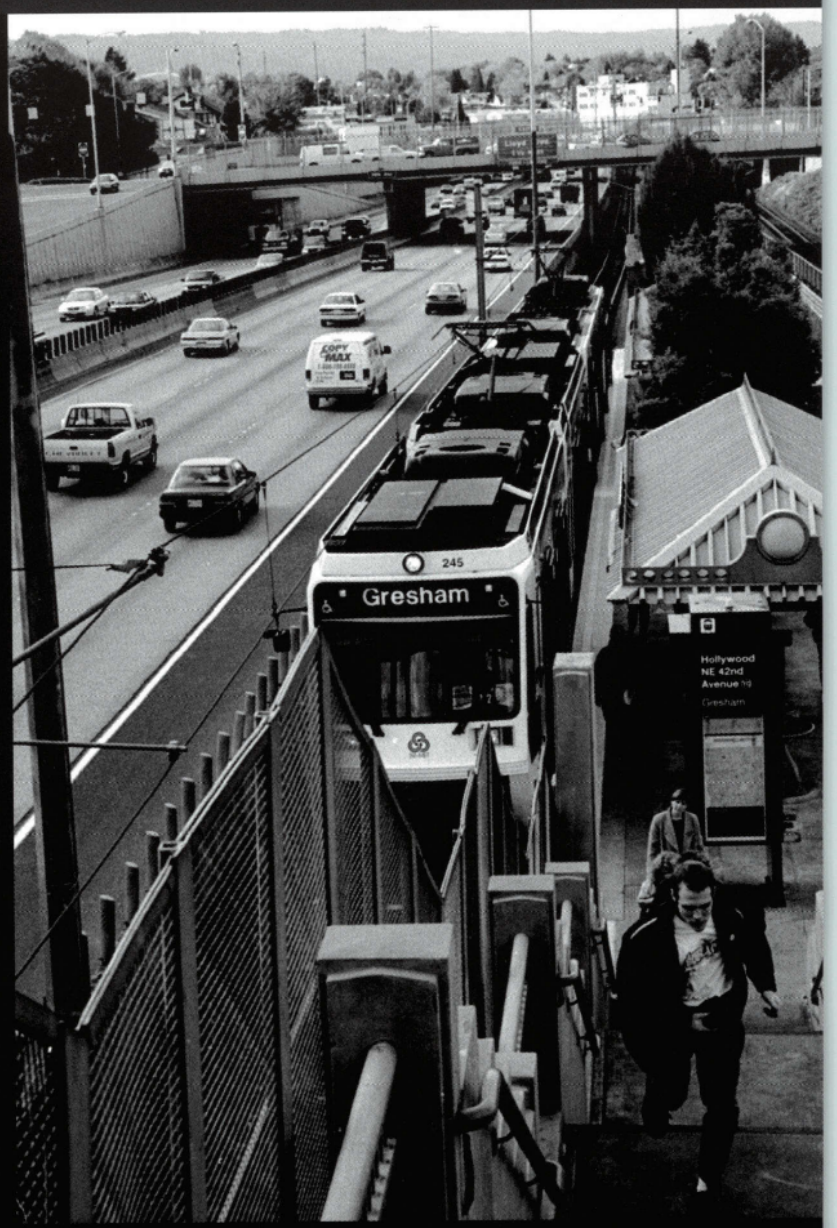
Transportation Asset Management Case Studies

Presented by

U.S. Department of Transportation
Federal Highway Administration

HIGHWAY ECONOMIC REQUIREMENTS SYSTEM

The Oregon Experience


245
Gresham
Hollywood
NE 42nd
Avenue

Note From the Director

The Federal Highway Administration's Office of Asset Management is promoting a different way for transportation agencies to distribute their resources among alternative investment options. This new way of doing business, "Asset Management," is a strategic approach for getting the best return on dollars spent for transportation improvements.

Each State transportation agency will likely have different methods for implementing an Asset Management strategy. For example, some agencies will pursue a data integration strategy in order to ensure comparable data for the evaluation of investment alternatives across asset classes. Others will move to deploy economic analysis tools to generate fact-based information for decision makers. Still others will want to integrate new inventory assessment methods into their decision-making processes.

