Road Transport Investment Model RTIM3

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To simplify the economic appraisal of road investments in developing countries, a new version of the Road Transport Investment Model (RTIM) has been issued by the Overseas Centre of the Transport Research Laboratory. The model consists of a series of linked compiled spreadsheets that take the user through the stages of an economic appraisal. It is easy to use and offers context-sensitive help facilities, data checking on input, and tabular and graphical outputs. The model runs quickly and easily on a small personal computer. Two examples of its use in Tanzania are described.

The Transport Research Laboratory (TRL) developed the Road Transport Investment Model (RTIM) for the economic appraisal of road schemes in developing countries (*1*). The model compares road expenditures on road improvements and road maintenance with the operating costs over the life of a road. It can be used to determine if improvements or given maintenance standards are economically justified.

The main elements of the model are road deterioration relationships, which predict how the condition of a road will change during its life, and vehicle operating cost relationships, which calculate how road user costs will vary with the state of the road. These two sets of relationships have been the subject of extensive field studies. RTIM has been in use for more than 20 years and has been applied to projects in more than 30 countries.

User Problems

TRL has been advising on economic appraisals in developing countries for years. There is a clear need for simple and easily understood investment models. The main problems include the following.

- Obtaining the necessary input data. The models usually require detailed data inputs describing the roads, the vehicles, traffic flows and compositions, and so forth. In general, the more complex the model, the greater the number of inputs required. Deriving them can be quite beyond the means of many users, who may have to estimate or rely on the default values provided with the models. This may not be appropriate.
- Adapting the models to deal with nonstandard situations. A large proportion of economic appraisals have aspects that are not standard and that are not expressly treated in the models. To deal with them, ad hoc modifications must be made to the input data or to the method of analysis. The full implications of these modifications are easily misunderstood.
- Training and retaining model users. Government ministries in developing countries often experience great difficulty training and retaining skilled computer modellers. Frequently, the only significant economic ap-

praisal exercises carried out are conducted by visiting specialists on short-term assignments. When they leave, there is little residual ability to extend or modify their analyses.

• Keeping up with research developments. Road investment models incorporate the results of extensive field studies carried out over many years. However, the research findings are not conclusive. New relationships are being developed to improve existing models and extend the models to other applications. An investment model must be able to incorporate new findings without needing a major rewrite.

NEW DESIGN

To address these problems and take advantage of facilities provided by the modern personal computer, RTIM was rewritten. The new version, RTIM3, was released in July 1993. It consists of a series of interlinked spreadsheets that take the user through the different steps of an economic assessment (Figure 1). A spreadsheet format was chosen because (*a*) it lends itself well to a year-by-year analysis, (*b*) it offers very direct user interaction, and (*c*) most PC users are familiar with it.

The spreadsheets were compiled using Baler. (Baler and Lotus are the respective trademarks of the Baler Software Corporation and the Lotus Development Corporation.) To help with data entry, the model provides context-sensitive help screens that give details of the required input, including typical values and acceptable ranges. In addition, help screens describe how each spreadsheet works and supporting background information is provided.

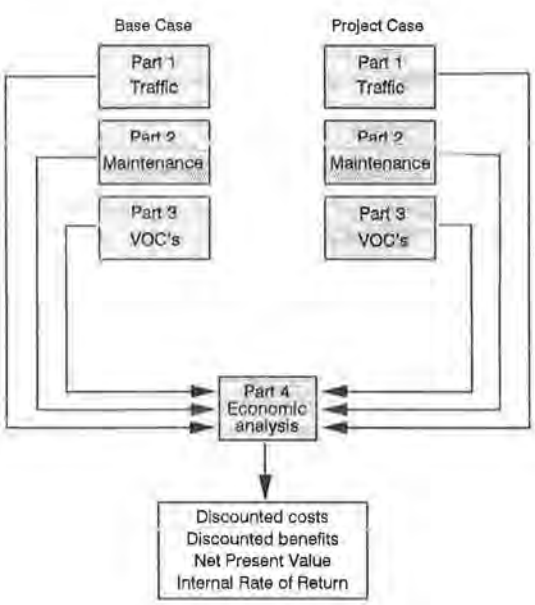

FIGURE 1 Program structure.

