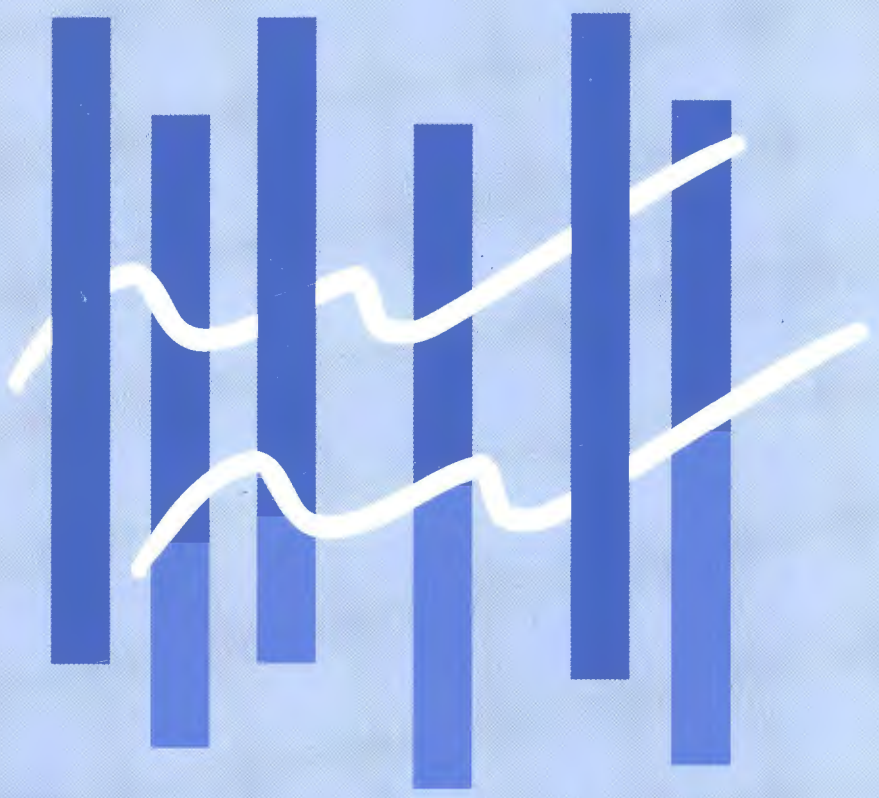
HERS-ST

Highway Economic Requirements System—State Version

Pilot Program Report 2002



U.S. Department of Transportation
Federal Highway Administration

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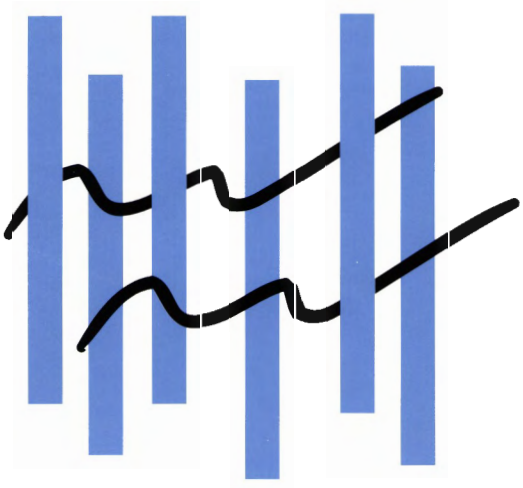

U.S. Department of Transportation
Federal Highway Administration

August 2002

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Office of Asset Management

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Note from the Director

I am pleased to provide this document reporting on the Highway Economic Requirements System–State Version (HERS-ST) Pilot Program Workshop. The HERS-ST software estimates the future condition, performance, and user cost impacts resulting from a particular level of highway investment. It can also predict the investment required to achieve a target level of condition, performance, and user costs.

The workshop, sponsored by my Office, took place in New Orleans, Louisiana, February 14–16, 2001. Our goal was to acquaint a small group of State representatives with a prototype version of the HERS-ST software and then solicit feedback as to its potential usefulness in a State department of transportation (DOT) setting. This document provides a summary of the program's findings and establishes the immediate future direction for HERS-ST.

Twenty-seven officials from 17 State DOTs participated in the program. Feedback from the workshop was positive, indicating that the software would indeed provide useful information and insight regarding State-level investment decisions. Guided by input from the pilot program, we have revised the HERS-ST prototype, making it more user-friendly and including enhanced capabilities for State DOTs. The pilot program will culminate in a national conference September 24–25, 2002, introducing the revised prototype to State transportation agencies.

The HERS-ST operates via a simulation process that evaluates the relationship between highway investment and performance, using concepts and principles from *both* engineering and economics. The HERS-ST will evaluate the condition and performance of the highway system and identify deficiencies consistent with standard engineering practices. However, when it simulates the selection of improvements for implementation, it relies on economic criteria. In general, HERS-ST will only select those improvement projects where future benefits exceed the initial cost.

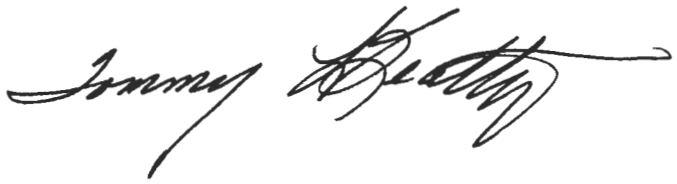
The Highway Economic Requirements System (HERS) has been used by the Federal Highway Administration since 1995 to provide estimates of the investment required to either maintain or improve the Nation's highway system. This information is submitted to Congress biennially via the *Status of the Nation's Highways, Bridges, and Transit: Condition and Performance Report to Congress.* The HERS-National model has been extensively and favorably reviewed by numerous groups, including the U.S. General Accounting Office.

The HERS-ST software was built using the national-level HERS model as its base. In other words, the HERS-ST and HERS-National share the same logic structure. The only difference is that the HERS-ST includes a user-friendly graphical user interface and some input/output features that will improve the usefulness of the software when it is applied by State DOTs. Consequently, HERS-ST enjoys an unusually high level of credibility for a new software package.

There is already widespread enthusiasm and anticipation regarding this software. Expectations are high that HERS-ST can be successfully applied by State DOTs in program development, "needs" analysis, and/or establishing performance objectives. In addition, HERS-ST may assist State DOTs in meeting the new Governmental Accounting Standards Board (GASB) Statement 34 provisions. Some States have already come to recognize the usefulness of HERS-ST output in interacting with decision-makers, including legislative bodies.

We believe that HERS-ST will potentially contribute to a State's Asset Management framework. Comprehensive Transportation Asset Management provides a strategic approach to the optimal allocation of resources for the management, operation, and preservation of the transportation infrastructure. HERS-ST is consistent with Asset Management concepts and principles in that it includes an economic dimension and assumes an extended time horizon in its simulation process. It also allows for trade-off analysis between improvements intended to correct highway condition deficiencies and those focused on performance deficiencies.

We want to thank the State representatives and others who participated in the pilot program for the considerable time and effort they spent evaluating the prototype HERS-ST software. Many of the pilot program recommendations are already reflected in the new software. Future customer reviews will provide feedback to guide the continuous HERS-ST improvement process.



Tommy L. Beatty
Acting Director, Office of Asset Management

Chapter 1:

Introduction

The primary purpose of this report is to summarize the findings of the Highway Economic Requirements System–State Version (HERS-ST) Pilot Program and discuss the steps taken to create the first version of HERS-ST intended for national distribution. The pilot program included white papers commissioned by FHWA, prototype software suitable for testing, and a workshop that provided not only training but peer exchange and ongoing technical support.

Overall, this report is intended to satisfy the following key objectives:

- Document comments regarding the usefulness of HERS-ST to State departments of transportation (DOTs);
- Catalogue, discuss, and assess comments and recommendations for HERS-ST improvements received from the participants;
- Assist the reader in understanding the background and development of HERS-ST, how it works, and how it is currently being used at both the Federal and State levels;
- Describe the expectations of current, new, and future users of HERS-ST;
- Outline FHWA's approach in developing HERS-ST software for broad release;
- Present recently completed and future HERS-ST activities.

