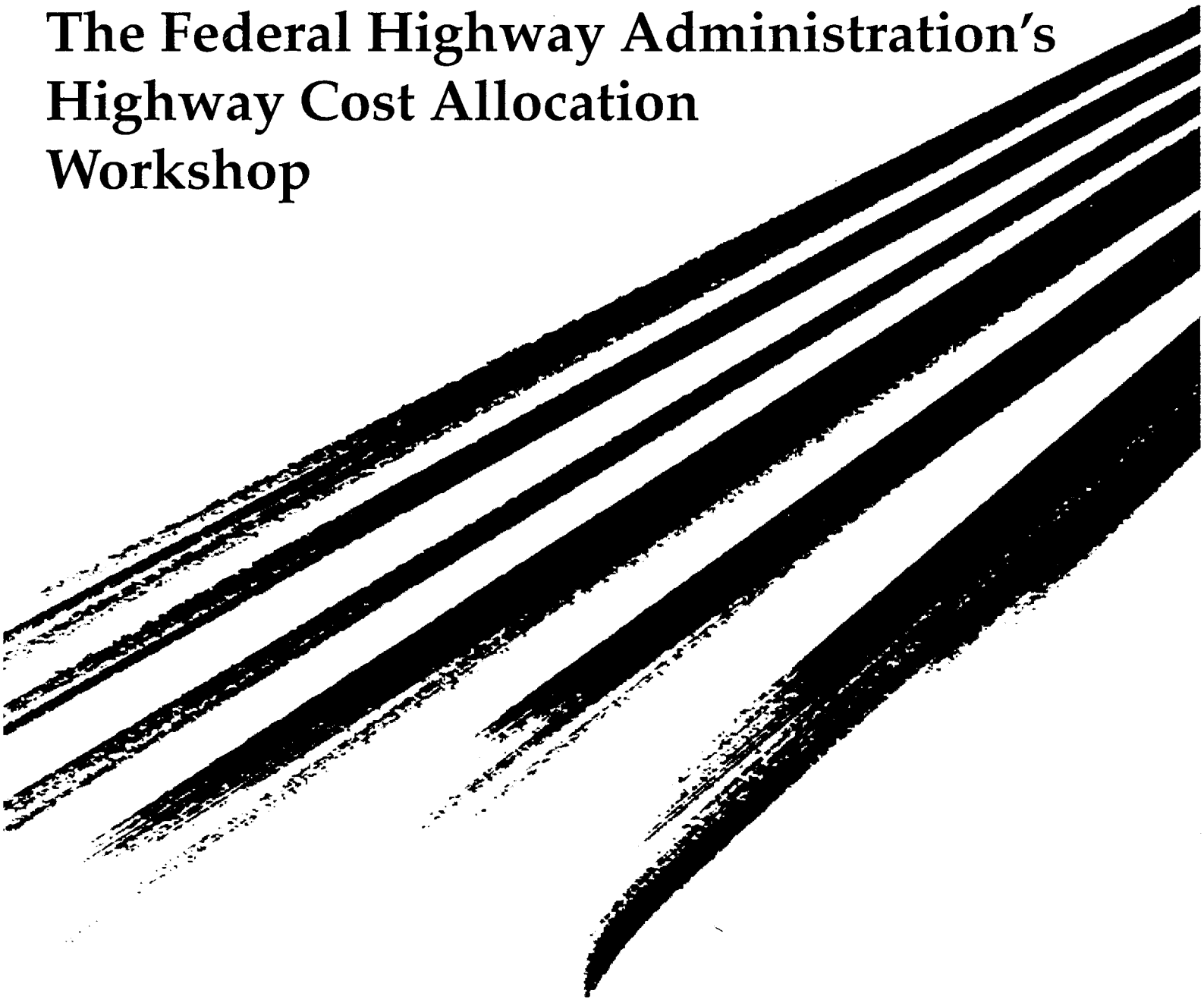
U.S. Department
of Transportation
**Federal Highway
Administration**
Number 14
June 1995

SEARCHING FOR SOLUTIONS

A Policy Discussion Series

The Federal Highway Administration's Highway Cost Allocation Workshop



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SEARCHING FOR SOLUTIONS
A Policy Discussion Series
Number 14

The FHWA Highway Cost Allocation Workshop

Sponsored by the Federal Highway Administration
in cooperation with the American Association of State
Highway and Transportation Officials (AASHTO)

October 12–13, 1994
Crystal City, Virginia

The following is a list of other publications in the Federal Highway Administration's "Searching for Solutions: A Policy Discussion Series."

Number 1	March 1992	Exploring the Role of Pricing as a Congestion Management Tool
Number 2	June 1992	Exploring Key Issues in Public/Private Partnerships for Highway Development
Number 3	August 1992	Public and Private Sector Roles in Intelligent Vehicle-Highway (IVHS) Deployment
Number 4	August 1992	Assessing the Relationship Between Transportation Infrastructure and Productivity
Number 5	August 1992	Transportation and Air Quality
Number 6	December 1992	Examining Congestion Pricing Implementation Issues
Number 7	December 1992	Edge City and ISTEA-Examining the Transportation Implications of Suburban Development Patterns
Number 8	July 1993	An Examination of Transportation Industry Productivity Measures
Number 9	February 1994	Bond Financing and Transportation Infrastructure: Exploring Concepts and Roles
Number 10	September 1994	Metropolitan American in Transition: Implications for Land Use and Transportation Planning
Number 11	October 1994	Summary of the Federal Highway Administration's Symposium on Overcoming Barriers to Public-Private Partnerships
Number 12	November 1994	Life Cycle Cost Analysis—Summary of the Proceedings: FHWA Life Cycle Cost Symposium
Number 13	December 1994	Conference on American Trade and Transportation (Border Crossings)

Foreword

This report summarizes results and recommendations of the Highway Cost Allocation Workshop sponsored by the Federal Highway Administration (FHWA) in cooperation with the American Association of State Highway and Transportation Officials (AASHTO). The workshop, held in Washington D.C. on October 12 and 13, 1994, was intended to discuss issues that should be addressed in the next Federal highway cost allocation study (HCAS) and data and research needs to support that study. More than seventy-five representatives from Federal and State transportation agencies, universities, consulting firms, and industry organizations attended the workshop.

