programme for the financial year 2000-2001 was prepared using the new version HDM-4.

The consultants of a DFID financed Institutional Development Component (IDC) project is helping RHD since 1994 for the development of their technical skills to maintain their road network according to the modern maintenance management system. A new HDM Circle has been established in the Head Quarter to help attain this goal.

The HDM Circle is carrying out the large-scale surveys like Road Condition Survey, Roughness Survey and Traffic Survey for the whole Road network every year since 1995. So RHD is rich in database. A central databank has been established in the Head Quarter. The data is stored in the local server and is accessible to the users through Local Area Network (LAN). The LAN will be converted to Wide Area Network (WAN) in near future so that the user from the local districts can have access to the database.

What Does HDM Do?

- ◆ **Project Analysis**
- ◆ **Program Analysis**
- ◆ **Strategic Analysis**
- ◆ **Research, Policy and Regulation Analysis**

Project Analysis

Project analysis allows the users to assess the physical, functional and economic feasibility of specified project alternatives by comparison against a base case (do nothing). The key issues are:

- **Pavement structural performance**

Pavement is generally designed to carry the load of traffic that runs over it. If the structure of the road is not strong enough to withstand the traffic loading then the road structure will fail. HDM has the analytical model that can calculate the structural strength of the pavement for the traffic running over it.

- **Life cycle prediction of deterioration, maintenance effects & costs**

For the particular traffic loading, HDM-4 is able to calculate the deterioration of the road structure and the surface for each year of the analysis period. If the user provides the maintenance option then HDM-4 can apply the maintenance, calculates the cost of maintenance and the effects thereof.

For example, if the user gives the option that whenever the roughness will reach 6 IRI, an overlay has to be applied. In this case the HDM-4 will calculate the roughness increase every year due to traffic loading and whenever the roughness will reach 6 IRI, HDM-4 will apply an overlay. As an effect of this maintenance the roughness will be decreased to an extent as will be specified in the overlay option. HDM-4 will also calculate the cost of the overlay with the help of the rate supplied by the user.

■ Road user costs and benefits

The road user costs consists of the Vehicle Operating Costs (VOC), the Travel Time Cost (TTC) and the Accident Cost (AC). If no maintenance is done (do nothing option) the road user costs will be high but if any maintenance is applied such as overlay (do something option), the road user costs will be reduced to a great extent. If the Road user costs of the above two options are compared then it will be seen that a benefit will be obtained by doing the maintenance.

■ Economic comparison of project alternatives

For the maintenance of the road, the user might have various maintenance strategies. HDM can calculate the economic indicators like NPV, IRR etc for every option of the maintenance strategies for the projected analysis period. The most beneficial maintenance option will be one that gives the maximum economic return.

The project analysis can be done for

◆ Maintenance of Existing roads

- Crack Sealing
- Pothole Patching
- Seal coat
- Single Bituminous Surface Dressing (SBSD)
- Double Bituminous Surface Dressing (DBSD)
- Carpeting
- Overlay
- Pavement strengthening

◆ Improvement of existing roads

- Pavement reconstruction
- Pavement upgrading
- Road widening and geometric improvements
- Realignment

◆ **New construction**

- Involves entirely new construction

◆ **Stage construction**

- Planned improvements at fixed stages, say from HBB to Bituminous pavement.

◆ **Project evaluation**

- Assessment of the performance of the completed project to see if objectives set out during appraisal have been met.

Program Analysis

- ◆ **Multi-year rolling program for road network through maximization of NPV/Cost ratio. It deals primarily with the prioritisation of a defined long list of candidate road projects into a one-year or multi-year work programme under a defined budget constraints.**

The Programme analysis as it is termed, is the analysis for doing the yearly maintenance programme or for the multi-year rolling programme. The programme analysis tool has been incorporated in HDM-4 for easy analysis of the whole road network for identifying the candidate road sections for the maintenance for a particular budget period. For the constraint budget, the economic criteria for selecting the candidate road is the maximisation of NPV/Cost.

RHD has prepared the yearly maintenance programme for the financial year 2000 – 2001 by doing this programme analysis for the bituminous roads of the whole road network.

By doing the programme analysis one can get the following:

- Identify the candidate road sections for maintenance,
- Determine the alternative improvements,
- Optimisation of the programme in case of budget constraints,
- Obtain the optimised list of projects for the budget period.

Strategic Analysis

◆ Analysis of whole network for long term planning under different budget scenarios.

The analysis is done on the entire road network for long term budget planning or for optimising the maintenance strategies. In any case whole network is subdivided into several network according to the key attributes that influence the pavement performance.

For example, we can subdivide the network according to three categories of traffic loading (High, medium and low) and three categories of surface condition such as Good, Fair and poor. In this case the entire network will be divided into $3 \times 3 = 9$ networks.

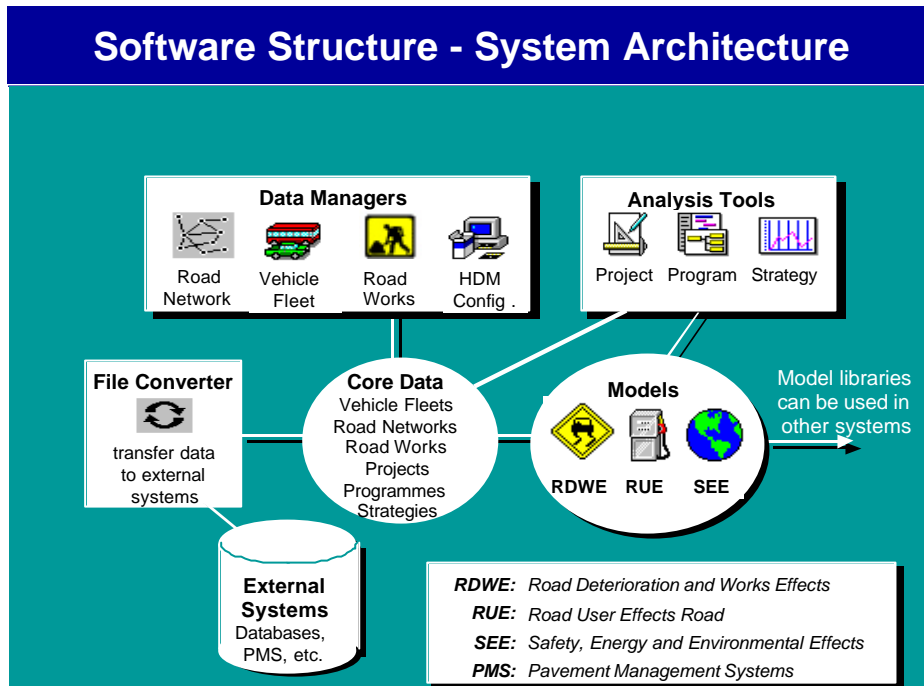
We can now make a life cycle analysis for 20 years say, run the 9 sections to see which maintenance option will be appropriate for which network, what is the total budget requirement and if we don't have the enough money we can make optimisation.

Research, Policy and Regulation Analysis

HDM may also be used for research purposes such as:

- ◆ Funding policies for competing needs; for example, Feeder roads versus main roads
- ◆ Road User charges for setting up road funds
- ◆ Impact of axle load limits
- ◆ Pavement design evaluation
- ◆ Pavement maintenance and rehabilitation standards

HDM-4 software System Architecture



Road Maintenance & Improvement

- Affects long term pavement performance
- Funding requirements depend on specified maintenance standards & unit costs