Equations are protected from accidental corruption and function keys have been redefined to automate procedures such as printing and saving files. Results can be exported in a Lotus spreadsheet. To facilitate error detection, data inputs are checked on entry, and error messages are prominently displayed. If an error message is saved, the program generates a warning tone.

The spreadsheet calculates the results of the information and presents the findings as tables and a graph. On the basis of intermediate outputs, the user has the opportunity to adjust the input data. It is easy to move on to the next spreadsheet or backtrack and change information in an earlier spreadsheet.

Overall, RTIM3 uses the same equations as does RTIM2. However, some of the relationships have been simplified, and facilities have been added to allow users to adjust relationships.

The modular structure makes it possible to use different spreadsheets in different situations. In addition to the alternative spreadsheets for earth, gravel, and paved roads, there is a simple spreadsheet that allows the user to specify the yearly road roughness and maintenance costs rather than having them calculated by the model.

If road conditions or traffic levels are not uniform, it may be necessary to divide the road into separate links. The model allows this, and up to five links can be combined in one analysis.

In most cases, the spreadsheet can calculate the effects of changing input data immediately. However, the vehicle operating cost equations and the economic analysis are complex. They are derived using automated routines but normally execute results quite quickly. The hardware requirements of the new program are modest, and include a PC with one megabyte of RAM, a few megabytes of hard disk space, and preferably a color monitor.

Figure 2 shows a typical graphical output from the economic analysis. It depicts the year-by-year discounted costs and benefits arising from a project to surface dress a gravel road. The construction costs are the large initial negative values. The vehicle operating cost benefits are shown over the next 20 years and decline steadily due to discounting. The positive spikes represent additional benefits, the savings in regraveling costs and the terminal value.

CASE STUDIES

Two very different case studies from Tanzania demonstrate the use of RTIM3. The first is the rehabilitation of a paved highway, and the second is improvements to a road network.

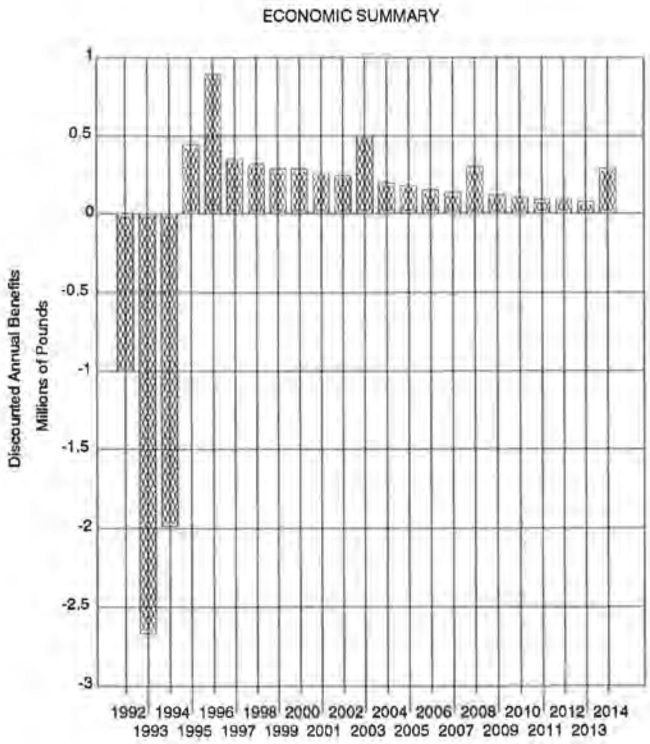

FIGURE 2 Typical program output.

