DEVELOPING A PAVEMENT FEEDBACK DATA SYSTEM

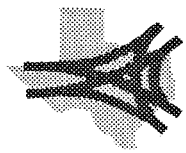
SUMMARY REPORT 123-4 (S)

SUMMARY OF
RESEARCH REPORT 123-4

PROJECT 1-8-69-123

COOPERATIVE HIGHWAY RESEARCH PROGRAM
WITH U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

TEXAS HIGHWAY DEPARTMENT



CENTER FOR HIGHWAY RESEARCH
THE UNIVERSITY OF TEXAS AT AUSTIN

TEXAS TRANSPORTATION INSTITUTE
TEXAS A&M UNIVERSITY

FEBRUARY 1971

SUMMARY REPORT 123-4 (S)

Foreword

Research Report 123-4, by R. C. G. Haas, is one of several prepared and published under Research Project 1-8-69-123, "A System Analysis of Pavement Design and Research Implementation," which is part of the Cooperative Highway Research Program and represents the combined efforts of the Center for Highway Research at The University of Texas at Austin, the Texas Transportation Institute at Texas A&M University, and the Texas Highway Department, in cooperation with the U. S. Department of Transportation Federal Highway Administration.

Introduction

The design and management of pavement systems is highly complex. One effective way to improve the technology which is necessary is to develop and use a viable, systematic, and comprehensive information system. Engineers have realized that the nation's highways are the best laboratory for developing improved pavement design technology, but until the advent of the computer it was not possible to intelligently handle the mass of available data. Now the pavement design and management engineer can capitalize on the tremendous information potential of the national highway system and by use of a systems analysis approach can feed back information into the total pavement system and obtain improved design and management models.

General Principles of Data Systems Development

Data systems are simple in concept but comprehensive in application. Experience has shown that it is easy to underestimate the effort required to institute and maintain them. To be effective, a data system must be more than an information repository; it must include efficient techniques for retrieving and analyzing the data if it is to fulfill its established purposes. If a system is not designed with specific objectives, it may be only a repository and have little application to the design and management problem.

Ultimately a pavement data system must be a part of a much broader highway information system, and three major items must be considered: (1) relationship of the data system to planning; (2) basic design and use criteria; and (3) indexing, control, and coordination. The first item concerns the problem of resource allocation, which is common to all state highway departments; resources can be intelligently allocated only if timely support information, which is a natural output of a properly designed data system, is available. The second item is generally self-explanatory; a system design which meets established objectives and will satisfy programmed users is fundamental. The third item is a logical step to satisfy the second; it is necessary in order to meet design and use objectives.

Data systems come in a variety of forms, varying from a simple manual system to an integrated computer system. Both capability and complexity are greatest with the integrated system, but because most highway departments already have computer hardware, an integrated system is the reasonable choice. However, a comprehensive integrated computer system requires a large number of files, and because implementation in stages is best, it takes several years for an integrated system to become fully operational.

Data systems have been developed and applied to a wide variety of fields, but there is little literature relating to pavement data systems. Performance evaluation is a part of the total pavement management system pursued in Project 123, and the logical major phases of development and application are as shown in Fig 1. In this closed loop process, results of the overall performance evaluation effort are fed back into the pavement management system. This feedback is the reason for this data system and gives it its name, Feedback Data System (FDS).

Integration of Existing Data Files

A logical first step in the design of an FDS (Fig 1) is an inventory of present practices and data files. A vast amount of information is stored within the Texas Highway Department and is added to or updated periodically; some of this information has already been automated. If the indexing and control scheme selected for FDS is similar to that now being used, FDS can readily access these existing automated files. Particularly desirable information now main-

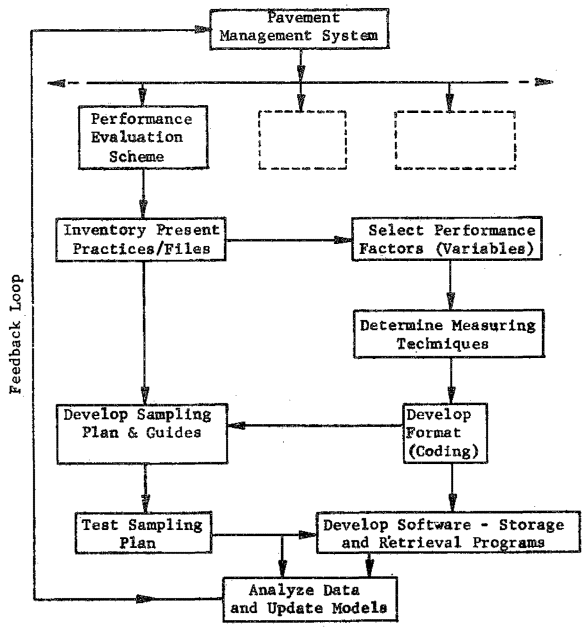


Fig 1. Major phases in developing a pavement performance evaluation scheme.

tained includes (1) the state roadway file, (2) the county roadway file, (3) the roadway construction record file, and (4) various traffic data files to include the loadometer study.

Initial Development of FDS

All of the existing files are expected to contribute significantly to FDS and to provide a quick start for the system. However, a great deal of essential information is manually recorded and will require conversion to the automated system. To prevent bogging down, it is anticipated that stage implementation will be followed, using FPS-designed pavements. Furthermore, it was concluded that selected segments of such pavements should be evaluated, rather than the widespread collection of information.

A feature of FDS which is particularly desirable is flexibility for expansion. Initially, information will be sought primarily to check and revise design models, but there should be no system restrictions on other significant management variables to be determined later.