Much can be learned from those who are readying their organizations for Asset Management. To spark the exchange of information, we are initiating a series of case studies focused on agencies that are leading the way. In this, the inaugural year of the series, we established four tracks: data integration, economics in Asset Management, the Highway Economic Requirements System–State Version, and life-cycle cost analysis. In upcoming years we will add new State reports to each of the tracks and will create new tracks addressing additional facets of Asset Management such as change management and performance measurement.

On behalf of the Office of Asset Management, I am pleased to introduce this new series. We believe the case studies will help agencies meet the challenges of implementing Asset Management programs.

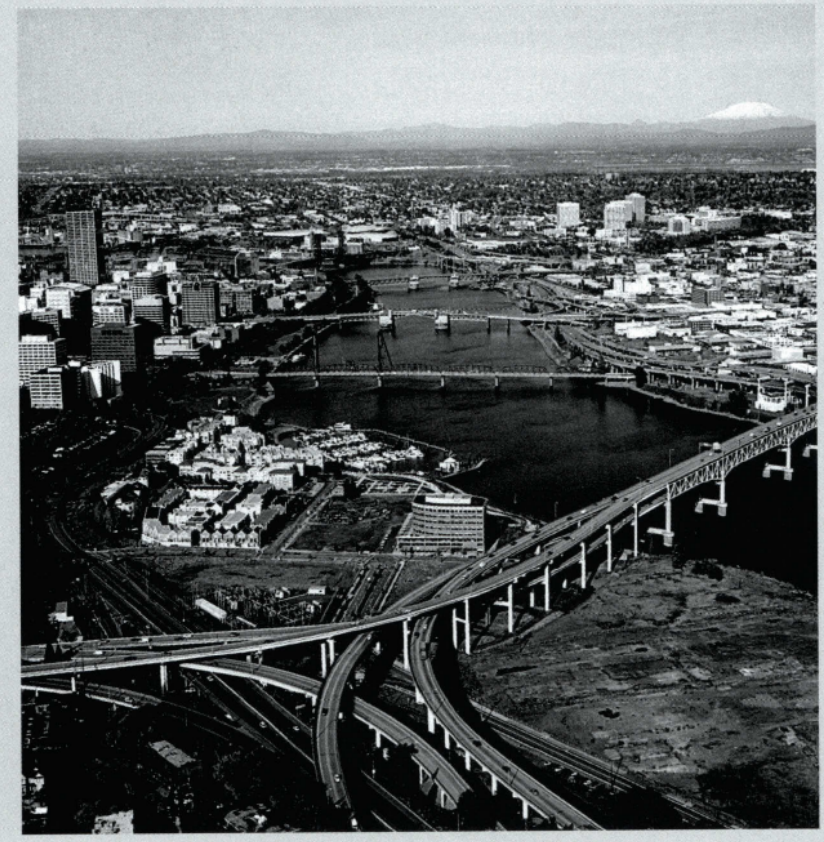
David R. Geiger

David R. Geiger
Director, Office of Asset Management

Note to the Reader

The Transportation Asset Management Case Study Series is the result of a partnership between State departments of transportation and the Federal Highway Administration's (FHWA's) Office of Asset Management. FHWA provides the forum from which to share information, and the individual States provide the details of their experiences. For each case study report, State transportation staff were interviewed by FHWA, and the resulting material was approved by the State. As such, the case study reports rely on the agencies' own assessment of their experience. Readers should note that the reported results may or may not be reproducible in other organizations. ■

Bridges of Portland



Executive Summary

Since 1991, the Oregon Department of Transportation (ODOT) has used computer models to support its investment decision-making processes. Initially, Oregon relied on the Highway Performance Monitoring System Analytical Process (HPMS AP). The HPMS AP is an investment/performance simulation model designed to predict the investment required to correct current and future highway system deficiencies. This approach relies primarily on engineering considerations and only marginally considers the highway user. While developing its 1999 Oregon Highway Plan, ODOT decided to change their methodology to one that incorporated economics and the impact of investment decisions on highway users.

At about this time, ODOT became aware of the Highway Economic Requirements System (HERS), a new investment/performance model that had just been introduced by the U.S. Department of Transportation (USDOT) for use at the Federal level. The HERS differs from the HPMS AP in that it incorporates economics into its investment selection simulation procedures. Initially, the national version of HERS was not available for State use, but ODOT obtained a copy through a contractor working on the update of its Highway Plan. ODOT worked closely with the contractor in modifying the software to make it useful as a State-level planning tool. The revised program, which came to be known as HERS-OR, was successfully used in producing the 1999 Oregon Highway Plan. ODOT continues to use the HERS model for selected planning and policy analyses, and envisions significant new applications in the future.