The last Federal HCAS was completed in 1982. Since then, there have been significant changes in both the structure of the Federal-aid highway program and Federal highway user fees that have implications for highway cost allocation. In fact, with the earmarking of highway user revenues for deficit reduction and trends toward increasing flexibility to spend highway funds for transit improvements, pedestrian and bicycle facilities, and a variety of other enhancements, basic questions about the continuing relevance of traditional highway cost allocation have been raised. Furthermore, increasing concern is being expressed about the need to account for all costs of highway transportation in highway planning and program decisions. While the 1982 Federal HCAS included rough order-of-magnitude estimates of external costs of highway transportation, serious questions arise about how to more directly consider external costs in the highway cost allocation process.

Although highway cost allocation must consider many new and interesting issues emanating from recent highway program changes, the vast majority of highway user revenues will continue to be spent to improve the safety, condition, and performance of our highway system. There is continued interest in making the highway user fee structure as equitable and efficient as possible and in correcting any large inequities that may exist. As we continue to explore potential new highway revenue sources, questions concerning the equity of alternative user fee structures will arise; highway cost allocation provides part of the answer to those questions.

In addition to the broad highway cost allocation issues noted above, many specific technical questions and research needs were discussed at the workshop and are reported in these proceedings. Workshop recommendations will be invaluable to FHWA as we begin work on the new highway cost allocation study.

This report is the fourteenth issue of *Searching for Solutions: A Policy Discussion Series*. The series was developed to explore key highway transportation issues such as congestion pricing, public/private partnerships, innovative financing, land use, transportation and air quality, and transportation and economic productivity. We hope this series will help stimulate a wide-ranging exchange of ideas and opinions on key transportation policy issues.

Gloria J. Jeff
Associate Administrator for Policy
Federal Highway Administration

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Executive Summary

Introduction

On October 12 and 13, 1994 the Federal Highway Administration (FHWA), in cooperation with the American Association of State Highway and Transportation Officials (AASHTO), sponsored a workshop on highway cost allocation. Over 75 participants, including representatives of Federal and State transportation agencies, transportation industry groups, universities, and other public and private organizations attended this 2-day workshop. Five plenary sessions and two breakout sessions were held.

Presentations during the plenary sessions covered the following topics:

- Federal studies and research since 1982 related to highway cost allocation.
- State perspectives on highway cost allocation.
- Review of recent State highway cost allocation studies.
- Highway cost allocation implications of the Intermodal Surface Transportation Act (ISTEA).
- Evolution of 1982 Federal highway cost allocation methods
- Marginal cost pricing considerations for Federal highway cost allocation.
- Other approaches to highway cost allocation.
- Cost allocation implications of changes in Federal and State highway finance since 1982 and the outlook for the future.
- How environmental and other externalities should be treated in Federal highway cost allocation.
- Technical issues in highway cost allocation.

Opening Remarks

Opening remarks by Tony Kane, FHWA's Executive Director, set the context for the workshop and provided historical perspectives on the relationship between highway cost allocation and broader transportation finance and policy analysis. He discussed several functions of highway user fees including their role as the primary source of funds for highway programs at both the Federal and State levels, their use in promoting an equitable sharing of the financial burden of highway programs, and their use in rationing the use of highways.

Mr Kane discussed some of the issues that he hoped would be examined during the workshop including the broader context within which highway policy issues must now be viewed, the increasing interest in market mechanisms to make more efficient use of scarce public resources, the need for a new vision of an integrated, multimodal surface transport system, and the uncertain outlook for traditional sources of highway financing.

Workshop Objectives

Madeleine Bloom, Director of the FHWA's Office of Policy Development, discussed specific objectives of the highway cost allocation workshop:

- To discuss the evolution of highway cost allocation data and methods since the 1982 study.
- To identify significant factors that have changed since 1982 that may affect how cost allocation could be carried out, including greater attention to life-cycle costs and greater concern about congestion and transportation implications for the environment.
- To identify factors that have changed since 1982 that may affect the scope of highway cost allocation, such as the eligibility of transit improvements for Federal-aid highway financing.
- To discuss how these various factors should be considered in the next Federal HCAS in preparation for reauthorization.
- To recommend improvements in data and methods that could be made in conducting the next cost allocation study.

Session 1: Highway Cost Allocation Developments Since 1982

Jim March of FHWA presented an overview of Federal studies and research related to highway cost allocation since the last Federal highway cost allocation study (HCAS) was completed in 1982. Major FHWA studies have included *Alternatives to Tax on Heavy Vehicle Use* (1984), *The Feasibility of a Nationwide Network for Longer Combination Vehicles* (LCVs) (1985), *Heavy Vehicle Cost Responsibility* (1988), and *The Feasibility of a National Weight-distance Tax* (1988). Each of these Congressionally-mandated studies included some consideration of highway cost allocation issues. Since 1982, FHWA has conducted significant research to improve analytical tools and data needed for highway cost allocation. Research has included development of a national pavement cost model (NAPCOM), improved bridge cost allocation techniques, improved data on travel and operating weight distributions, and improved methods for considering life-cycle costs and external costs in highway cost allocation. These research efforts are continuing and expanding.