Chapter 2:

Background: Highway Investment/ Performance Analysis and HERS

2.1 Overview

For the past three decades, Congress has required the U.S. Department of Transportation (USDOT) to estimate the funding level required to maintain and improve the condition and performance of the Nation's highway system. Congress uses this information, reported biennially via the *Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance (C&P) Report to Congress*, to support legislative budget development. In addition, investment/performance relationships are used to identify and evaluate transportation policy and program options.

As a result of the Congressional requirement, USDOT's Federal Highway Administration (FHWA) has been engaged in a continuous process of developing and refining the procedures used to estimate the relationship between highway investment and system condition and performance. Development of the analytical tools and data supporting this analysis process has been largely driven by innovations in computing power, improved data collection techniques, increasingly sophisticated analytical tools, new empirical information, and changes in transportation planning objectives.

From FHWA's perspective, quantifying the relationship between highway investment and system performance began in 1968 when the States were asked to report the investment required to correct current and anticipated future deficiencies over a 20-year horizon. The resulting information amounted to a "wish list" of highway needs because national standards for defining deficiencies and classifying roads were not available. In addition, information on the national road inventory was incomplete. Over the next few years, a set of national engineering standards was identified that could be applied in a national model to identify highway system deficiencies, and by 1983 the FHWA had established the Highway Performance Monitoring System (HPMS) and Analytical Process (AP) to support the estimation of highway investment requirements.

2.2 Highway Performance Monitoring System Analytical Process

The HPMS is a continuous data collection system. Its comprehensive database consists of sample sections representing the Nation's highway system. The system's analytical companion, the AP, is a computer-based investment/performance model. Using standard engineering concepts and practices, AP simulation (1) identifies highway system deficiencies and (2) selects appropriate improvement option "packages" to correct the deficiencies. In the case of constrained funds, the AP selects an optimal set of improvement projects from a larger set of indicated projects, based on their impact on physical condition, performance, and safety as measured against engineering standards.

Taken together, the HPMS database and AP made possible reproducible estimates of future investment requirements. FHWA deployed the HPMS AP for over a decade to estimate future national-level investment requirements. The HPMS database continues to be used to support development of future investment requirements as well as to monitor, from the national perspective, the effectiveness of the highway program.

Although the AP is highly regarded as useful in producing credible estimates of future highway investment requirements, it does not explicitly consider user impacts in assessing alternative improvement options. Projecting user impacts became an issue as a result of the increased emphasis during the last two decades on maximizing the benefits from the use of constrained public funds. In particular, Congress, the Administration, and USDOT developed a strong interest in moving the process of estimating future investment requirements from one focused on engineering principles to one that also considers economic factors.[1]

2.3 The National HERS Model

In 1987, FHWA initiated an effort to develop an alternative to the AP that would include economic considerations as part of the simulation procedure. This effort resulted in the Highway Economic Requirements System (HERS). The *1995 C&P Report* was the first such report to reflect use of the HERS model. Since its introduction, HERS has been proven a useful tool for evaluating the implications of alternative programs, policies, and investment levels on the condition, performance, and user costs associated with highway systems.

When the HERS concept was first introduced, it represented a significant change in thinking about the relationship between highway investment and performance. In addition to considering physical condition and capacity in project selection, HERS incorporates the economic benefits of each project to the highway user—the customer for whom the highway system is built and operated—into the decision-making routine.

In particular, the HERS model evaluates current condition information, determines deficiencies, and designs alternative improvement options according to engineering standards, and selects the best improvements to correct the deficiencies according to economic principles. In other words, only projects having benefits exceeding the initial improvement cost of the project will be selected. Benefits consist of reductions in user, agency maintenance, and societal costs over the life of the improvement.

This shift in emphasis from the highway infrastructure to highway users often results in different project selection outcomes. For example, a potential improvement being considered for implementation on a section with relatively few users might not generate sufficient benefits to warrant its selection. Alternatively, BCA might indicate substantial user benefits and therefore result in a recommendation for investment exceeding that indicated by traditional engineering analysis.

[1]For instance, in 1989, the U.S. House of Representatives Committee on Public Works and Transportation called for DOT to accelerate its efforts to examine the costs, benefits, and national economic implications associated with a broad array of highway investment options.

The principle underlying the HERS approach is that capital investments in highways provide benefits to highway users that can be quantified. Investments that produce user, agency, and societal benefits in excess of their costs can be economically justified. However, investments whose benefits are lower than their costs cannot be justified. HERS attempts to optimize the relationship between public highway investment and user costs.

2.4 The State Version of HERS

Following the introduction of HERS, Congress and the Administration expressed their views that State DOTs should compare benefits to costs when considering alternative investment strategies. Executive Order 12893, *Principles for Federal Infrastructure Investment*, dated January 1994, formalized this consensus. This order directs that Federally-funded infrastructure investments should be based on a systematic analysis of expected benefits and costs. At the same time, a number of States became aware of HERS and were interested in exploring the model in their own context. In fact, as discussed later in this report, Indiana and Oregon commissioned customized versions of the national model.

Through the Office of Asset Management, established in 1999, FHWA is well positioned to respond to the demand for a version of HERS applicable at the State level. As part of its charter, the new office has responsibility for the development and promotion of engineering economic analysis tools such as the HERS-ST software.

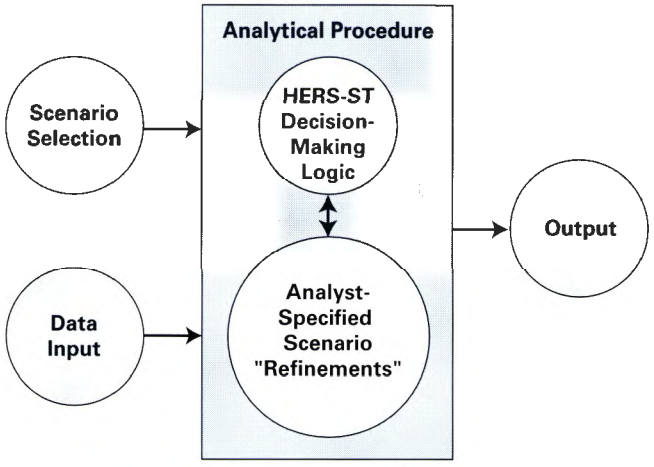
Chapter 3:

The HERS-ST Application

3.1 Overview

The HERS-ST application is flexible and allows for the development of analyst-specified scenarios. The analyst selects one of several scenario types provided by HERS-ST and then tailors it by indicating values from an array of user-specified parameters. The analytical procedure relies on a database of records in the HPMS format. These data supply information regarding the highway system, particularly its current condition and performance. The analytical procedure involves identifying highway deficiencies and candidate improvements based on engineering standards. Finally, the analytical procedure selects the most economically worthwhile improvement projects for implementation according to economic criteria and analyst-supplied scenario specifications. Summary statistics are calculated and final reports detailing the state of the system and the cost of improvements are generated. Figure 1 provides an overview of the HERS-ST process. Further information follows. In addition, information also is available in the HERS and HERS-ST documentation (see Appendix A).

Figure 1
Overview of HERS-ST process



3.2 Scenario Development

The HERS-ST application allows for the evaluation of three general types of scenarios:

1. Constrained Funds Scenario: Given a funding constraint, invest so as to maximize the net present value of benefits accruing from improvements selected for implementation.

   Question: What user cost/condition/performance level will result from a given spending level?

2. Performance Scenario: Given a performance goal related to user and agency costs, minimize investment required to achieve the goal.[2]

   Question: What level of spending is required to achieve a certain user cost level?

3. Benefit-Cost Scenario: Implement all improvements having incremental benefit-to-cost ratios (BCRs) exceeding a set threshold value.