ODOT is one of the first States to use the HERS model for planning and policy analysis at the State level. Recently, Oregon has begun to upgrade from HERS-OR to HERS-ST, the State-level HERS model supported by USDOT. HERS-ST has most of the features of HERS-OR, but also has updated formulas and calculations and is considerably more user friendly. ■

AGENCY FACTS

The Oregon Department of Transportation (ODOT) is headquartered in Salem, Oregon. First created as the State Highway Department by the Oregon legislature in 1913, ODOT was re-established by legislative action in 1969 to incorporate other State modal agencies, such as motor vehicles, ports, aeronautics, and mass transit. ODOT has 5 regional offices, 14 districts, and 83 maintenance facilities. ODOT maintains 7,500 State highway miles and more than 5,000 bridges. The agency employs approximately 4,700 persons statewide.

ODOT's mission is to provide a safe, efficient transportation system that supports economic opportunity and livable communities for all Oregonians. The department manages the State's highway and bridge systems, administers motor vehicle and motor carrier laws, and oversees public transit, rail, and traffic safety programs throughout Oregon. The State's economy depends heavily on well-maintained transportation systems. Oregon's two main interstates, I-5 and I-84, are vital to commerce throughout the State. Recent studies indicate that the Portland and Upper Willamette Valley areas, located in the northwest part of the State, account for 75 percent of the State's economic production—and much of this productivity depends on the interstate system. Transportation systems are also essential in rural areas, where the remaining 25 percent of the State's production occurs, production that includes the movement of timber, agriculture, and other products.

For the 2002 fiscal year, ODOT reported that it had spent more than $251 million on 896 highway and bridge construction projects and nearly $27 million on capital equipment used to maintain highways and bridges. The department had committed $321 million for future highway and bridge construction.

Scenic Byway signage

SETTING THE STAGE

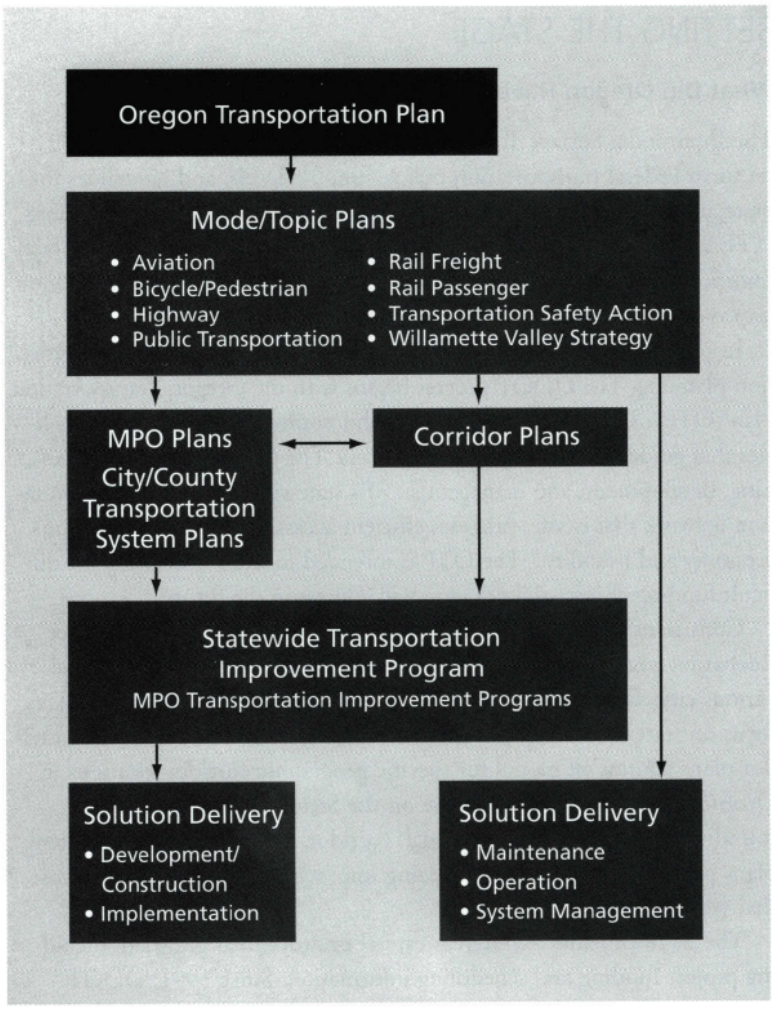
What Did Oregon Have?