Otto Sonefeld of AASHTO presented State perspectives on highway cost allocation. Most States have their own cost allocation models, many of which are based in part on Federal methods. While supportive of the 1982 Federal study, AASHTO recognizes the importance of updating data and methods; States stand ready to assist FHWA in updating needed data and methods. Mr. Sonefeld noted that highway cost allocation holds the potential for providing information to improve the highway user charge structure.

Joe Stowers of SYDEC presented a paper, "Review of Recent State Highway Cost Allocation Studies." He noted that more than half the States have conducted studies since the 1982 Federal report to Congress. The best State studies use high quality data bases and special surveys, they consider revenues and expenditures by all levels of government, and they deal comprehensively with highway-related costs. He recommends that State studies be conducted frequently to establish credibility.

Mr. Stowers remarked that the consumption-based approach used in the 1982 Federal highway cost allocation study needs to be reevaluated because of the development of rational pavement rehabilitation procedures. Data bases need to be better integrated, and capabilities to analyze special vehicle types also are needed. State Departments of Transportation (DOTs) need to create more effective relationships with their legislatures to promote understanding and potential use of cost allocation study results. Highway cost allocation studies need to focus on improving accepted methods rather than testing new methods.

Session 2: Emerging Issues in Highway Cost Allocation, Part I

Gary Maring of FHWA summarized essential provisions in ISTEA and other emerging issues that may affect cost allocation. Six issues were discussed that particularly may affect highway cost allocation: **(1)** program changes, such as the Congestion Mitigation and Air Quality (CMAQ) program, **(2)** increased eligibility for transit improvements, **(3)** earmarking of highway user revenues for deficit reduction, **(4)** temporal equity issues related to appropriate costs to be allocated, **(5)** revenue implications of alternative fuels and fuel tax evasion, and **(6)** increased use of tolls and congestion pricing. Mr. Maring commented that none of these issues are irreconcilable in a cost allocation context. He observed that although ISTEA complicates some issues, it also provides several positives for improved investment decisions, including better data from the ISTEA management systems and traffic monitoring programs, increased use of investment tools such as life-cycle cost analysis, and leveraging greater investment through innovative financing.

Loyd Henion of the Oregon DOT described the evolution of highway cost allocation studies in Oregon that increasingly have emphasized estimating the cost responsibility of different vehicle classes. He advocated that Federal policy makers adopt Oregon's practice of using advisory committees to help convince users that highway user charges are fair. Other suggested improvements for Federal and State cost allocation studies included a more in-depth analysis of data at the local level, use of life-cycle analysis, and a marginal cost approach to reflect cost responsibility, and more attention to pavement charge issues and user charge structures to capture costs identified in studies.

Ray Chamberlain of the American Trucking Associations (ATA) called for "elegant simplicity" in the conduct of highway and transit cost allocation studies, so that their results can be used by legislators. He contended that highway cost allocation must address the social objectives contained in ISTEA and the Clean Air Act Amendments, that consideration must be given to these "diversions" and how they relate to transportation issues for purposes of appropriating expenditures. He said that a new Federal cost allocation model, to be productive, must incorporate an ISTEA-era conceptualization, of which highway cost allocation is a subset. He concluded that an invigorated ISTEA management system can achieve a paradigm shift in cost allocation and garner far better results than reconfiguring existing incremental "buggy-whip" tools.

Brian Vogel of the American Association of Railroads commented that he sees an unfortunate movement towards a study similar to the 1982 version, which he said would be unproductive and unreflective of the dramatically changed concept of highway cost allocation since that time. Referring to Executive Order 12893, "Principles of Federal Infrastructure Investment," that mandates a new set of principles for infrastructure investment and management, Mr. Vogel called for a different kind of study, one that includes a full panoply of user-borne environmental and congestion costs and uses advisory committees of economists and government representatives to give advice on the study's methodology.

In an open discussion, participants asked those at the Federal and State level to focus on the public policy issues they want cost allocation to solve. Implicit is the question of whether user fees will continue to be the source of Federal and State highway revenues. Also urged was the use of a multimodal perspective, more in keeping with surface transportation precepts. Fundamental questions raised during these sessions included whether to have an incremental highway cost allocation study, a zero-based cost allocation study for highways on a new basis, or a zero-based surface transportation cost allocation study.

Alternative Approaches to Highway Cost Allocation

Roger Mingo of R.D. Mingo and Associates addressed the evolution of 1982 Federal cost allocation methods. Studies have evolved from engineering-based to cost occasioned-based, an approach that looks at design, construction, rehabilitation, and maintenance factors, then makes suggestions on costing according to shares of cost responsibility for classes of vehicles using the highway system. The new study should combine both a design and consumption approach; incorporate a better replacement bridge cost function; begin to estimate and define capacity-related costs and common costs and their relationship; and in general consider the other cost allocation options resulting from improved data streams.

Gerald McCullough of Putnam, Hayes, and Bartlett presented his paper, "Marginal Cost Pricing Approach to Federal Highway Cost Allocation." Defining the issue of marginal cost as the intersection between engineering and economics, he called marginal costs relevant, feasible, and essential to any highway cost allocation study, and consistent with Government guidance and intent. Marginal cost allocation can be performed by following specific rules, including keeping a clear distinction between fixed and variable costs.

Arlee Reno of Cambridge Systematics spoke of other approaches to highway cost allocation. Even with the technical challenges inherent in marginal cost and benefits-based analyses, they nonetheless have theoretical and practical benefits: they lend themselves to multimodal analysis; they reflect economic principles more soundly; they provide historical bases for comparison; they offer more potential than incremental approaches; and, in the final analysis, they represent a needed fresh methodological approach.