   Question: What level of spending is required to achieve an economically optimal program-structure where all projects having BCRs greater than 1.0 are implemented. (The C&P Report *terms this the "economic efficiency" scenario because all economically worthwhile projects are implemented.)*

   Question: What level of spending is required to implement all projects generating BCRs greater than "x"?

The general scenarios may be tailored by providing alternative input values such as for the discount rate and deficiency levels. The analyst specifies the overall length of the analysis period and the length of the funding periods (FPs). When the national-level HERS model is used to evaluate scenarios for the *C&P Report*, the Nation's highways are evaluated over a 20-year horizon (overall analysis period) divided into four FPs of 5 years each.

In addition, other information may be obtained by creatively manipulating the HERS-ST analytical process. For example, spending required to achieve a given level of system condition/performance may be estimated through an iterative series of benefit-cost runs where the constraining BCRs are adjusted until the system condition/performance target is realized.

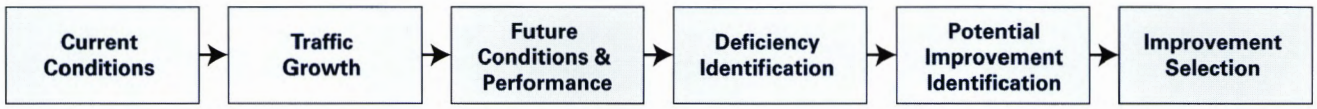
3.3 HERS-ST Analytical Logic

The HERS-ST logic flow begins with an evaluation of the current state of the highway system based on analyst-supplied input. From the initial state, using section-specific traffic growth forecasts, HERS-ST projects future conditions and performance for each FP through the end of the overall analysis period. At the end of any given FP, HERS-ST examines each highway segment according to accepted engineering standards and checks for deficiencies (e.g., volume-to-capacity ratios). Then, using standard engineering practices, the procedure identifies a set of potential

[2] The performance-constrained or "cost to maintain" scenario was not available in the prototype version of HERS-ST, but has been enabled in its first revision (version 2.0).

improvement options to correct each of the deficiencies. An incremental BCR is calculated for each potential improvement and the "best" improvement options are selected for each section. The section improvements are prioritized based upon BCR, and the most cost-beneficial improvement options are selected for systemwide implementation, given funding constraints, performance objectives, or BCR targets indicated by the analyst. The logic structure is shown in Figure 2, and each step is described in the remainder of this section.

Figure 2
HERS-ST logic



Current Conditions

Information on current highway condition and performance is provided to HERS-ST from the State's HPMS database. The HERS-ST prototype only accepted those HPMS records that had been provided to the FHWA via the HPMS submittal process.[3] Within the FHWA HPMS submittal, the sections are drawn to represent the Nation's highway system.

The latest version of HERS-ST will accept other data, so long as it is in the HPMS format and contains the data elements used by HERS-ST. Accordingly, States may run HERS-ST against their entire highway system by creating a file for all highway sections with the same data items as in their current FHWA HPMS submittal file. Each HPMS record contains current information on a section's characteristics such as pavement condition, traffic volume, vehicle mix, and traffic capacity.

Traffic Growth

For each highway segment, traffic volumes in the initial year and at a date in the future are obtained. These two estimates are essentially demand points that reflect exogenous demand factors such as the regional economy and demographics. HERS-ST uses these two points as a baseline for estimating traffic growth and then applies the anticipated response of traffic to changes in highway user costs, thus accounting for travel demand elasticity. [4]

Future Conditions and Performance

Traffic growth information is used to forecast traffic, volume/capacity (V/C) ratios, and pavement condition for each FP in the overall analysis period. HERS-ST uses these forecasts to estimate the

[3] FHWA maintains and uses the HPMS data for strategic planning, projecting future system investment requirements, and monitoring national-level program effectiveness.

[4] As the cost of traveling on a facility (e.g., its price, including travel time, operation costs, and crashes) increases, consumers will want to use it less. They will either travel via another facility or simply not make the trip. Alternatively, if travel time costs decline, travelers will use the facility more, either in lieu of traveling on another highway section or in addition to their overall current travel. The travel demand elasticity procedures in HERS-ST account for the fact that, as a highway becomes more congested, the rate of traffic growth may decrease, and when lanes are added to a facility, the rate of traffic growth may increase.

point at which a pavement or capacity improvement will be required and the extent of improvement indicated. The methods for forecasting V/C ratios (e.g., congestion levels) and pavement condition are based on standard engineering practices, pavement deterioration models, and capacity calculations. As appropriate, the section data are revised in each FP to reflect the simulated changes expected to occur over time due to the implementation of an improvement or to continued deterioration in the absence of an improvement.

Deficiency Identification

At the end of each FP, HERS-ST checks the following highway elements for deficiencies based on deficiency levels supplied by the analyst: pavement condition, surface type, V/C, lane width, right shoulder width, shoulder type, horizontal alignment (curves), and vertical alignment (grades). HERS-ST allows the analyst to determine three different deficiency levels—normal, serious, or unacceptable—for each of the highway attributes of interest. Deficiency levels are trigger values for HERS-ST. That is, a highway section will be considered deficient only when a deficiency level is violated. The type and severity of the deficiency determines what type of improvement is required. Improvements to correct normal deficiencies will be evaluated but may be rejected. All serious deficiencies will be corrected (assuming sufficient funds). Unacceptable deficiencies must, if enabled by the analyst, be corrected, whether the best improvement is cost-beneficial or not (again, assuming sufficient funds are available). In all cases, HERS-ST will only correct deficiencies that are also accompanied by pavement condition or capacity deficiencies.

Potential Improvement Identification

For each deficient section, engineering standards are applied to identify potential improvements that would correct the deficiencies. HERS-ST will identify up to six improvement "types" for correcting all or a portion of a section's deficiencies. These improvements involve pavement, widening, and alignment corrections. HERS-ST has 28 combinations of improvements from which to select.

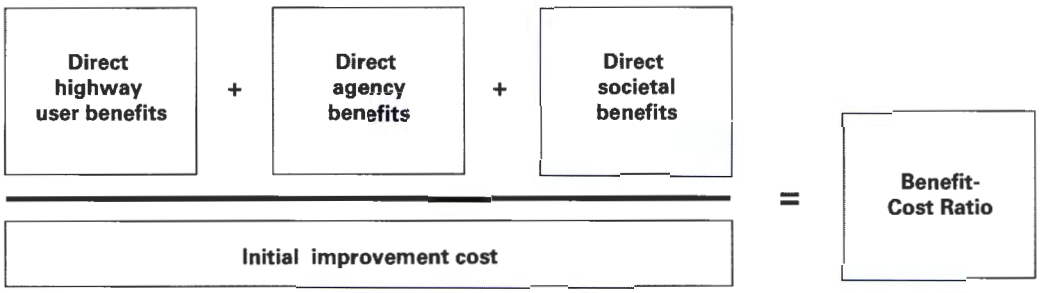
Improvement Selection

The HERS-ST logic relies on the application of BCA to evaluate and select the best set of section improvements for systemwide implementation. Improvements in highway transportation will influence the costs accruing directly to highway users because of changes in travel time, fuel consumption, vehicle life, crash costs, and inventory costs. Improvements will impact State highway agency costs associated with maintenance and future construction. Highway improvements may also impact highway nonusers through effects such as reduced motor vehicle emissions as a result of lower traffic congestion.

BCA involves the comparison of expected benefits (the reduction in user, agency, and societal costs) over the life of the improvement with the initial cost of implementing the project. Within the HERS-ST framework, a BCR of the form shown in Figure 3 is calculated for each proposed improvement option.

HERS-ST addresses two questions when evaluating improvements for possible implementation: Should a section be improved in the current FP? If a section is to be improved in the current FP, which option from the set of candidate improvements would be the best to implement?

Figure 3
Method for calculating the benefit-to-cost ratio in HERS-ST



Direct highway user benefits = change in travel time, crash, and vehicle operating costs

Direct agency benefits = change in highway maintenance costs and the residual value of the projects

Direct societal benefits (externalities*) = change in emissions

Initial improvement cost = project cost at time of implementation (e.g., right-of-way acquisition, grading structures, etc.)

