MODEL DEVELOPMENT

One of the major activities of the project is the direct adaptation of relationships developed in the project to the latest version of the Highway Design and Maintenance Standards Model (HDM) developed from a combined MIT/TRRL/World Bank effort. Following a number of modifications to this model by the World Bank, it was made available to the project, and is currently operational and being tested in Brazil.

The Brazil version of the model could be directed to any one of a number of planning levels. To illustrate, a subjective scale of sensitivity is shown in Figure 31. At the top end of the scale we show network planning. At this level, the planner wants to establish the character of the links in a state or countrywide analysis. Considered are traffic patterns and benefits resulting when links are added to or improved within the existing network. The number of combinations requiring examination is large, and therefore only the most general evaluation of individual link costs are feasible.

Next we have the selections of alternates, from where it is possible to examine any number of possible paths and roadway standards between two points and select an alternative based on the optimization of a specified value function. In this situation, one expects to evaluate different length routes over different terrain. A moderate level of sophistication is warranted such as predicting earthwork as a function of maximum grades and contour line crossings.

At the project link analysis level, essentially one path is considered. The geometry may be optimized to minimize either construction or total transport costs over the link. One expects a reasonably good description of the terrain, and accuracy sufficient for feasibility estimates of cost.

Finally, a model can be developed to produce essentially final design details suitable for construction plans.

The major thrust of the Brazil study is to develop improved

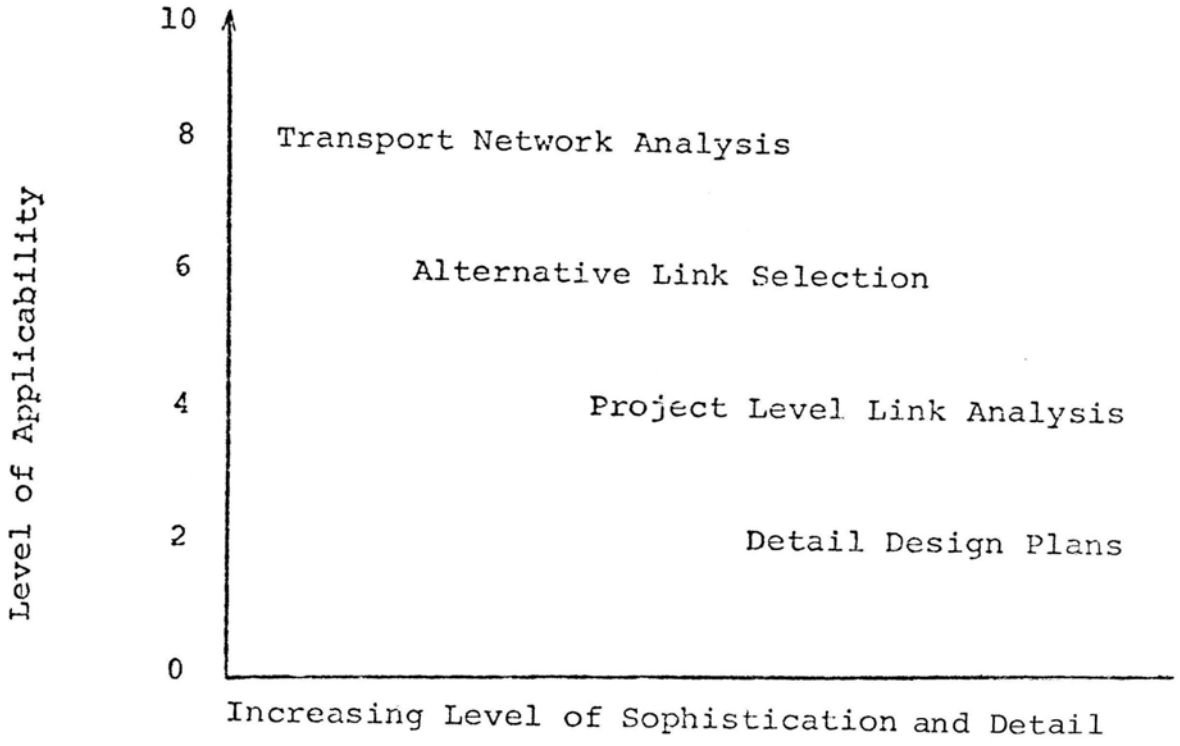

Figure 31 - Relationship Between Level of Applicability of a Planning Model and the Level of Sophistication Warranted.

relationships on pavement performance and vehicle operation costs in Brazil. Further, the study has been formulated so that it will be possible to develop routines with details comparable to those used in the TRRL construction subroutines.