Emerging Issues in Highway Cost Allocation, Part II

Highlighting issues from a paper he co-authored with Dick Mudge, Porter Wheeler of Apogee Research emphasized the importance of communicating complex cost allocation issues to legislators. Changes in the use and financing of the transportation system have important implications for cost allocation that beg new research. It will be important to present results in terms that policy makers can understand and use. Mr. Wheeler questioned the continued relevance of prior methods of distributing the historical tax burden. He advocated focusing research on issues leading to a new consensus on how future transportation infrastructure programs should be funded. He identified several changes to the transportation system reflected in the rapid, relatively unplanned economic growth in the mid-1980s and several emerging trends inspired by ISTEA that have prompted the need for new views and require new policies. These include how we finance highways, how highway improvements relate to urban/suburban growth, sources of funds, uses of highway funds for non-highway purposes, and special energy treatments to achieve non-transportation objectives. He emphasized the need for strengthening the linkage between highway finance and the provision and use of our transport systems. He advocated considering overall ISTEA-related benefits and costs, not just negative externalities. Such a comprehensive approach promotes the adoption of cost-effective programs for infrastructure development.

In suggesting how Federal highway cost allocation should treat environmental and other externalities, Harry Cohen of Cambridge Systematics listed several reasons for including external costs in highway cost allocation. These included the need for a highway cost study rather than a highway cost allocation study, the occurrence of external costs as an important component of marginal costs of highway use, and the need to prompt private sector interests to make decisions that reflect costs to other highway users and non-users. Mr. Cohen identified several ways to value externalities: control or mitigation costs (air pollution), damage costs, market prices, revealed preferences, expressed preferences, and preferences expressed by jury awards. After discussing difficulties in estimating external costs, Mr. Cohen offered several recommendations for treating these costs in the next Federal study:

- Include estimates of external costs of highway use.
- Include estimates of the relative contribution to these costs by different vehicle classes.
- Present the marginal costs of highway use for different types of vehicles, noting differences between marginal and average costs.
- Emphasize the high degree of uncertainty and variability surrounding these costs.
- Net out benefits before comparing tax rates with marginal costs.

While recognizing the inherent ambiguities that make determining the physical costs of highways a difficult task, Damian Kulash of the National Research Council (NRC) called the marginal cost approach one worth exploring, particularly for this purpose. He offered his own recommendations for the Federal study, including using it to raise broader social questions in consideration of positive and negative externalities.

Mary Lynn Tischer of the Virginia DOT also called for changes in highway cost allocation to expand its focus beyond a small range of issues and needs. She cautioned that because of its inability to address all problems, it is best viewed as just "one tool in the toolbox." One suggested application was to allocate environmental cleanup costs based on a reasonable relationship to vehicle classes, with environmental penalties based on vehicles and vehicle classes—"You can share anything out as long as it makes sense," she stated.

During the open discussion, participants asked questions of panel members that centered primarily on issues related to the viability of marginal costing in various contexts, the difficulty of quantifying externalities, and other potential approaches to cost assignment. One panel member commented that a lack of precise information inhibits meaningful discussion of what constitutes highway user costs for either equity or efficiency purposes. He said more work is needed to achieve a comfort level with marginal costs by ensuring that more good than harm is being done.

Technical Issues in Highway Cost Allocation

Kumares Sinha of Purdue University presented his paper, "Technical Issues in Highway Cost Allocation." Highway cost allocation has several different aspects, with highway classification being a major associated technical issue. Highway cost allocation has certain guiding principles, including an equity-based approach performed by analyzing costs occasioned and the ability to pay. Pavement cost allocation is another large issue, to be approached by using a thickness incremental method, which serves to improve allocation of maintenance and rehabilitation costs. Mr. Sinha identified a need for an index to express cost allocation results.

In the subsequent panel discussion, Gedeon Picher of the Maine DOT articulated some new factors, including the need to accommodate external benefits. He said that the direct allocator method, while effective, needs fine tuning. Jack Deacon of the University of Kentucky observed that defining the scope and context of the next Federal study will be a significant effort, that the 1982 study cannot simply be discarded, and that cost allocation has technical limitations that belie

its affinity for sophisticated economic analyses. Chuck Sanft of the Minnesota DOT focused on the need to build confidence in the cost allocation process. As transportation systems invariably involve a social component, any future cost allocation cannot ignore, but should not obsess over, the social element. There is never a perfect time to do a study, he commented, and this time is as good as any.

Issues Raised in Breakout Sessions

Breakout group A-1 identified five issues and prioritized them by importance. These included **(1)** identifying study objectives (efficiency vs. equity); **(2)** defining the study's context, scope, and methodology; **(3)** using explainable and defendable methods; **(4)** filling data gaps; and **(5)** giving more explicit attention to uncertainty and sensitivity. Recommendations developed within each of these major categories included using cost allocation to provide information upon which to base recommendations for user fees and road taxes, respond to Executive Order 12893 by incorporating social benefits and costs in investment decisions, develop a basis for future refinements now, provide guidance to the States, establish over-arching principles, attempt to cover all the highway-related programs, include all highway user generated revenues, and incorporate all surface transportation, or at least the transportation network to be incorporated into the National Transportation System (NTS).

Breakout group A-2 advised that the study should **(1)** clearly identify its objectives and audience; **(2)** judiciously consider multiple methods, including social costs, common costs, and a benefits-based approach; **(3)** be mindful of various contexts, including temporal equity, cost/use relationships, preventive maintenance; **(4)** improve data and risk analysis; and **(5)** consider such externalities as vertical and horizontal equity and tax collection.