* Direct externalities occur when persons affected by highway improvements are not necessarily a part of the transaction that created the consequence. Examples include noise, air quality, water, pollution, excess runoff, and danger to pedestrians, among others.

Improvements are selected on the basis of the ratio of the net present value of each improvement's incremental benefits to the present value of the incremental costs. Potential improvement options are sequentially compared until the optimal alternative is identified.

The benefit-cost result for each tentatively selected project is used to rank, on a systemwide basis, the best improvements selected for each section. If benefits exceed costs, and funds are available, the option will be selected. For a benefit-cost run where the BCR threshold is set to 1.0, the best improvement for each section is implemented. When constrained by budget or performance goals, HERS-ST ranks the best improvements for all sections by their BCRs, then implements the improvements one at a time, by BCR rank, until the constraint is met.

HERS-ST allows the user to override some or all of the improvement decisions recommended by the model for individual highway sections. This means that the analyst may specify a particular type of highway improvement for implementation, when the improvement will be made, how much it will cost, and what impact the improvement will have on the capacity of the segment. When the analyst specifies an improvement, regardless of whether it is cost-effective as measured by the model's internal calculations, the model will select that improvement for implementation. This feature allows HERS-ST to reflect the often more complete information available to State DOT officials, relative to that found in the HPMS database.[5]

[5] For example, there may be additional benefits from an improvement that HERS-ST does not know about, or the State may not want HERS-ST to recommend improvements to sections where decisions have already been made and will not be changed.

3.4 Output

ERS-ST provides information concerning the impact of highway capital improvements on system condition and performance and on highway users. In particular, the model reports on benchmarks relating to economic impacts, such as changes in user costs as well as vehicle-miles-traveled under deficient conditions.

HERS-ST produces estimates of justifiable expenditures for each FP by functional class and improvement type, subject to the parameters the model is given and any constraints that are imposed on the solution. The primary output of HERS-ST is a set of summary tables providing these descriptions:

- The state of the highway system at the start of the run and at the end of each FP;
- The changes occurring during each FP and during the overall analysis period;
- The benefits and costs of the improvements simulated during each FP and the overall analysis period; and
- Detailed output for all sections that are recommended for improvement.

Limitations of HERS-ST

- HERS-ST simulates the application of benefit-cost analysis (BCA) at the project level. Therefore, its results should be interpreted as the sum of net direct benefits as measured from project-level analyses rather than as a macro-level representation of highway program impacts. For example, the model does not account for benefits accruing from system accessibility, connectivity, or predictability.
- HERS-ST pertains only to highway assets. Other transportation classes such as bridges and transit are not considered.
- Analysis results are appropriate at the system level, not at the project level. Although model analysis is initially conducted at the project level, the information available to the model about any given project is incomplete. Therefore, the BCA results for any given project may be high or low. However, on average for the overall system, project-level errors should be compensating.
- Network impacts and new construction on new alignments are not modeled.
- Full life-cycle costs, such as delay costs arising from the implementation of improvement options, are not considered.
- Most, but not all, relevant costs and benefits are included (e.g., noise pollution costs are not included).
- HERS-ST output is not meant as a definitive answer regarding highway program structures or investment levels. The model does not capture the full extent of relevant considerations such as social equity, political issues, financial impacts, and institutional practices.

Chapter 4:

Use of the HERS Concept

4.1 Introduction

As explained in Chapter 2, the HERS approach has been used by the FHWA since 1995 to produce estimates of future national highway investment required to maintain or improve system condition and performance and/or user costs. Two States, Oregon and Indiana, have also been using HERS to support their long-range planning activities. This chapter describes these applications.

4.2 HERS at the National Level

The *1999 C&P Report* provides results for a number of alternative 20-year highway investment scenarios, which are analyzed using the national-level HERS model. In each case, current and accruing deficiencies are addressed.

The first scenario, economic efficiency, explores the case of correcting all deficiencies (defined according to engineering standards) where the potential improvements are economically viable, or, in other words, where the benefits of implementing a given project are greater than the cost. The economic efficiency scenario provides the level of national investment considered justifiable based on engineering and economic criteria.

Other scenarios identify the level of investment required to maintain physical conditions, average user costs, and average travel time costs. These scenarios are analyzed via a series of HERS runs where the BCR threshold for improvement implementation is progressively increased above 1.0 until projected key statistics at the end of 20 years match their baseline values. The performance indicators are calculated for the system as a whole; some highway segments will improve and some will deteriorate, but overall, the average value of the condition/performance indicator for the system remains the same as in the initial year.

4.3 HERS at the State Level

In 1998, Oregon and Indiana started to use customized versions of the national-level HERS model. Oregon DOT was facing increased funding constraints and greater public demands for accountability and was therefore interested in an economics-based tool to identify deficiencies and prioritize candidate highway projects. Indiana's objective was to identify deficiencies and prioritize potential highway projects, and to integrate this ability with their statewide travel demand model and the Indiana DOT road inventory data.

Both the Oregon and Indiana versions of HERS (HERS-OR and HERS_IN respectively) were based on the national-level HERS model. In each case, the State applications were customized with a number of special features, including:

- An override feature that allows model-generated improvements to be replaced with analyst-specified improvements. This feature may be used, for example, to accommodate locally initiated projects or pavement improvement options from a more data-rich or technically robust pavement management system. In HERS_IN, the analyst may specify the type of improvement, its cost, when it will be implemented, and its impact on section capacity. HERS-OR allows the user to specify only the type of improvement and when it will be implemented.

- Model output that includes section-specific information for each highway segment in the input database, ranging from condition and performance statistics to the type of improvement implemented (OR and IN).

- Output in a form that will support the production of maps displaying the location of model-generated improvements. Incorporating linear referencing information for each segment allows the output from HERS-OR and HERS_IN to be displayed in a geographical information system (GIS). The use of maps facilitates the presentation of findings to decision-makers. Maps are also beneficial in reviewing the validity of model-based recommendations. Oregon uses the outputs as input for other analytical programs, as well.

- The capability to evaluate the implementation of capacity expansion projects and to estimate the impact of each capacity improvement on traffic systemwide. This feature is supported by a sophisticated travel-demand model that provides the State HERS model with the forecast traffic growth rates (IN).

- Provisions allowing the analyst to enter exogenous changes in traffic volumes (IN).

- The ability to evaluate investment requirements according to unique statewide classifications as opposed to only the National Functional Classification System (OR).

In both Oregon and Indiana, the HERS analysis typically includes all State highway sections. The data are in the HPMS format, but are not necessarily part of the HPMS database submitted to FHWA. Indiana typically runs HERS against their State jurisdictional highway segments. This means that some default values are included in the HPMS records, since Indiana's road inventory database does not contain HPMS data for all highway sections.

Oregon and Indiana use their HERS models as long-range system planning tools to support development of their Statewide Highway Plans. Both HERS-OR and HERS_IN are deployed to estimate funding requirements and performance for each State's highway system under various funding scenarios. In Indiana, HERS has also been used at the district level to identify highway investment needs.

In both States, HERS is focused on identifying and evaluating potential capacity additions. Pavement preservation improvements are considered according to the State's pavement management systems. However, HERS-OR is used to conduct impact analyses of all potential investment alternatives (e.g., to calculate BCRs). Although neither HERS-OR nor HERS_IN is used to determine specific projects to recommend for implementation, Indiana DOT uses HERS_IN as an early warning system to identify needs.

Both States find their models valuable in estimating investment requirements (e.g., needs analysis) and planning highway projects at the macro level. In addition, Oregon DOT found the HERS-generated benefit-cost information helpful in corridor planning and goal setting.

In Oregon, the "what if" analyses produced by HERS-OR helped legislative bodies and other decision-makers by providing a clear picture of how the condition and performance of the highway system would change under different funding scenarios. Oregon officials also found that output generated by HERS-OR could be used as a potential source of quick actions and improvements for each highway segment under varying funding levels.