The general functional format for FDS is illustrated in Fig 2. The supplier and user of data will often be the same person. Data transmission or communication implied in the format requires (1) computer programs to process, update, and retrieve data; (2) equipment such as the Dynaflect, Profilometer, and computer; (3) delineation of information flow within the Highway Department structure; (4) operational guides and sampling plans; (5) designation of desired output reports; (6) testing of new information channels for feasibility; and (7) absence of constraints within the data system itself. Detailed development of the FDS will entail subdivision of these items. Implementation will be progressive, conforming to a fundamental concept of the project, i.e., to implement and improve step-by-step in order to reap payoffs not accrued by delay to develop the ultimate system. Usefulness will be explicitly and continually evaluated using the project standards of operationality, rationality, acceptability, and reviseability.

The next major task in the development of FDS (Fig 1) is identification and classification of key factors or variables, a continuing process involving much trial and error. A starting point is the list of variables used in the FPS program and the recently developed Rigid Pavement System (RPS) program. Beyond this, the variables will be selected by the FDS designers. Experience with the system will dictate additions and deletions to satisfy future changes in design concept, data collection resources, and special research studies.

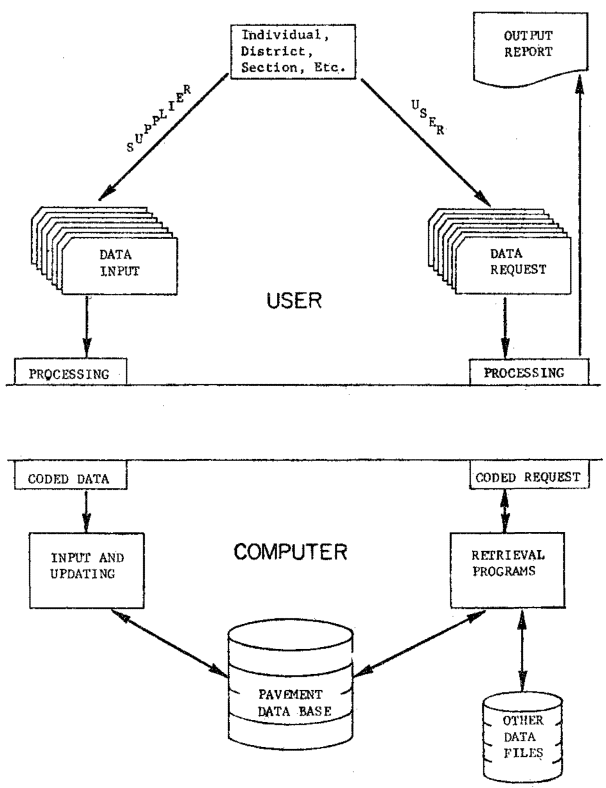


Fig 2. General functional format for a pavement data system.

The classification of these selected variables is really a concurrent task and involves the logical grouping of factors according to particular criteria. This has been found to be a trial and error procedure. In Report 123-4, it is concluded that the following classification scheme and designations are appropriate:

RI-123	Master File
RI-123-01	Performance Data Subfile
RI-123-02	Structure Capacity Subfile
RI-123-03	Maintenance Resurfacing and Seal Coats Subfile
RI-123-04	Environmental Subfile
RI-123-05	Materials Data Subfile
RI-123-06	Traffic Data Subfile

The Master File contains the as-built data and other basic features of the pavement, and the subfiles contain specific detailed information. All files contain appropriate location identifiers corresponding to those now in use by the Texas Highway Department, thereby permitting accessibility to existing data files. A complete detailed description of each file and the accompanying code sheets are contained in Report 123-4.

Further Development and Implementation

The sampling plan and accompanying guides are the next major development task in FDS and must be carefully considered with district staff resources in mind, since the majority of new data must come from the district organizational elements.

Development of software necessary to retrieve and analyze the data is a concurrent major task. Examples of retrieved data in Report 123-4 illustrate the desired software features.

As stated in Report 123-1, full achievement of the FPS and RPS is not possible without the feedback information necessary to complete the cycle and begin subsequent improvements. This aptly describes the importance of the link represented by FDS and again emphasizes the extreme importance of stage implementation and progressive improvements to obtain prompt payoffs from research.

References

1. Hudson, W. R., B. F. McCullough, F. H. Scrivner, and J. L. Brown, "A Systems Approach Applied to Pavement Design and Research," Research Report 123-1, published jointly by Texas Highway Department; Texas Transportation Institute, Texas A&M University; and Center for Highway Research, The University of Texas at Austin, March 1970.
2. Hart, J. E., "The Highway Network Data and Information System," Paper presented to Highway Research Board as part of a five paper series on the Wisconsin Department of Transportation's Integrated Operations System, Washington, January 1970.
3. Texas Highway Department, "Systems Analysis of the Planning Survey Division," Staff Report, Vol. 2, Prepared in cooperation with U. S. Bureau of Public Roads, June 1, 1968.
4. Hutchinson, B. G., and R. C. G. Haas, "A Systems Analysis of the Highway Pavement Design Process," *Highway Research Record No. 239,* Highway Research Board, 1968.
5. Haas, R. C. G., and W. R. Hudson, "The Importance of Rational and Compatible Pavement Performance Evaluation," Paper presented at Highway Research Board Western Summer Meeting, Sacramento, California, August 1970.

KEY WORDS: feedback data, computer, data acquisition, data analysis, data retrieval, design information, information retrieval, information systems, systems analysis, pavements, pavement management, research management.

The full text of Research Report 123-4 can be obtained from R. L. Lewis, Chairman, Research and Development Committee, Texas Highway Department, File D-8 Research, 11th and Brazos Streets, Austin, Texas 78701 (512/475-2971).