Breakout group B-1 identified many different research needs based on their general recommendation to do both marginal and benefits-based analyses. Recommendations included **(1)** gathering more information to help in applying a marginal cost approach, including information on marginal maintenance costs; **(2)** learning how marginal costs vary over time under certain conditions; **(3)** performing more detailed cost breakdowns; **(4)** looking at the highway user costs associated with highway agency repair and maintenance activities; **(5)** devising more rational ways of allocating fixed costs through a marginal cost approach; **(6)** analyzing the distribution effects of user fees; and **(7)** learning how to apply cost allocation to multiple modes and how to determine optimum budget level.

Breakout group B-2 recommended that the study **(1)** employ a broad-based and inclusive technical advisory committee to help define its scope; **(2)** define marginal cost as an attendant but not fundamental part; **(3)** pay special attention to costs occasioned, including all highway user charges; **(4)** conduct research on such issues as life-cycle and replacement cost analysis, updating 1982 procedures to ensure inter-study compatibility; **(5)** address intermodal connectivity and the impact user fees on different modes; **(6)** account for alternative revenue sources and enhancements; and **(7)** pay some attention to taxes in these various contexts.

Conclusion

The last full Federal cost allocation study was completed more than a decade ago. Since then, dramatic changes have occurred in transportation industry and in transportation programs. New legislative provisions related to transportation and taxes, new technologies, and new methods for approaching the complex issues involved in allocating costs to highway users have come to pass. This workshop was held in response to these changes, which, because of their magnitude, prompted the need for an update of the Federal highway cost allocation study. This workshop, by providing a thoughtful discussion of the issues and specific recommendations, helped set the stage for the next Federal study to evaluate the vast array of cost allocation options, including how to set user fees.

The current transportation policy debate recognizes that some functions of highway user charges are not being fully realized, especially

the function of rationing use of the highway. Failure to use highway user fees to ration use of the highway has contributed to significant social and environmental costs. Federal analysts are considering proposals to redefine "cost recovery" to include the full range of social and economic effects attending the existence and use of transportation infrastructure. Additionally, ISTEA implies many changes for highway user taxation and for ways of pricing and utilizing the road system. Some of these changes challenge underlying principles of road user taxation known in the past.

Workshop participants discussed the implications of these and other new events. They urged that the next cost allocation study address the multiple levels of government and include all expenditures related to highways. They identified several concerns, particularly the lack of sound, reliable data on which to base decisions, and strongly recommended the use of advisory groups at both State and Federal levels as a way to improve the study's methodologies. Workshop participants seemed divided on the extent to which alternative cost allocation approaches should be pursued and how they should be presented in the final report. There was a general consensus, however, that these alternative approaches need a full airing in the report even if they do not become the principal basis for analyses of highway user fee equity.

Ensuring the Federal study's applicability and usefulness to individual States was a common theme. Participants called for standardized and improved data and study results that can be communicated to and understood by legislators and policy makers.

Introduction

Cost allocation traditionally has involved estimating the relative responsibility of different vehicle classes for pavement, bridge, and other highway costs. The equity of highway user fees has been evaluated by comparing the cost responsibility of different vehicle classes to the highway user revenues contributed by those vehicle classes. Some vehicle classes contribute a larger share of revenues than their share of highway costs, while others contribute a smaller share.

The last complete Federal HCAS was completed in 1982. Since then, there have been changes in the structure of the highway program, earmarking of highway user revenues for deficit reduction, and increasing interest in estimating the full costs of highway use and operation. Each of these factors has implications for highway cost responsibility and user fee equity. Several organizations including AASHTO and the General Accounting Office have recommended a major update of the Federal HCAS.

In conducting this workshop, FHWA sought guidance on ways to improve the accuracy and credibility of highway cost allocation data and methods and views on the relative importance that should be placed on various emerging highway cost allocation issues to improve the usefulness of the next Federal HCAS. The workshop brought together over 75 representatives of Federal and State transportation agencies, transportation industry groups, academic institutions, consulting firms and other organizations (see Appendix A). Specific workshop objectives included :

- Define the state-of-the-art and the state-of-the-practice among States, Federal agencies, and other organizations in the application of cost allocation analysis procedures.
- Identify and discuss the importance of emerging issues should be considered in the next HCAS.
- Recommend data and research needs for the next HCAS.

Copies of papers presented at the plenary sessions are available upon request by writing or phoning:

The Federal Highway Administration
Transportation Studies Division
Attn: Systems Analysis Branch, HPP-12
Washington, D.C. 20590
202-366-9233

Opening Remarks

"For much of the last 100 years," began **Tony Kane, FHWA's Executive Director,** "cost-based highway pricing has provided the resources for expanding, improving, and preserving the Nation's road system." In his opening remarks, Mr. Kane provided a historical overview of highway cost allocation and finance, a brief description of highway user fees, and a discussion of issues that the workshop should address.

Historical Overview

Mr. Kane suggested that the extent and quality of America's highway system is testimony to the efficacy of financing highway construction through dedicated highway user fees. Over the years, cost allocation studies have played an important role in domestic transportation policies and have attracted widespread interest. Cost allocation techniques and objectives have changed over time in response to changing transportation needs and policy agendas. While the 1982 Federal HCAS was driven largely by the need for increased revenues, user fees on heavy trucks were increased in the Surface Transportation Assistance Act of 1982 (STAA) at the same time that changes in Federal truck size and weight limits were enacted.

For more than 60 years, continued Mr. Kane, formal cost allocation studies have been available to assist transportation officials and legislators in implementing effective, rational, and equitable highway user charges. While Federal and State user fee structures may not fully reflect the highway cost responsibility of different vehicle classes estimated in highway cost allocation studies, those studies provide decisionmakers with important information on relationships between user fee contributions and highway cost responsibility for different vehicle classes.

Historically, the following principles have guided public policy makers in charging for use of the road system, according to Mr. Kane: **(1)** those who directly benefit from use of the road system should pay for its cost, and **(2)** highway use should be measured and priced "fairly." It is unlikely, he said, that the "user pays" principle will be abandoned any time soon in conducting future cost allocation studies. Neither is it likely that "user equity" will cease to be one of the core criteria for judging user fee options, although the definition of equity is variable.