Officials from both States report that their long-range goal is to use their HERS models to support the capital programming process. Furthermore, Indiana officials intend to use HERS_IN in prioritizing potential capacity expansion projects for the Long-Range Statewide Transportation Plan.

Chapter 5:

The HERS-ST Pilot Program

5.1 Description

In 1999, FHWA's Office of Asset Management, in cooperation with the FHWA Office of Legislation and Strategic Planning, established the HERS-ST Pilot Program. This program was intended to obtain information from State DOTs regarding the appropriateness of the model to assist in State decision-making about highway infrastructure investment levels. The pilot was conducted in the following stages:

- Commissioning of two white papers to evaluate the potential role of HERS at the State level;[6]
- Development of a HERS prototype for evaluation for State-level use;
- A survey of State DOT pilot participants regarding their planning and programming practices and their expectations of HERS-ST software;
- A national workshop at which the prototype software was distributed with training;
- Post-workshop evaluation of the prototype software by the State DOTs; and
- FHWA review of pilot participant comments.

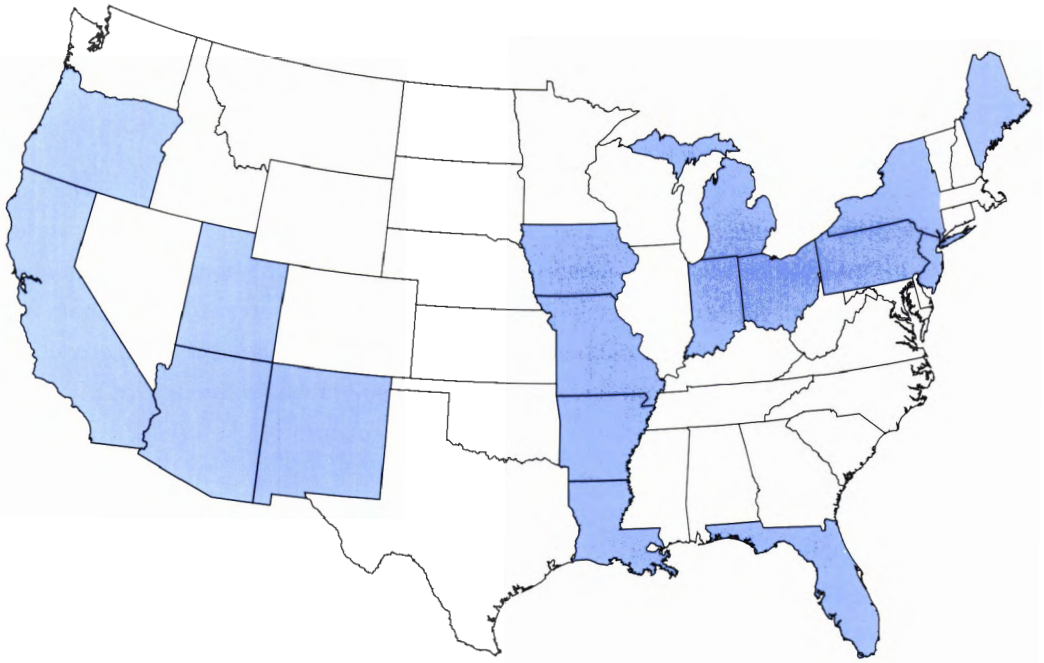
In preparation for the pilot program, FHWA commissioned the consultant who had developed the customized versions of HERS for Oregon and Indiana to produce a HERS-ST prototype for testing. A prototype was developed for three reasons: (1) general use of the national-level version of HERS was not practical since it was developed for a limited number of users to measure national-level investment requirements and did not include any user-friendly features; (2) FHWA wished to confirm the HERS model's applicability at the State level before investing significant resources in development; and (3) FHWA wanted to ensure that the first version of the model intended for broad use would reflect the State user's requirements.

Through an article in *Focus* magazine[7] State DOTs were invited to participate in a national pilot program workshop. This article generated enormous interest in the pilot. Prior to the workshop,

[6] Battelle & Wilbur Smith Associates, *Potential Role of HERS in State-Level Highway Capital Investment Program Planning and Modifications for State-Level Use*, January 2000. Cambridge Systematics, Inc., *Using the HERS to Enhance State DOT Plans, Programs and Budgets*, February 28, 2000.

[7] Federal Highway Administration, "Software Package Offers States a Tool for Estimating Highway Investment Needs," *Focus*, December 1999.

Figure 4
States participating in the HERS-ST Pilot Program



the State participants were asked to answer questions about their States' current practices concerning planning and programming, as well as their views regarding the potential contribution of the HERS-ST software to this process. The feedback from the participants was used by FHWA to adjust the content of the workshop to address most of the questions and concerns submitted. The survey questions can be found in Appendix B, and the State responses are summarized in Section 5.2.

Twenty-seven participants from 17 self-selected States, shown in Figure 4, were introduced to HERS-ST at the national workshop on February 14–16, 2001. Participants from the State DOTs and FHWA are listed in Appendix C.

At the workshop, the participants learned about the history of HERS and HERS-ST, the underlying HERS logic, and the operation of the HERS-ST prototype software. The HERS-ST training

Some State Comments

- An interesting and powerful tool
- Compares favorably to method used for Interstate analysis
- Useful tool for State-level analysis
- Provides a different perspective on highway system needs
- Flexible in looking at different timeframes for funding and improvements
- Useful tool for long-range planning efforts
- Hope FHWA will develop a final version of HERS-ST

portions of the workshop provided an opportunity for the participants to better understand the intricacies of the HERS analytical approach and receive instruction on the operation of the HERS-ST software. Participants learned about the Oregon and Indiana experiences with customized versions of HERS. The open discussion format of the workshop allowed participants to voice questions and concerns, as well as share experiences and potential uses for HERS-ST. (See Appendix D for the workshop agenda.)

At the conclusion of the workshop, participants received copies of the HERS-ST software for evaluation over the following three months. The participants were given six exercises to work through and three evaluation questions to answer. The evaluation exercises and questions can be found, respectively, in Appendices E and F. FHWA provided technical support during the evaluation period. At the conclusion of the evaluation period, the States submitted comments and suggestions to FHWA. These recommendations are summarized in Section 5.3.

5.2 State Expectations

Prior to the workshop, State participants were asked about their agencies' current planning and programming practices, as well as their expectations regarding the potential or desired application of the HERS-ST software to these processes (see Appendix B). Following is a summary of participants' comments about the potential applicability of HERS-ST in addressing State DOT requirements.

System-Level Needs Assessment and Prioritization

Many States are required to conduct assessments of their current and future investment requirements, particularly to support development of their long-range highway plans. A number of participants indicated the need for a tool that would help them to prioritize projects, subject to funding constraints. Ideally, such a tool would use economic principles in the prioritization routine. Several of the pilot participants reported success in using the HERS model with their State HPMS data to conduct needs analyses.

Benchmarking and Performance Measures

Many States are in the process of benchmarking their highway system performance and establishing highway system performance measures. HERS-ST is able to assess current highway system performance as well as predict future highway system performance, given different funding levels and investment strategies. States can then use this information to set targets and measure performance of their highway systems at the macro level.

Supplement Existing Management Systems

Most of the management systems used by the States are rich with project-level data. HERS-ST includes an override feature that allows for the substitution of improvement projects selected through, for example, management systems in place of projects that might otherwise be selected by HERS-ST. In addition, it may be possible, after appropriate revision, for HERS-ST to accept data from the management systems and then conduct its standard analysis. The analytical routines within HERS-ST would have to be revised to accept more detailed information. At this point, however, HERS-ST cannot easily be integrated with management systems.

Project Evaluation and Prioritization

As previously mentioned, States have a tremendous amount of project-level data in their management systems. Some States indicated a desire to run analyses on their entire highway system for the purpose of project-level evaluation and prioritization. At this time, HERS-ST is not designed for this purpose. The HPMS data items used by HERS-ST are sufficient for system-level analysis but are not appropriate for project-level analysis. Before HERS-ST could conduct project-level analysis, the model would need modification to allow the input and analysis of numerous additional data items.