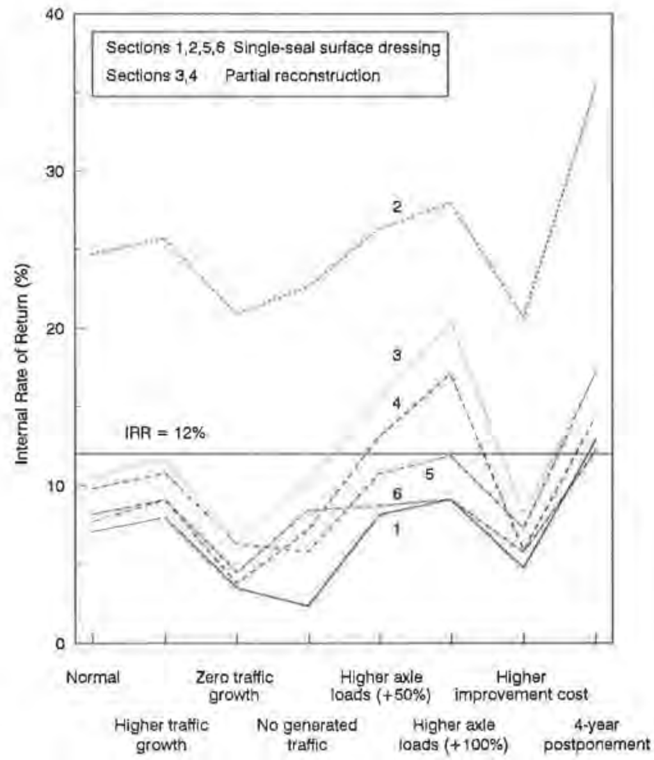

FIGURE 3 Nyanguge-Bunda-Musoma pavement evaluation: sensitivity of internal rates of return.

Nyanguge-Bunda-Musoma Pavement Evaluation

The study was designed to determine the economic viability of proposed improvements to a 192-km highway. Improvements to two nearby roads were expected to increase traffic flow, which raised the possibility of rapid deterioration of the highway. To carry out the analysis, the highway was divided into six sections and each was examined separately.

In the base case, it was assumed that a routine maintenance regime would be adopted; in the project case, it was assumed that there would be partial reconstruction or single-seal surface dressing. Figure 3 shows the calculated internal rates of return (IRR) for each section. The second section, which is the roughest, had the highest IRR. The others were not economically justified because their IRRs were less than the specified discount rate of 12 percent.

A number of sensitivity tests were carried out, the results of which are also shown in Figure 3. Traffic growth, level of traffic generation, axle loading, and improvement costs were examined. The consequence of a 4-year postponement in implementation was also considered.

The results show that the improvement to Section 2 was always justified; higher traffic growth could almost justify the improvement to section 3; increased axle loads (due to overloading) could justify the improvements to Sections 3, 4 and possibly 5; and a 4-year postponement would make all the proposed improvements economically sound.

Road Network Improvements in Ruvuma and Southern Iringa

The second study considered possible improvements to a 1200-km network of trunk, district, secondary, and tertiary roads. The network was divided into 51 separate roads, and an improvement project was proposed for each one. Limited funds were available, so the projects were ranked in order of rate of return. The form of the improvement varied with road type and ranged from resurfacing (in the case of paved trunk roads) to gravelling (in the case of rural earth roads).

The analysis included economic allowance for social benefits, such as more reliable access to schools and hospitals. Overall, the rates of return were very high: 43 projects had an IRR greater than 12 percent and 23 projects had an IRR greater than 24 percent. The analysis was supplemented by a series of sensitivity tests.

Discussion of Results

The model has proven to be quite successful. Users have found it easy to understand and operate; therefore, they are quickly able to identify the key factors in their analyses. One factor it often highlights is a heavy dependence on the assumed level of road maintenance in the base case.

RTIM3 is issued under license and sold at a nominal price (£150). To date, 100 copies have been distributed to users worldwide. Further spreadsheets on road deterioration are planned to incorporate more recent research findings. The possibility of producing further modules on vehicle operating costs and traffic congestion is under review.

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1. Parsley, L. L., and R. Robinson. *The TRRL Road Investment Model for Developing Countries (RTIM2).* TRRL Laboratory Report 1057. U.K. Transport and Road Research Laboratory, Crowthorne, Berkshire, England, 1982.