

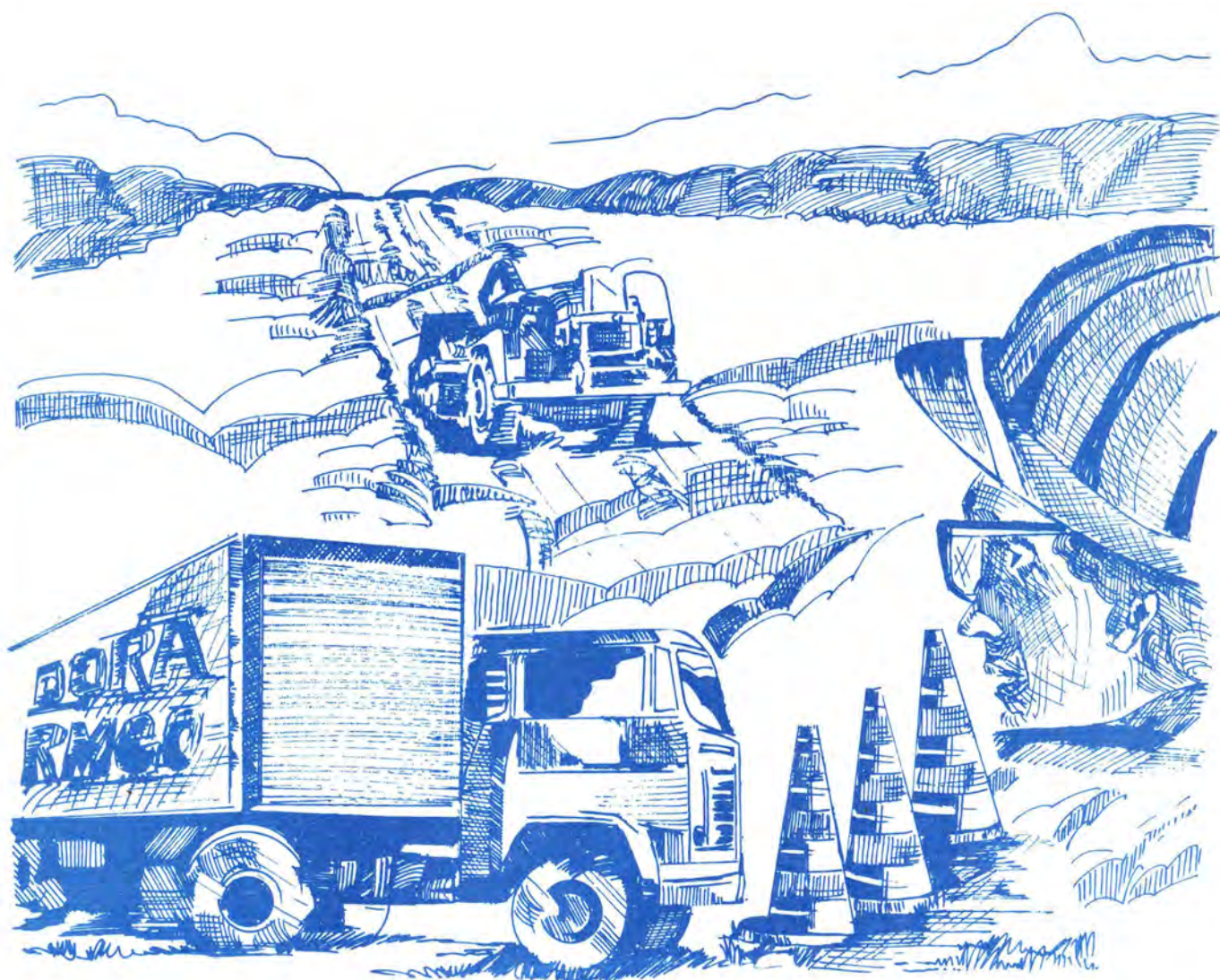
REPÚBLICA FEDERATIVA DO BRASIL

MINISTÉRIO DOS TRANSPORTES

United Nations Development Programme (UNDP)

Research on the Interrelationships Between Costs of Highway Construction, Maintenance and Utilization

Final Report - 1981



VOLUME 7 – Study of Pavement Maintenance and Deterioration

REPÚBLICA FEDERATIVA DO BRASIL

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Final Report - 1981

SPONSORED BY:

MINISTÉRIO DOS TRANSPORTES

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Conteúdo: v.1 Summary of the ICR Research v.2 Methods and organization v.3 Instrumentation v.4 Statistical guide v.5 Study of road user costs v.6 Study of vehicle behavior and performance v.7 Study of pavement maintenance and deterioration v.8 Highway cost model (MICR) v.9 Model of time and fuel consumption (MTC) v.10 Model for simulating traffic (MST) v.11 Fundamental equations v.12 Index to PICR documents.