The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 set forth Federal transportation policy, funding levels, and guidelines for State and metropolitan transportation planning. Among other provisions, ISTEA required each State to prepare a long-range, statewide multimodal transportation plan and to produce a short-term, statewide transportation improvement program (STIP) consistent with the plan.

In response to ISTEA, ODOT adopted a new approach to transportation planning. The ODOT process begins with the Oregon Transportation Plan (OTP). The OTP establishes the philosophy, vision, and broad policies that guide the overall planning process. The OTP calls for the "planning, development, and management of a statewide, integrated transportation network that is safe, provides efficient access, and enhances Oregon's economy and livability." The OTP is intended to assist in making the difficult funding choices that Oregon will address in the future.

Consistent with the OTP, Oregon's integrated planning process (see sidebar on page 6) includes statewide modal plans, corridor plans, and various city/county transportation system plans (TSPs). The modal plans focus on statewide needs and policies for each transportation mode; corridor plans address all modes for specific geographic corridor locations in Oregon; and the TSPs concentrate on the State's cities and their surrounding areas. Together, the modal, corridor, and transportation system plans provide the basis for prioritizing improvements and selecting those that will be included in the STIP.

The STIP provides a four-year capital improvement program, including project funding and scheduling information. Since 1991, ODOT has used sophisticated analytical models, including pavement and bridge management systems, to support development of their STIP. From the onset, a critical component of this effort was the USDOT's Highway Performance Monitoring System Analytical Process (HPMS AP), an investment/performance model designed to assess the physical condition, safety, service, and efficiency of highway system operations given alternative funding levels, policies, or program structures.



Source: 1999 Oregon Highway Plan

What Did Oregon Want?

In 1997, ODOT initiated work to revise its 1991 Oregon Highway Plan, which is one of a number of modal plans that provide direction and input to the STIP. The Highway Plan provides long-range policies and investment strategies given current funding levels and explains how potential future revenues could be productively invested.

With the guidance established in the OTP—that transportation investments should enhance Oregon's economy and livability—ODOT recognized that the Highway Plan needed to reflect all of the benefits and costs resulting from potential investments, not just agency costs and benefits. In addition, ODOT saw that as transportation needs grow and funding becomes more constrained, the ability to evaluate potential improvements according to economic criteria will become more important.

The engineering-oriented HPMS AP had a long history of successful use by ODOT analysts. It was a robust analytical system that could systematically analyze the impact of planned investment levels and document the results of higher levels on system performance. There was, however, a growing recognition that it lacked an important economic dimension necessary to address user costs and benefits more fully. Years earlier, FHWA had come to the same conclusion and, in response to this concern, developed the Highway Economic Requirements System (HERS). In 1995, FHWA used HERS to produce the national investment requirement estimates included in the "Status of the Nation's Surface Transportation System: Conditions and Performance Report to Congress."

HERS and HPMS AP are similar computer models. Both simulate highway system deterioration and selectively choose investments for implementation to correct current and projected deficiencies. Their simulations are based on analyst-specified constraints such as funding levels. Both models report system condition and performance levels resulting from the analysis of a given scenario. They both use engineering standards to identify roadway deficiencies and consider capital improvement projects intended to correct pavement and capacity deficiencies. The models differ in that HPMS AP identifies needed improvements based primarily on engineering standards, while HERS uses not only engineering standards, but also economic criteria to select the optimal mix of improvements for

system implementation. In summary, the major difference between the two models is that HPMS AP looks at the impact that highway users have on the condition and performance of the highway system, while HERS focuses on the impact that the condition and performance of the highway system will have on highway users.

HOW DID OREGON GET THERE?

