

CHAPTER 1  
BACKGROUND, OBJECTIVES,  
ORGANIZATION



## 1.1 BACKGROUND

Transportation planners and technicians seek to maximize the return on highway transportation investments, particularly in the case of roads characterized by low volumes of traffic, by minimizing the overall costs of construction, maintenance and utilization of these roads.

These costs are correlated, since a highway constructed on the basis of high quality design and materials will result in lower maintenance costs, and the operating costs of the vehicles utilizing the highway will also be reduced. However, the fact that this alternative demands a high level of initial investment reduces the number of highways that can be built, while unnecessarily increasing the overall costs of the road. This is demonstrated by the fact that the additional costs of construction will be greater than the reductions in the costs of highway maintenance and vehicle operation. On the other hand, if construction is based on an overly modest standard of quality, the costs of highway maintenance and vehicle operation will be excessive and the final overall costs will be greater. Therefore, one can perceive that, between these two extremes, there is a project of intermediate quality which minimizes the total cost of highway transportation.

However, to determine which project yields the lowest total costs, one must know: (1) the costs of each of the alternative projects; (2) the costs of maintenance consequent upon the interaction of project quality with traffic volume, in the context of local climate and soil conditions; and (3) the influence of the project parameters - the surface quality and the horizontal and vertical geometry of the future road - on the operating costs of the vehicles which will utilize the highway during its life span.

The construction cost of a given project can be obtained by calculating the costs of the operations of earth moving, paving, drainage and complementary tasks, such as tunnels, viaducts, etc., either through the utilization of economic engineering methods or through the evaluation of proposals submitted in past public bidding.

However, it is more difficult to specify the cost of maintenance, since highway wear depends on the interaction of project quality with the type and volume of traffic. Particularly in the case of Brazil, studies on the quantitative nature of this interaction were few.

Notwithstanding this, the major unknown factor in the composition of the total cost of highway transportation was the cost of vehicle operation on roads with differing parameters of geometry and surface quality.

The Research on the Interrelationship of Highway Construction, Maintenance and Utilization Costs (PICR), was planned and executed with the objective of gaining more precise knowledge of the composition of the total cost of highway transportation, composed of the costs of construction, maintenance and utilization of highways.

The sponsors of the project were the Secretariat of Planning of the Presidency of the Republic (SEPLAN), acting through the Institute of Economic and Social Planning (IPEA) and the Secretariat of International Economic and Technical Cooperation (SUBIN), both of which are subordinated to SEPLAN, and the United Nations Development Programme (UNDP).

The Brazilian Transportation Planning Agency (GEIPOT) was charged with the execution of the project. In order to carry out its task efficiently, GEIPOT associated itself with the National Highway Department (DNER), through its Institute of Highway Research (IPR).

The International Bank for Reconstruction and Development (IBRD) was designated as executor of the UNDP responsibilities. After consulting with GEIPOT and receiving its approval, the Bank contracted the Texas Research and Development Foundation (TRDF), to act in its name in the technical direction of the project.

This research project has been previously planned in a study ordered from the consulting firm *Centre Experimental de Recherches et d'Etudes du Batiment et des Travaux Publiques* (CEBTP).

## 1.2 OBJECTIVES

In the agreement between the Brazilian government and the UNDP, the short-term objective was that of ascertaining the correlation among the three major components of the total cost of highway transportation: the costs of highway construction, maintenance costs, and the costs of vehicle operation. In the form of equations and/or parameters, these correlations could be used individually by highway transportation planning technicians, in the evaluation of the gains or savings implicit in the diverse investment alternatives, thus making it possible to arrange the outlays of the sector in hierarchical form.

The long-term objective was that of minimizing the total cost of highway transportation. To attain this objective, adaptations or modifications would be introduced into the model produced by the Massachusetts Institute of Technology (MIT), or into that of the Transport and Road Research Laboratory (TRRL), while the correlations, equations and parameters developed by the PICR would be utilized.

The aforementioned models calculate and add - with the aid of computers - the annual costs of construction, maintenance and utilization corresponding to each highway project under consideration.

The results of the simulations produced by the models would then constitute a discrete series of results, which would then make it possible for the planner - with considerable speed and at low cost - to effect comparisons and opt for a specific investment policy.

## 1.3 ORGANIZATION

To attain these objectives, it was necessary to obtain information on the physical characteristics of different types of roads and on the operation of representative vehicles of the national fleet, in the context of the widely varied combinations of highway geometry and surface roughness. Among other things, this demanded

a complex and detailed survey of the surface quality and vertical and horizontal geometry of thousands of kilometers of roads, as well as tests which would determine travel time, fuel consumption, wear of tires and parts, etc., in different combinations of roughness and geometry.

A research project of the scope of the PICR demanded an adequate organization, as well as technical-scientific support that was not available in Brazil at the time work began. Other necessities included special measuring instruments and a multidisciplinary team with a high degree of knowledge of the problems associated with highway research.

To obtain the additional human and financial resources, the Brazilian government sought out the United Nations Development Programme (UNDP), and obtained from this agency the complementary support necessary for contracting a multidisciplinary team, as well as for selecting, acquiring and testing the necessary equipment and bringing it to Brazil.

The UNDP delegated the task to the World Bank which, after consultations with GEIPOT, contracted the Texas Research and Development Foundation (TRDF), to act as its project agent.

GEIPOT joined with the National Highway Department (DNER) in the constitution of the project's technical team, while also assuring itself of the cooperation of the Highway Departments (DERs) of Goiás, the Federal District, Minas Gerais and São Paulo. GEIPOT assumed the task of overall project coordination, while the TRDF, acting in the name of the World Bank, took on the responsibility for the technical direction.

In terms of data gathering, three groups were created with the following specific tasks:

1. To gather information on the costs of vehicle operation, including such major components as consumption of fuel, lubricants, grease, parts, tires, mechanic labor, operating labor and travel time;
2. To observe the behavior of the highway users, in the context of the geometric characteristics of the road,

environmental factors, surface quality, etc.; and to simulate this behavior in controlled experiments, while measuring fuel consumption;

3. To collect data and carry out tests on selected highway segments, with the purpose of observing the process of gradual deterioration.

To provide adequate technical support to the groups responsible for the gathering of data, three general technical support groups were formed:

1. The group of analysis and statistics was given the task of designing and accompanying the data gathering process of each group, while also analyzing the resulting data;
2. The group responsible for the measuring instruments was charged with the task of maintaining the instruments and equipment in good operating condition, while carrying out the adaptations indispensable to local conditions;
3. The data processing group had the major task of punching, filing and maintaining the data gathered by the different groups in a suitable way, for the later task of statistical analysis.

A consultative group designated the Expert Working Group (EWG) was formed, which was composed of six specialists of international renown. This group was given the specific task of providing guidance in the determination of methods and techniques that would better satisfy the demands of the research project, while also holding periodic meetings with the project team for the purpose of discussing the course and progress of the work.

Detailed information on the work carried out and on the localization of the information produced by the PICR is found in the eleven subsequent volumes of the present report, as well as in the working documents and manuals described in this volume.