Highway User Fee Functions

Mr. Kane noted a few of the functions assigned to highway user fees under prevailing concepts of highway finance.

1. **Revenue adequacy.** Most cost allocation studies in the U.S. and elsewhere are of the "cost recovery" variety. Road user charges are set with the expectation of recouping highway agency expenditures. In other words, highway cost allocation becomes a means of obtaining the funding needed to maintain and operate the road system.

2. **Willingness to pay for highways.** The overall revenues from road user taxes serves to encourage or discourage highway investments in a manner consistent with the public's long-term willingness and ability to pay for the highway infrastructure. The States' success in raising fuel taxes and selling bonds to provide funds for road improvements is evidence of broad public support for good roads. "Legislators may not have had the political will to recommend the level of fees the public is truly willing to invest," Mr. Kane observed.

3. **Price highway use.** User fees are expected to function such that the level of road user taxation directly influences the use of highway facilities. Mr. Kane noted that this area is least used in considering cost allocation and user fees. "Witness the low real level of user fees and the lack of charging by the demand curve," he said.

4. **Rationing of traffic.** Cost-based user fees promote a rational division of traffic among the different modes of transport, based on the individual shipper's utility maximizing function. User fees that internalize government expenditures that otherwise would have to be considered a subsidy are said to be "competitively neutral." Road user fees establish a level playing field for competing modes in a mixed public/private transport market.

5. **Equitable distribution of highway cost responsibility.** The general public and their elected officials view as "fair" user fees that reflect the relative cost responsibility of different highway users.

The current transportation policy debate recognizes that the expected functions of highway user charges have not been fully realized. Some suggest that inefficient highway pricing contributes to significant social and environmental costs. Proposals to redefine "cost recovery" to include the full range of social and economic effects attending the existence and use of transportation infrastructure have been heard.

Workshop Issues

The ISTEA implies potential changes in highway programs and financing, some of which challenge historical principles of road user taxation. They include:

- A greater reliance on market mechanisms to make more efficient use of scarce public resources.

- The need for a new vision of an integrated, seamless, multimodal surface transport system.

- Changing governmental responsibilities and evolving intergovernmental relationships that shift the locus of decision making. "For example, should the unit of government that can best collect a given user fee focus on that component of the price?" asked Mr. Kane (e.g., local government for peak period prices).

- Changes in highway cost responsibility as a result of the following:

  - Designating and focusing Federal resources on a National Highway System (NHS).

  - Use of flexible funding for a variety of modes.

  - Increased use of highway taxes for environmental improvements

  - Investments based on life-cycle costing and increased Federal financial support for preventive maintenance activities.

  - Research and technology spending for transportation system applications such as ITS and high-speed rail.

  - Removing legal and institutional impediments to greater private sector participation in providing transport infrastructure.

  - Reducing regulatory and reporting burdens on shippers and carriers and promoting greater transportation productivity through vehicle registration, license, and tax uniformity initiatives.

  - Changes in truck sizes and weights and new funding subsidies for other freight modes.

- A greater recognition of the interrelatedness of urban congestion, environmental quality, and international competitiveness issues. Highway cost allocation studies provide an appropriate forum for the comparison of social costs and infrastructure investment and economic performance benefits.

"This workshop is an opportunity for us to address contemporary issues such as these in the context of establishing a sound financial base for the repair and improvement of vital infrastructure," said Mr. Kane in closing. He thanked participants for coming, then introduced Madeleine Bloom, Director, Office of Policy Development, FHWA.

Dramatic Changes Require Study Update

The impetus behind this workshop, explained **Madeleine Bloom, Director of the FHWA's Office of Policy Development,** was provided by the dramatic changes occurring in transportation legislation and user fees that have significant implications for Federal highway cost allocation. The workshop offers a venue for considering complex analytical issues through an open exchange of ideas that not only will inform FHWA's HCAS, but is necessary in light of upcoming ISTEA reauthorization. Many significant factors have changed since the last Federal allocation study:

- Part of Federal fuel tax revenues are set aside for transit purposes in a separate Mass Transit Account of the Highway Trust Fund (HTF).
- Part of Federal fuel tax revenues currently are dedicated for deficit reduction.
- The eligibility of projects financed by the Highway Account of the HTF has been expanded to include public transportation, air quality improvement projects, transportation enhancement, and other activities that formerly were not eligible.
- Innovative highway financing approaches are evolving as traditional sources of highway funds become less reliable and as the value of user taxes declines in light of inflation, fuel efficiency, and alternative fuel usage.
- Intermodal transportation is becoming increasing important.

Workshop Objectives

Ms. Bloom identified the workshop's objectives as the following:

- To discuss the evolution of highway cost allocation data and methods since the 1982 study.
- To identify significant factors that have changed since 1982 that may affect how cost allocation could be carried out, including greater attention to life-cycle costs and greater concern about congestion and transportation implications for the environment.
- To identify factors that have changed since 1982 that may affect the scope of highway cost allocation, such as the eligibility of transit improvements for Federal-aid highway financing.
- To discuss how these various factors should be considered in the next Federal HCAS in preparation for reauthorization.
- To recommend improvements in data and methods that could be made in conducting the next cost allocation study.

In closing, Ms. Bloom recognized that although the primary focus of the workshop is not to assess the relative merits of specific user fees, it would be impossible to avoid their mention altogether, especially when discussing marginal cost approaches and emerging highway finance issues related to cost allocation. She asked that comments on user fees, where possible, be related to broader, more generic points. "This workshop, at its core, is designed to be analytical and thought provoking," she said, "and hopefully will focus on the types of information that should be obtained from the next Federal highway cost allocation study in order to allow a variety of user fee options to be evaluated."