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PREFACE

This research project was funded through an agreement signed in January, 1975 by the Brazilian Government and the United Nations Development Programme (UNDP). The Ministry of Transportation, acting through the Brazilian Transportation Planning Agency (GEIPOT), assumed the responsibility for the project on behalf of the Brazilian Government and the International Bank for Reconstruction and Development (IBRD) acted as the executing agency for UNDP.

The research was carried out by GEIPOT and the National Highway Department (DNER), acting through its Road Research Institute (IPR). Funding from the Brazilian Government was channeled through the Institute for Economic and Social Planning (IPEA) and the Secretariat for International Economic and Technical Cooperation (SUBIN), along with the Ministry of Transportation.

The World Bank contracted the Texas Research and Development Foundation (TRDF) to organize the international technical staff and to select and purchase the imported equipment needed for the research. The participation of the TRDF continued until December of 1979.

This report is comprised of twelve volumes (each edited in both English and Portuguese) which summarize the concepts, methods and results obtained by December, 1981 by the project entitled "Research on the Interrelationships Between Costs of Highway Construction, Maintenance and Utilization (PICR)". It includes a documentary index volume which will aid researchers in locating topics discussed in this report and in numerous other documents of the PICR. This report contains much detailed analysis which is being presented for the first time, and also incorporates relevant parts of earlier reports and documents produced under the 1975 Agreement, updating them through the inclusion of new results and findings.

A special mention is due the Highway Departments of the States of Minas Gerais and Goiás, the Universities of Aston, Birmingham and Texas, and the Western Australia Main Roads Department which placed some of their best and most experienced personnel at the service of this project to fill many key positions on the research staff.

Finally, thanks are due to the Transport and Road Research Laboratory for its assistance during the initial stages of the project, along with specialists from various countries who periodically visited Brazil to discuss the work being done in the PICR and to assist the permanent research staff in conducting analyses.

JOSE MENEZES SENNA
President

VOLUMES IN THIS REPORT

- VOLUME 1 - SUMMARY OF THE ICR RESEARCH
- VOLUME 2 - METHODS AND ORGANIZATION
- VOLUME 3 - INSTRUMENTATION
- VOLUME 4 - STATISTICAL GUIDE
- VOLUME 5 - STUDY OF ROAD USER COSTS
- VOLUME 6 - STUDY OF VEHICLE BEHAVIOR AND PERFORMANCE
- VOLUME 7 - STUDY OF PAVEMENT MAINTENANCE AND DETERIORATION
- VOLUME 8 - HIGHWAY COSTS MODEL (MICR)
- VOLUME 9 - MODEL OF TIME AND FUEL CONSUMPTION (MTC)
- VOLUME 10 - MODEL FOR SIMULATING TRAFFIC (MST)
- VOLUME 11 - FUNDAMENTAL EQUATIONS
- VOLUME 12 - INDEX TO PICR DOCUMENTS

* Volume 1 contains a brief description of the contents of each volume, while Volume 12 provides a subject index to this report and all other PICR documents, including technical memoranda and working documents.

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SUMMARY

The primary objective of the Pavement and Maintenance Studies was to develop models to describe pavement performance and behavior for Brazilian paved and unpaved roads. The models are needed to relate road user costs and road maintenance costs to roadway conditions in order to predict total highway transport costs.

The experimental design sampling matrix addresses the major factors considered to influence pavement performance and behavior. Existing road sections were selected and used to satisfy the requirements of the sampling matrix. Detailed information on traffic, vehicle weights and material characteristics was collected for each section. The same data were collected on unpaved roads as well as information related to blading and regravelling. On paved roads, the dependent variables measured were roughness, rut depth, cracking and patching. The dependent variables studied on unpaved roads included roughness, rut depth, and gravel loss.

The results presented in this report are based on data files that were closed in 1981. The data collection effort will continue and future analyses of the expanded data base are expected to change some of the equations. Because of the preliminary nature of the relationships presented, no consideration was given to modifying the equations so that they could be directly implemented. Therefore, engineering judgement and experience should be used in any application of the equations. Finally, the application of the models is defined by factor ranges and the study environment. Extreme care should be taken in extrapolating the models beyond these limits.