Implementing an Integrated Asset Management Framework

Work is currently underway in several States to develop integrated Asset Management decision-making frameworks. When complete, these systems will make investment decisions and resource allocation recommendations that span several asset classes. HERS-ST, however, is intended only as a highway investment/performance-modeling tool. Furthermore, HERS-ST makes improvement recommendations for a given highway section independently of the surrounding highway sections. Because of these limitations, HERS-ST will not support the multi-asset or multimodal trade-off analyses required for comprehensive Asset Management. It can, however, inform such a framework.

HERS-ST can be used to enhance the management of highway assets. Highway improvement recommendations generated by HERS-ST can be used for projecting future funding-level requirements and determining what impact current funding levels will have on future pavement condition and user costs. Also, HERS-ST can be used to help agencies comply with the Governmental Accounting Standards Board's Statement 34,[8] which (under the modified approach) requires a government to calculate the maintenance and preservation levels associated with alternative condition targets and estimate the spending levels necessary to achieve those targets.

It is notable that HERS-ST is unique among highway investment analytical tools in its ability to make preservation versus capacity trade-offs. This capability might be useful for States, even outside an Asset Management framework. Furthermore, HERS-ST might be of value in that its overall approach systematizes benefit-cost analysis.

[8] The Governmental Accounting Standards Board's (GASB's) Statement No. 34, "Basic Financial Statements—and Management's Discussion and Analysis—for State and Local Governments," was promulgated by GASB on June 15, 1999. To be in compliance with Statement 34, governments (State, local, and municipal) must report capital assets—including infrastructure—at historical cost and then depreciate those assets over their useful lives. However, if infrastructure assets are maintained so as to preserve remaining service potential, the "modified approach" may be employed instead of reporting depreciation for the assets. GASB recognizes that when assets are consistently maintained and renewed so as to ensure essentially an infinite life, they are not "used up" as is assumed under traditional depreciation rules.

Under the modified approach, governments must inventory and assess the condition of the assets comprising a network, decide on a minimum level of acceptable condition, estimate the amount necessary to maintain and renew the assets, and then demonstrate that investment has been sufficient to maintain the target condition level established by the government. If these requirements are met, the government may report as expense the cost of maintaining and preserving or renewing the asset network as opposed to reporting depreciation. The HERS-ST model may be helpful in determining the appropriate minimum level of acceptable condition and also the amount necessary to maintain and renew the assets.

5.3 Findings

As of June 2001, 14 of the 17 States that participated in the HERS-ST Pilot Program had returned over 30 pages of comments to FHWA. The majority of the comments were positive and supported further development and improvement of the HERS-ST prototype software. Over half of the respondents indicated that they would use an improved version of HERS-ST. Table 1 summarizes the participants' comments, and frequently raised suggestions are discussed in more detail in this section.

Documentation

Three States recommended modification of the HERS-ST documentation to make it easier to understand and use. FHWA initiated actions, discussed in the next chapter of this report, to address these concerns.

Software

Half of the respondents suggested that the software should be Windows-based and made more user-friendly. The prototype version of HERS-ST was DOS-based and therefore did not have the look and feel of most of today's Windows-based programs. The process of running the HERS-ST prototype was complex: the user had to execute two programs and use a text editor to modify the individual input data files. Several participants specifically recommended the addition of a GIS interface. One State requested the ability to integrate HERS-ST with existing State databases. Chapter 6 describes actions that FHWA undertook to address these issues.

Analysis Features

Collectively, the pilot program participants made numerous suggestions for enhancing the analytical capabilities of the HERS-ST prototype that would require significant revisions to the model or the input data. Many of these suggestions have been considered by FHWA as important areas to pursue in future research initiatives. In general, revisions to the HERS-ST analytical approach will be undertaken by FHWA's Office of Legislation and Strategic Planning in the context of the national-level HERS model. The Office of Asset Management will ensure that each version of HERS-ST reflects the latest technical enhancements.

The following list highlights some suggestions for analytical changes over the long term:

Include bridges in the analysis

FHWA has recently developed a national-level investment analysis model for bridges that is analogous to HERS. This model, known as the National Bridge Investment Analysis System (NBIAS), will be a separate system from HERS-ST for the foreseeable future.

Take into account network effects (e.g., impact of facility improvements on adjacent sections)

The HERS-ST model currently captures certain improvement-induced system network effects in its travel demand forecasts. Such changes in demand are calculated by applying the price elasticity of demand for highway travel to the reduction in user costs on the improved sections. FHWA may develop other means of estimating network effects in future versions of the national-level HERS. However, explicit modeling of network effects (between either highway sections or transportation modes) is not yet possible with state-of-the-art transportation modeling.

Table 1
Summary of recommendations made by pilot program participants

Recommended Improvement	Participating State												
	AR	CA	FL	IA	ME	MI	MO	NM	NY	OH	OR	PA	UT
Revise and enhance existing documentation	X										X		
Integrate HERS-National and HERS-ST documents								X					
Make software user-friendly/Windows-based	X					X	X	X		X		X	X
Enable all scenario options as in national-level HERS		X		X					X		X		
Include help file in software											X		
Combine data preprocessor and HERS-ST		X											
Develop software to install and configure HERS-ST		X				X							
Put model in GIS framework			X			X							X
Put HERS-ST into a relational database									X				
Integrate with existing State databases and management systems						X							
Accommodate proposed routes			X			X							
Include bridges in analysis						X		X		X			
Account for impact of improvement on adjacent sections			X			X	X						
Provide for project-level analysis		X						X				X	
Revise Residual Value Calculation									X				
Eliminate age-related vehicle depreciation		X											
Include option for minimum time period between improvements				X									
Add a capacity factor override											X		
Add an improvement cost factor to the existing overrides											X		
Include additional pavement strategies									X	X			
Improve pavement analysis				X									
Enable analysis by user-defined portions of the database	X		X										
Add adjustable expansion factors										X			
Include different minimum BCRs for urban and rural sections											X		
Include multimodal analysis capabilities			X						X				
Change to match current HPMS format		X				X	X	X	X				
Create look-up tables to reduce reentry of data	X												
Improve method of entering special State data										X			
Create a data input screen that is tied to a database										X			
Enable the use of HPMS-formatted State input files						X							
Improve ease of inputting data items			X		X				X			X	
Create concise summary reports								X					
Improve abiltiy to view output on screen						X							
Allow user to define file type											X		
Create GUI-type output—user-defined graphs and tables					X					X		X	
Add date and time of run to header										X			
Correct discrepancies in output file											X		
Include all sections in output file				X							X		
Include lane-miles at beginning and end of funding periods									X				
Include backlog in output file											X		
Include statistics—confidence level and uncertainty						X							

Note: Arizona, Indiana, Louisiana, and New Jersey did not supply written review comments. AR = Arkansas, CA = California, FL = Florida, IA = Iowa, ME = Maine, MI = Michigan, MO = Missouri, NM = New Mexico, NY = New York, OH = Ohio, OR = Oregon, PA = Pennsylvania, UT = Utah; HERS = Highway Economic Requirements System; ST = State Version; GIS = geographical information system; BCR = benefit-to-cost ratio; HPMS = Highway Performance Monitoring System; GUI = graphical user interface.

Include project-level analysis capabilities

Incorporating project-level BCA capabilities into the HERS-ST model would require much more input data than is currently measured in the HPMS and would therefore greatly increase the data support needed for the model.

Accommodate proposed

The ability to accommodate new highway routes would require substantial modifications to model algorithms and data input requirements.

Provide for multimodal analysis

FHWA is currently researching ways to incorporate multimodal trade-offs into HERS. If this effort comes to fruition, multimodal analysis will be included in HERS-ST.