Highway Cost Allocation—Developments Since 1982

Federal Studies Related to Highway Cost Allocation

Jim March of FHWA's Office of Policy Development presented an overview of FHWA studies since 1982 related to highway cost allocation. Those studies have included *Alternatives to Tax on Heavy Vehicles, The Feasibility of a Nationwide Network for Longer Combination Vehicles* (LCVs), *Heavy Vehicle Cost Responsibility*, and *The Feasibility of a National Weight-Distance Tax.*

The study, *Alternatives to Tax on Heavy Vehicles* examined potential alternatives to the heavy vehicle use tax (HVUT). The study considered alternative bases for heavy truck taxes, including vehicle size, vehicle operating weight, and distance traveled, all of which are relevant factors in quantifying vehicle cost responsibility. The 1985 report concluded that the equity of the user fee structure could be improved by adjusting rates for the existing highway user fees. However, major improvements in overall equity could not be achieved within the existing user fee structure because existing user fees do not directly reflect the two principal variables affecting cost responsibility—weight and distance traveled.

A study of the feasibility of a nationwide network for LCVs evaluated various costs and benefits associated with LCVs. Findings of relevance to highway cost allocation were that many factors affect the cost responsibility of different vehicle classes, and that the absolute size and weight of a vehicle is not always the most important factor. The heaviest vehicles evaluated in the study, turnpike doubles, were found to have lower equivalent single axle loads (ESALs) per 1,000 pounds of cargo than some existing vehicles. Their length, however, did create some additional costs associated with roadway geometrics. smaller impact on concrete than some smaller vehicles, as sheer weight is not the only contributing factor to pavement wear. Axle configurations also have an effect.

A third study since 1982 assessed heavy vehicle cost responsibility, finding that most pavement costs incurred are directly related to heavy vehicles, and that axle loads are more important than gross weight in determining a vehicle's pavement cost responsibility. The *Heavy Vehicle Cost Responsibility Study* compared 14 categories of trucks varying by weight and axle configuration. In examining the cost responsibility for each vehicle class, relatively small increments of weight (5,000 pounds) were analyzed because even such small increments can significantly affect highway cost responsibility. The study concluded that heavy single-unit trucks often are responsible for significant pavement and bridge costs, and that cost responsibility can vary significantly depending on whether a vehicle is traveling predominantly on higher order systems or on lower order systems where pavements and bridges may not be designed to such high standards.

Another FHWA study examined the feasibility of a national weight-distance tax and considered concepts of both "horizontal" and "vertical" equity. Horizontal equity measures the extent to which user fees are proportional to cost responsibility for vehicles within the same general class, and vertical equity measures the extent to which user fees are proportional to cost responsibility for different classes of vehicles. The study concluded that a Federal weight-distance tax was feasible from the standpoint of administrative costs and enforcement, but that additional analysis of the cost responsibility of different vehicles operating at different weights was necessary before such a tax could be implemented.

Mr. March noted that the FHWA has conducted significant in-house research since the 1982 study. These efforts include developing the

NAPCOM for pavement cost allocation, improving bridge cost-allocation techniques, improving the quality of travel and operating weight data, and paying increased attention to life-cycle costs and external-cost analysis.

The NAPCOM uses the Highway Performance Monitoring System (HPMS) data set, with over 100,000 pavement sections representing a thorough sampling of highway segments nationwide. It simulates traffic flows and pavement deterioration over an analysis period, then estimates the responsibility of specific vehicle classes for projected pavement improvement costs.

FHWA's research efforts for NAPCOM are continuing and expanding, Mr. March observed. Future projects include using data from the Long Term Pavement Performance (LTPP) study to update pavement distress equations; investigating application of mechanistic pavement deterioration models that more accurately reflect characteristics of pavement materials and axle loadings; incorporating improved pavement management studies into NAPCOM; incorporating user costs and life-cycle costs more directly into NAPCOM; and investigating the integration of NAPCOM with the Highway Economic Requirements System (HERS).

The FHWA has expanded the number of bridge costs considered in cost allocation from three to four since the 1982 study, said Mr. March. It has also increased the number of design/cost increments and expanded the scope of bridge analysis. Analysis has been extended to include user costs. A new FHWA model, the bridge needs and investment program (BNIP), looks at bridge needs and investment.

Life-cycle cost considerations now include long-term pavement and bridge improvement needs and optimum investment strategies directly incorporating user costs.

Mr. March described FHWA's ongoing research as including a review of all highway cost-allocation data and analytical tools, preparation of papers on key highway cost-allocation issues, revisions of FHWA's Highway Revenue Forecasting Model, and research on external costs.

State Cost Allocation Studies—An AASHTO Perspective

Otto Sonefeld of AASHTO presented AASHTO's perspective on highway cost allocation. While AASHTO's membership of States and affiliated members may diverge on various issues and viewpoints, a consensual policy of the organization is still that users should pay their proportionate share of highway costs, and that changes in user fees should be based on equity. Differences among AASHTO's member have both a regional and a State-by-State component.

Most States have their own highway cost allocation models, based partially on Federal cost allocation methods. The complex nature of cost allocation has led States to commission specialists from academia and consulting firms to help them.

Many of the new factors affecting highway cost allocation over the past decade, including but not limited to ISTEA, have been inevitable changes. Assessments of external costs are more difficult to conduct than they were 20 years ago; the issue's societal impact magnifies its complexity.

While AASHTO remains a "big fan" of the 1982 study, it also recognizes the need for modifications to it. An AASHTO subcommittee on highway transport defined the problems which largely relate to outdated and invalid data, a common problem for States as well. Mr. Sonefeld said further studies will need to get input from State and municipal levels, a process the States are willing to facilitate. The AASHTO envisions the final product of the next Federal HCAS as user-friendly, updatable, and readily adaptable by States for use as a model.