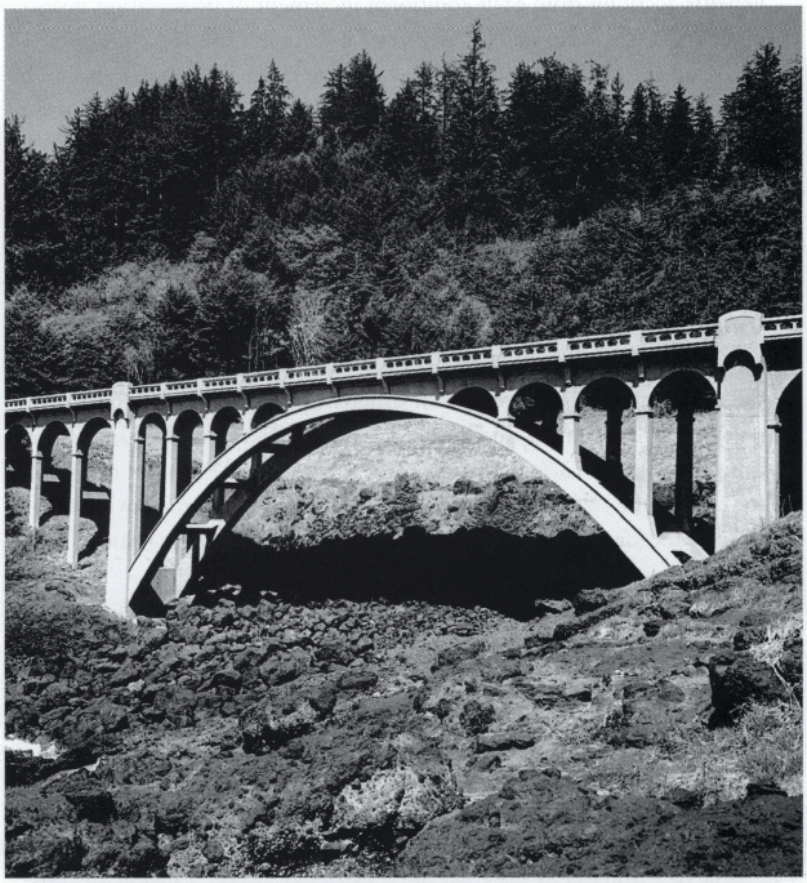
ODOT decided to use a HERS-like approach to assist in developing their Oregon Highway Plan. The consultant brought in to help with the Highway Plan was familiar with HERS and agreed to tailor the national version of HERS for use by Oregon's Planning staff.

To facilitate the analysis required for the Highway Plan, Oregon directed the contractor to make a number of enhancements to HERS. Two were significant and are presented here: First, a feature was added to allow the analyst to modify HERS-simulated improvements. Because of this revision, the analyst using HERS-OR (Oregon's version of the national HERS model) may revise the model's output so that improvements selected for implementation will reflect "real world" conditions (i.e., anticipated changes in traffic volumes based on known land use changes). Therefore, HERS-OR results can include a combination of model-identified improvements as well as ODOT-identified improvements. ODOT can also simply delete a HERS-OR recommended improvement, without including a substitute.

In addition, Oregon requested that output files be developed that would contain, for each highway section in the input database, the recommended HERS-OR improvement or the analyst-specified improvement, the costs and benefits of those improvements, and the expected condition before and after any improvement. This feature was helpful in allowing Oregon staff to review and understand the analysis recommendations for each section.

WHERE IS ODOT TODAY?

In Oregon, HERS has proven its value as a transportation planning tool. The Oregon version of HERS was used to support the needs analysis requirements in development of the modal, corridor, and MPO plans leading to the STIP. In each case, HERS-OR was used to analyze the impact of different investment levels on the system and its users. HERS-OR continues to be used to conduct various needs analyses and selected features of the model have been applied in producing special studies. The model has been integrated into the department's day-to-day activities, as the following examples of HERS-OR applications show.



Rocky Creek Bridge, near Lincoln City

Transportation Planning

In 1999, HERS-OR was used to analyze three scenarios for the Oregon Highway Plan update. Each of the scenarios included a different mixture of preservation and modernization improvements, ranging from "Preservation Only" to "High Cost Modernization." Modernization improvements are primarily focused on addressing congestion issues. The scenarios were analyzed to determine highway system condition and performance and user cost impacts over a 20-year analysis period (see sidebar on page 11). Performance was reported in terms of average effective speed and user cost saving per mile.