Instead of a generalized rise-and-fall index for vertical geometry, plans were formulated to evaluate the influence of individual grades on vehicle operation cost. The same was true for horizontal curves. The entire inference space on each experiment was made as wide as possible. A detailed program was outlined to monitor the behavior of pavements receiving two extreme maintenance responses. The objective was to have information at hand to develop relationships which would improve on the sophistication of the maintenance and pavement performance subroutines and the vehicle operating cost routines of the TRRL model.

A construction routine that outputs a description of the roadway link in terms of each grade and horizontal curve is not part of the HDM model, yet the project approach to developing vehicle speed and fuel consumption requires this detail. Also details on terrain will be needed to accomodate a required construction routine.

The HDM model uses average annual daily traffic volumes (AADT). Thus, to handle volume and composition effect on traffic congestion, hourly distributions of traffic by vehicle class are required.

During the conceptualization of this study for the Inception Report (Ref. 6) the TRRL Model was examined as a guide. The level of detail varied considerably within this model, but the construction subroutines were far more sophisticated than either the pavement performance maintenance routines or the user costs routines.

Therefore, it seemed clear that the output of this study would be relationships more detailed and sophisticated than those used in the TRRL pavement and user costs routines, and comparable in detail to the TRRL construction routines.

Approach

As a result of the work being pursued in Brazil we expect to establish major modifications to some of the relationships used in the existing models. Foremost will be the manner vehicle speeds and fuel consumption are to be handled. Instead of using a single predictor equation for a link or section, we propose to simulate the behavior of a vehicle on the study link and develop a continuous speed profile reflecting the impact of changes in vertical and horizontal alignment by vehicle class for given different levels of volume and various vehicle compositions.

Fuel consumption also will be computed in increments and accumulated for every change in speed or mode of operation defined by the speed profile.

The greater number of different classifications of vehicles over a range of loading being studied is expected to produce relationships covering a wider spectrum of the vehicle stream. Therefore, more classifications of vehicle types will be handled in the model than is currently possible.

A high priority item in this study is the development of information on the utilization rates of vehicles on different roadways. This will have an important impact on determining depreciation rates where almost no information has been developed historically on the influences of the road itself on vehicle utilization.

A completely new set of equations are expected to be developed for vehicle maintenance and repair, tire wear and oil consumption, based on the user cost surveys.

New and improved relationships, permitting the impact of various maintenance levels on future pavement performance, are expected to be developed from our pavement performance and maintenance studies.

Thus far, the staff has made very little progress toward actually putting together a Brazil version of the Model. The reason is that higher priority has been assigned to the basic research activities. Each of the three study groups has marsh

alled considerable resources to generate information from which interrelationships on highway construction, maintenance and utilization are to be developed for Brazil. Without these relationships, the development of a new planning model is meaningless. Therefore, it is still necessary to allocate the principal resources of the study to the development of the basic relationships needed for the model.

Yet, the final product of this research project will be an operational Highway Investment Model that incorporates the relationships developed during the study. It also will be necessary that the model be documented so that it can be readily modified and updated by Brazilian personnel after the project is complete and the research team is dismantled.

The option to generalize the detailed relationships being developed is always available. However, if the relationships were generalized now, it would not be possible to work back to the detail and sophistication feasible with the data being developed. Therefore, the modeling effort will first be directed towards establishing the detail possible with the data in hand. Next, relationships will be generalized and incorporated into the existing program structure of the HDM. This will represent the first step in adaptation to Brazil conditions. The resulting model will be called MOBAIR-1 (Modelo Brasileiro para Avaliação de Investimentos Rodoviários).

Following the initial adaptation process and the creation of MOBAIR-1, further refinements and adaptations will be made. This process will produce subsequent versions of the model, MOBAIR-2, 3 etc. and each new version will attempt to improve the utility of the model to Brazilian needs.