Input Data Format

The HERS-ST model requires that the input data be in the HPMS format and that all data fields used by the model contain valid data. Some of the pilot States indicated an interest in running the HERS-ST model with a database representing their entire highway system (or some portion thereof), but the records included in such a database, although in the HPMS format, might be incomplete. In many cases the missing information, while required to run HERS-ST, would not make an appreciable difference to the model results. These respondents suggested that HERS-ST include a feature that would allow easy (e.g., global) entry of default values in these fields, as opposed to the line-by-line entry of data required by the prototype.

Another suggestion arising from the pilot program was to incorporate a database front end into the HERS-ST model. This would allow users to view and modify data on the computer screen without using or installing another piece of software. With the HERS-ST prototype, the analyst viewed the input database from software external to the model.

These recommended changes have been included in the first revision, version 2.0, of the HERS-ST software (see Chapter 6).

Output Data Format

Most of the comments concerning the output data focused on improving its format and readability or making the data easier to view. A number of respondents suggested that the addition of visual aids such as graphs, charts, and maps would be very useful. The prototype version of HERS-ST output data in a tabular report format. Viewing the data on the computer involved opening the output files in a text editor or spreadsheet. The process of producing graphics from the data was not difficult but could be time-consuming. For the most part, these comments have been addressed in the upcoming version of HERS-ST, as indicated in Chapter 6.

Chapter 6:

FHWA's Short-Term Plan for HERS-ST

FHWA has pursued a number of initiatives building on the prototype software to create a version of the model, for broad distribution, that is more accessible and useful to State officials. Other FHWA activities include promoting the software, establishing a departmental coordinating group, and developing a long-term HERS-ST research/action plan to guide future work. Many of these projects are or will be conducted in partnership with the Office of Legislation and Strategic Planning. Activities recently completed or currently underway include model revisions, a Web page, a coordinating committee, and a national conference. Table 2 presents the status of addressing the pilot program participants' recommended model revisions.

6.1 Model Revisions

A major project to develop a Windows-based interface for HERS-ST has been completed. This effort addressed a number of concerns raised by the pilot States, primarily those calling for enhanced user friendliness, as well as improved data input, output, querying, and reporting capabilities. HERS-ST users will benefit from a software package that is easier to use, more functional, and more analytically robust. The new national HERS features have been integrated into HERS-ST.

6.2 HERS-ST Web Page

The FHWA Office of Asset Management has created a HERS-ST Web site at http://www.fhwa.dot.gov/infrastructure/asstmgmt/hersindex.htm. Shown in Figure 5, the home page is accessible from the Office's main page. The HERS-ST site provides information suitable for users and nonusers alike. It includes a brief history of the national HERS and HERS-ST programs and describes the future direction of the State version. Users can download the HERS-ST software and documentation, send e-mails to the HERS-ST program manager, and exchange information in a HERS-ST community of practice.

Table 2
Status of HERS-ST projects in relation to State-suggested improvements

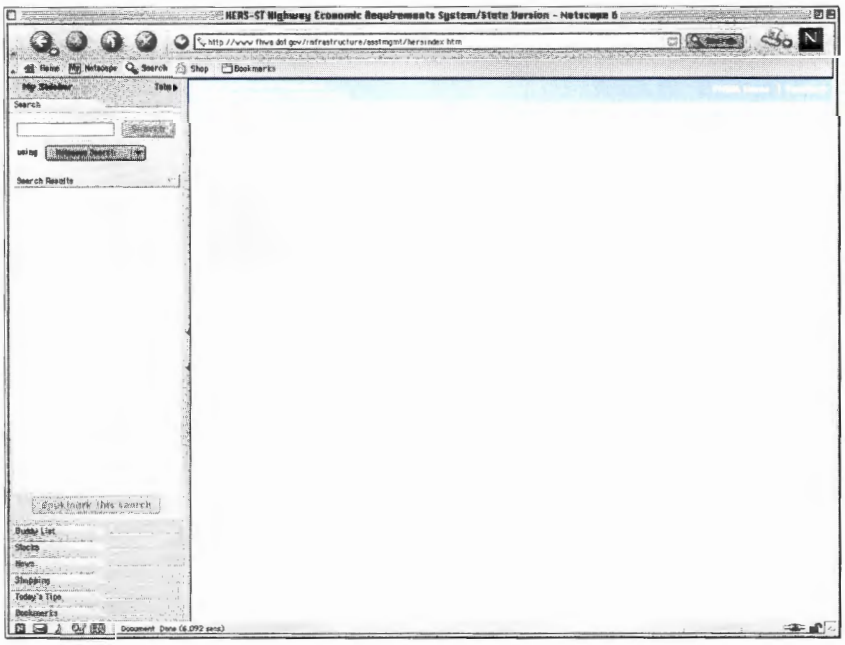
Pilot Program Recommended Improvement	Status of Improvement	
	HERS Agenda[1]	HERS National Agenda[2]
Documentation		
Revise and enhance existing documentation	Complete	
Integrate HERS-National documents into HERS-ST documents	Complete	
Software		
Make software user-friendly/Windows-based	Complete	
Enable all scenario options as in national-level HERS	Complete	
Include help file in software	Short term	
Combine data preprocessor and HERS-ST	Complete	
Develop software to install and configure HERS-ST	Complete	
Put model in GIS framework	Complete	
Put HERS-ST into a relational database	Long term	
Integrate with existing State databases and management systems	Long term	
Analysis Features		
Accommodate proposed routes	Long term	
Include bridges in analysis		Under evaluation
Account for impact of improvement on adjacent sections		Under evaluation
Provide for project-level analysis	Under evaluation	
Revise Residual Value Calculation		Complete
Eliminate age-related vehicle depreciation		Long term
Include option for minimum time period between improvements	Long term	
Add a capacity factor override		Long term
Add an improvement cost factor to the existing overrides		Long term
Include additional pavement strategies		Long term
Improve pavement analysis		Long term
Enable analysis by user-defined portions of the database	Complete	
Add adjustable expansion factors		Underway
Include different minimum BCRs for urban and rural sections		Long term
Include multimodal analysis capabilities		Long term
Input Data		
Change to match current HPMS format		Complete
Create look-up tables to reduce reentry of data	Complete	
Improve method of entering special State data	Complete	
Create a data input screen that is tied to a database	Complete	
Enable the use of HPMS-formatted State input files	Complete	
Improve ease of inputting data items	Complete	
Output Data		
Create concise summary reports	Complete	
Improve abiltiy to view output on screen	Complete	
Allow user to define file type	Complete	
Create GUI-type output—user-defined graphs and tables	Complete	
Add date and time of run to header	Complete	
Correct discrepancies in output file	Complete	
Include all sections in output file	Complete	
Include lane-miles at beginning and end of funding periods	Complete	
Include backlog in output file	Complete	
Include statistics—confidence level and uncertainty	Long term	

Note: HERS = Highway Economic Requirements System; ST = State Version; GIS = geographical information system; BCR = benefit-to-cost ratio; HPMS = Highway Performance Monitoring System; GUI = graphical user interface.
[1] The Office of Asset Management has lead responsibility for these projects.
[2] The Office of Legislation and Strategic Planning is overseeing these projects.

HERS-ST Coordinating Committee will serve as the vehicle by which the Office of Asset Management informs, communicates, and coordinates with other program offices within USDOT regarding HERS-ST programs and activities. Representatives from throughout USDOT will be included on the committee. 6.3

ollowing the development of the revised HERS-ST software, the Office of Asset Management is hosting a national conference to distribute the newly completed HERS-ST software, train participants in its use, and obtain input for a long-term research/action plan. The conference is scheduled to take place in Charlotte, North Carolina, September 24–25, 2002. 6.4

Figure 5
HERS-ST home page



Chapter 7:

Summary

In February 2001, FHWA initiated the HERS-ST Pilot Program to determine the applicability of HERS-ST, or a similar application, at the State level. The results of this pilot program are summarized in this report. The pilot program was an important first step in ascertaining the level of interest among the States for a HERS-like tool. FHWA wanted to confirm State interest prior to committing significant time and resources. The program participants, all State DOT volunteers, were asked to evaluate HERS-ST in the context of their State investment decision-making processes. Over half of the responding participants indicated that HERS-ST would be applicable at either the State or local level. Based on comments submitted by the State participants, FHWA determined that continued support and enhancement of the model are warranted.