Through its HERS-OR analysis, ODOT was able to calculate the benefits accruing from each additional increment of preservation investment and each additional increment of investment in modernization. Based on the HERS-OR analysis, a case was successfully made that additional funds, over and above ODOT's current resources, could be invested in the system. The HERS-OR analysis also helped frame the difficult choices that arise from decreases and increases in spending when resources are constrained.

Special Analyses

Value of Travel Time. In the late 1990s ODOT was publicly criticized for producing inconsistent estimates of the value of travel time. While the estimates had been created for different purposes, clearly there was a need for uniform, fully documented, and readily accessible value of travel time estimates. To accomplish this, the portion of HERS-OR responsible for calculating travel time costs was extracted and used to provide a framework for developing official ODOT estimates of the value of travel time.

In the early 2000s, a major accident on I-5 closed a portion of the interstate for 13 hours and spotlighted a remaining problem associated with ODOT's travel time estimates: effectively disseminating the information internally. A local newspaper article about the accident cited an ODOT estimate of user costs associated with the incident that did not match the official ODOT estimates produced using the HERS-OR framework. In response to this problem, ODOT created two reference documents for agency staff and the media: "Unexpected Delay Map" and "Table of Estimates of the Cost of Unexpected Delay." Oregon analysts

Oregon's Highway Economic Requirements System: Scenario Analysis

- At the start of the analysis, evaluate the current condition and performance of the highway system.
- Using traffic growth projections for each highway section in the database, forecast future conditions and performance for each 5-year period (of a 20-year overall analysis period).
- Identify section deficiencies based on analyst-defined triggers.
- Analyze deficient sections to identify potential improvements.
- For each section, list the possible improvements and apply economic criteria to rank-order the possible improvements according to relative economic merit.
- Select improvements for systemwide implementation until the system funding constraints or user cost objectives are satisfied.
- Consider analyst-determined substitutions for the improvements that the model selected for implementation.
- Evaluate model-generated improvement costs and consider appropriate revisions.
- Evaluate performance at the end of each funding period.

developed a spreadsheet to calculate the cost of delay based on the HERS-OR methodology. This information was provided as reference points on a State map and is now available for quick and easy look-up. These information sources are routinely used by regional personnel in communicating with the public.

By using the value of travel time methodology from the HERS-OR model, the Oregon DOT has been able to report, with the credibility that comes from consistency, the travel time costs accruing from incidents that cause unanticipated delay, such as mud slides, rock falls, and major crashes. These results are provided to the public and help to not only generate interesting background information, but also demonstrate

the importance of highway infrastructure to the citizens of Oregon. The estimates also serve as the basis for other time-related estimates of delay associated with detours, weight restrictions, construction work zones, and road closures.

Congestion Management System. Oregon's statewide Congestion Management System (CMS) provides information on transportation system performance. This information is intended to help decision makers identify, select, and implement policies and technologies that will alleviate traffic congestion. The CMS reports congestion trends on the State highway system and highlights congestion severity. The Oregon CMS uses the capacity analysis from HERS-OR—ODOT literally imported the HERS capacity module into its CMS.

WAS IT WORTH IT?

ODOT has found HERS-OR to be a powerful decision-support tool that can be used in program development and needs analysis as well as for establishing performance objectives. While the model has some limitations, Oregon has discovered many strong points. ODOT has learned that although HERS-OR is not a total solution to the challenge of planning, it can play a primary role in the transportation decision-making process by providing economically justified benchmarks. HERS-OR provides a solid foundation for budgetary and legislative program development and evaluation. The department sees this capability as being of increasing importance as funding constraints intensify and the public's demand for accountability increases.

In Oregon, the "what if" analysis 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 HERS-OR could be used as a communication tool for responding to questions from the general public about the transportation system, particularly its relationship to the user. In addition, the model's underlying relationships, assumptions, and outputs have provided input to other Oregon analytical efforts.

Cyclists, Columbia River Gorge, near Interstate 84

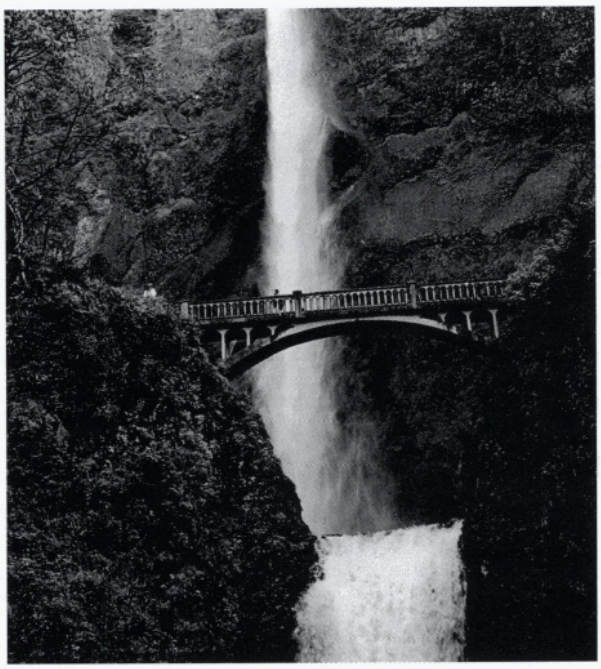
WHAT HAS OREGON DOT LEARNED?

Building on the useful applications of HERS-OR, ODOT is exploring ways to integrate the model with other agency tools in order to enhance statewide planning. For example, ODOT is pursuing data integration between HERS-OR and the Oregon Statewide Model. The strength of HERS-OR lies in its ability to provide an optimized list of improvements based on specified decision criteria and budget parameters. The statewide model effectively addresses trip generation and distribution assignments from policy-driven changes in the network. This capability is particularly significant for the planning group because Oregon has unique land-use laws that require the agency to follow stringent statewide planning goals during the planning process. HERS-OR is not sensitive to these land-use laws, and the travel demand model is not sensitive to budget constraints. ODOT is confident that these models offer tremendous potential when used together.

Data accuracy and accessibility are essential to producing meaningful and useful HERS-OR analysis. In 1997, while preparing the Oregon Highway Plan, ODOT developed a dataset that covered the entire State highway system, about 7,500 miles. This comprehensively validated database, known as the OHP dataset, has been used continually since that study. ODOT has worked to ensure that the data are regularly updated, which has improved the quality of HERS-OR analysis. ODOT uses the output from HERS-OR in other analytical applications, such as databases, spreadsheets, and geographic information systems (GIS) applications, further promoting data integrity.

WHAT'S NEXT?

ODOT is moving toward adoption of the FHWA-sponsored State version of HERS, HERS-ST. HERS-ST is a direct extension of the national-level HERS model. HERS-ST is analytically similar to HERS-OR, but has additional features, such as a user-friendly Windows interface, a GIS capability, and customizable graphical reporting tools not found in HERS-OR. Also, Oregon is interested in the revised capacity calculations and updates for various internal formulas, functions, and calculations found in HERS-ST.



Bridge at Multnomah Falls, near Portland

Another reason that ODOT is moving to adopt HERS-ST is because of FHWA's commitment to ongoing HERS-ST technical support, periodic updates, and user group forums. ODOT Planning staff view HERS-ST as a significant upgrade to the HERS-OR model.

As one of the early users of HERS for State-level application, ODOT has actively supported FHWA's development of HERS-ST. ODOT is an original member of the HERS-ST Developer's Group and, in that capacity, has provided insight and guidance in directing production of HERS-ST. ODOT staff also participated in the national HERS-ST conference as well as other related forums. ODOT plans to continue their involvement in HERS-ST, recognizing that not only do they gain valuable information and ideas regarding the experiences of other States in using the HERS model, but they also have an enormous opportunity to shape the HERS-ST software.

Oregon continues to explore new ways in which to use the HERS analysis and to integrate it with other applications within the agency. ODOT believes its use of HERS-ST will continue to grow as the program

becomes more integrated within the State's policy and planning organizations and is working on additional applications for the model:

- As input to average-effective-speed analysis
- For evaluating travel times and calculating truck speeds on specific roadway sections
- To develop a quick-response decision-making tool for evaluating the cost-effectiveness of improvements at the project level based on performance measures or benefit-cost ratios
- In studying the economic impact of bridge restrictions on trucks
- For integrating HERS-ST analytical modules with ODOT's management systems to allow those systems to take advantage of the model's economic analysis capabilities.

Amtrak Cascade route, southern Oregon

Further Information

ODOT Transportation Planning Division Web Site
http://www.odot.state.or.us/tdb/planning/
Transportation Planning Analysis

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Front cover: Yaquina Bay Bridge, Newport
Inside front cover: MAXX, Portland's light rail, alongside Interstate 84

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