FHWA has completed a number of initiatives aimed at addressing issues raised by the State participants, most notably, development of a powerful, user-friendly graphical user interface for HERS-ST. In addition, the Office of Asset Management is organizing a HERS-ST Coordinating Committee to synchronize HERS-ST efforts with related efforts throughout USDOT. The Office will also develop a long-term research/action plan for HERS-ST that will continue FHWA efforts to provide an appropriate, customer-focused tool in a timely manner.

This report marks the completion of the HERS-ST Pilot Program and the beginning of a new generation of the HERS concept. FHWA will continue to use the information gathered from the pilot program as well as future feedback from users to mold HERS-ST into a product that will meet the needs of State transportation officials across the country.

Appendix A:

Documentation

HERS Overview: Federal Highway Administration, October 1994.

HERS Technical Report: Federal Highway Administration, December 2000.

HERS User's Guide Final Report: Federal Highway Administration, December 2000.

HERS-ST Overview: Federal Highway Administration, March 2001.

HERS-ST RunPrep Guide: Federal Highway Administration, January 2001.

HERS-ST User's Guide: Federal Highway Administration, December 2000.

Appendix B:

Pilot Program Peer Exchange Survey

major component of the workshop is the Peer Exchange session. This is an opportunity for the participating States to share their planning and programming practices, as well as their expectations regarding the contribution of the HERS-ST software to this process. To facilitate this session, I am asking that you answer the following questions concerning your State's approach to program and plan development, and project selection. In addition, any information you feel is relevant to the use of economic analysis in your planning/programming process would also be beneficial to note. This is not intended to be a lengthy exercise—1 to 3 pages is sufficient. I would like to receive your responses to these questions by e-mail (julie.trunk@fhwa.dot.gov) no later than January 26, 2001, so that we may better prepare for the session. Thank you in advance for your participation in making the Peer Exchange a dynamic learning experience for everyone.

Programs

- What timeframe is covered by your Transportation Investment Plan (TIP) or Statewide Transportation Investment Plan (STIP)? How far in advance are individual projects committed or listed?

- What agency or agencies generate projects and assemble TIPs/STIPs? How are projects prioritized? What are the technical inputs (project evaluation, economic impacts, engineering standards) to this process?

Plans

- What is the date of your current regional or State long-range transportation plan? What technical analysis contributes to the plan?

- What is the content of the plan (policy, program, project)? Are expenditure targets or limits included? Are projects or corridors identified or prioritized?

- What financing and funding constraints are imposed, either in the plan or the TIP/STIP, such as matching, cap on local funds, or borrowing limits? At what point in capital investment decision-making do resource limitations "bite"?

Projects

- How are individual project proposals generated?
- Who generates supporting documentation, and what analysis is conducted (benefit-cost, sufficiency ratings, cost-effectiveness, other)?

HERS-ST

- How do you feel HERS-ST might help in supporting project and program planning efforts in your State?

Appendix C:

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Appendix D:

Pilot Program Workshop Agenda

New Orleans, Louisiana
February 14-16, 2001

Welcome
Madeleine Bloom, Director, Office of Asset Management,
Federal Highway Administration (FHWA)

Introductions, Pilot Overview, and Logistics
Julie Trunk, HERS-ST Project Manager, Office of Asset Management, FHWA

The HERS-ST Environment
Regina McElroy, Team Leader, Office of Asset Management, FHWA

Nontechnical Overview of the National HERS Model
Ross Crichton, HERS Project Manager, Office of Policy, FHWA

HERS-ST Prototype Overview
Regina McElroy, Team Leader, Office of Asset Management, FHWA

General Accounting Office (GAO) HERS-ST Report
Katherine Siggerud, Assistant Director, GAO

State's Experience—Oregon Department of Transportation
Richard D. Arnold, Senior Transportation Analyst

State's Experience—Indiana Department of Transportation
Steve Smith, Transportation Planning Manager

Peer Exchange Discussion Points
Facilitated by **Doug Lee**, Planner, U.S. Department of Transportation/Volpe Center and
Lance Neumann, President, Cambridge Systematics, Inc.

HERS-ST Technical Overview
Doug Lee, Planner, U.S. Department of Transportation/Volpe Center

Using the HERS-ST Model
Greg Camus, Principal Research Scientist, U.S. Department of Transportation/Volpe Center

Support Procedures
David Winter, Highway Engineer, Office of Asset Management, FHWA

Feedback/Recommendations from Workshop
Regina McElroy, Team Leader, Office of Asset Management, FHWA

Appendix E:

Prototype HERS-ST Evaluation Exercises

Exercise 1

- The first exercise is to run the PreProcessor
- Use the 1997 data for your State
- Prepare PPSPEC.DAT
  - Name the output files "AA_st.XXX" where AA is your State's two-character abbreviation, and XXX is the extensions HRS and DST
  - Use the default values for the other entries
- Run the PreProcessor and create the .HRS, .DST, and EIFIL.BIN output files
- Make backup copies of these three files

Exercise 2

- Use HERS-ST to perform an economic efficiency run using your State's data
- Use RunPrep to prepare RUNSPEC.DAT
  - Use the input files you created in the first exercise
  - Name the run "AA_EE" and the output file "AA_EE.OUT"
  - Set the Objective to "3," and the minimum BCR to "1.00"
  - Select some optional output pages
  - De-select the output files describing selected improvements
  - Otherwise, use default values
- Run HERS-ST and examine the output
  - Do system conditions improve or decline over the period
  - If necessary, adjust the units of costs and VMT to provide more detailed output and repeat the exercise

Exercise 3

- In the PARAMS.DAT file, modify one parameter:
  - WDFOVR - widening feasibility
  - Truck growth factor
  - PDRAF - pavement deterioration rate
  - State cost factor
- Perform an economic efficiency run using your State's data (repeating exercises one and two)
  - Use a different run name and output file names
  - If you saved the PreProcessor output files, you can make copies and use them
- Examine the output of the two runs: do the differences make sense

Exercise 4

- The fourth exercise is to perform a constrained fund run using your State's data
  - Use a different run name and output file names
  - You can re-use the PreProcessor output files
  - Select a constrained fund run, Objective 1
  - Select a constraint specification (functional class grouping)
  - Enter available funds for each functional group for each FP
- After the run, compare the outputs with Exercise 2
  - How do system conditions change
  - What about average BCR

Exercise 5

- The fifth exercise is to create a small subset of data and specify some improvements
- Open your State data (STnn_97.DAT) in a text editor
  - Select 20–30 sections
  - Copy them to a new file
  - Copy the /ST template into the new file
  - For some of these sections, specify improvements during the analysis period
  - Set the expansion factors to "1"
  - You may wish to change other section characteristics as well

Exercise 6

- PreProcess the small dataset
- Perform an economic efficiency run using the small dataset
- Examine the IMPRSnn.OUT files
  - Make a working copy of the file TEMPLATE.XLS
  - Open a spreadsheet program and load the working copy
  - Load the IMPRS01.OUT file to the spreadsheet and paste it into the working copy
- Were the expected improvements implemented
- Were other improvements implemented

Appendix F:

HERS-ST Evaluation Questions

1. Now that you have an understanding of the capabilities, input requirements, outputs, and general operation of the model, do you or do you not see a role for the HERS-ST model in its present or modified form in your planning activities? Please explain usefulness or limitations of the software and how it does or does not meet your needs.

2. What improvements would you propose be made to the HERS-ST model so that it would better meet your needs? Please be as specific as possible and address any enhancements you would like to see made to the model.

3. What other tool(s) and/or types of analysis do you think would be most useful for your purposes either for updating the long-range plan or for other strategic planning purposes?

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Federal Highway Administration

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