In summary, Mr. Sonefeld noted that highway cost allocation has the potential to improve the user fee structure and provides a rational method for achieving improvements in equity and efficiency without the need for extensive new research. The AASHTO agrees that current methods can be enhanced through careful analysis of data problems, through improved

documentation of work already performed, and through use of more than one method to identify differences in theories and approaches.

State Highway Cost Allocation Activities and Related Studies

Joe Stowers of SYDEC summarized recent State highway cost allocation studies and experience in a paper entitled "Review of Recent State Highway Cost Allocation Studies." More than half the States, he said, have conducted highway cost allocation studies since 1982, and SYDEC has participated in several. Only a few States, however—Minnesota, Oregon, Nevada, Kentucky, and Maine—have regularly repeated studies to establish an effective working basis for building credibility with legislatures and other interested groups.

Through its experience in working with States, SYDEC sees State studies becoming similar, with relatively little collaborative movement in substantial methodological terms. SYDEC's work has included helping States develop better methods with expanded and detailed databases.

The superior State studies are characterized by major efforts to improve the quality of databases and include special surveys on local expenditures and tax receipts, and special truck weight surveys tailored to the specific needs of the cost allocation study. The better studies tend to be more inclusive, dealing with user taxes and expenditures for all government levels, and encompassing all highway-related programs, including air quality, highway patrol, and other highway-related expenditures.

Mr. Stowers addressed the issue of which is the more sensible approach—consumption or design—for a highway cost allocation study to take for pavement rehabilitation. He maintained that the consumption-based approach used in the Federal study prior to the development of rational pavement rehabilitation design methods, allocates costs in a manner that leads to double counting because vehicles are being charged for **(a)** load-related costs of new pavements, plus **(b)** load-related costs of pavement deterioration on the same pavements that have to be rehabilitated. The design approach can instead be used to charge vehicles for weight-related costs of the rehabilitated pavements to avoid such double counting. Mr. Stowers suggested that the use of modern pavement management systems and more accurate predictions of axle loads prompt a real need to rethink the consumption approach.

Mr. Stowers spoke of several issues facing States in their highway cost allocation studies. A strong argument can be made for the need to include all local government programs in State studies, as States have an influence on the actions of local governments. This should not be done at the expense of relinquishing focus on *all* State highway-related programs, including State aid, police, and enforcement. Federal programs should also be included in State studies, as cost allocation funding is affected by the State's ability to substitute Federal dollars for State dollars. It is important, however, that the three levels of government be kept separate in such analyses. Other issues Mr. Stowers identified for consideration in State studies follow:

- **Data problems in State studies.** For one thing, half of the resources are spent on refining data, in part due to the diversity of databases. Databases have not been standardized, partly because of a lack of standard practices or guidelines from the Federal level.

- **Need for a special weight survey.** A special survey is needed to relate observed weights to registered weights, including the use of weigh-in-motion (WIM) data for axle-weight relationships. Traditionally, States have not covered weight-relationship issues well. The presence of large percentages of out-of-State trucks creates a problem in using automatic scanners and computer searches to classify vehicles by registered weight at highway speeds.

- **Need for a special-vehicle analysis capability.** Current cost allocation programs are not designed for special-vehicle analysis. Different vehicle classes are described in terms of different weight distributions and average vehicle characteristics. For the Idaho study, SYDEC developed a serviceable, if cumber-

some, type of special-vehicle analysis that uses a spreadsheet requiring recalibration after any change in highway cost allocation study inputs.

- **Need to deal with the diversion and use of non-user sources.** There are many reasons for imbalances between revenues and costs, including taxes collected from highway users but not spent for highway-related purposes and the common use of other, non-highway-related funding sources. Addressing this imbalance should be done by clearly identifying all factors, then calculating all user revenues and highways costs creating two different equity ratios—**(1)** absolute ratios of revenues-to-cost responsibility for each vehicle class and **(2)** shares paid by vehicle classes divided by shares of cost responsibility for highway use. Large imbalances imply a need to view it from different standpoints.

- **Bond programs.** Bond programs pose a problem of equity between generations. The issue of users paying for past and future programs is often pronounced in States having a large population of retirees.

- **Evasion of fuel and use taxes.** Who shoulders the cost responsibility for evasion of fuel and user taxes—**(1)** vehicles in the class that is responsible for the evasion, **(2)** all highway users, or **(3)** taxpayers in general? Evasion of taxes can be roughly estimated by comparing vehicle miles traveled (VMT) by vehicle class with reported mileage, an admittedly crude comparison requiring better data.

- **Need to develop more effective relationships with legislatures.** States need an in-house capability to work together with legislators to ensure greater acceptance of study results. Educating legislatures will foster acceptance. The challenge is complicated by the complexity of the studies themselves. Oregon has had considerable success in creating such a working relationship.

In defining research needs for future highway cost allocation studies, Mr. Stowers emphasized the need to improve the "state-of-the-practice rather than state-of-the-art," focusing on credible methods rather than innovative approaches. A need exists for analysis to help States predict weights so that only a modest calibration effort is required. Many different traffic adjustment factors are needed for seasons, day of week, type of route, and mixes of trucks on particular routes. Mr. Stowers called for more research on maintenance cost responsibility for pavements and bridges to provide a better basis for allocating these costs than the crude rules of thumb that are now used based on "expert" opinion. There is also a need for improved special-vehicle analysis capabilities and for development of software and guidelines that can be used by all States, based on standard inputs of data and format structures.

The goals, then, concluded Mr. Stowers, are to do continuing, regular studies aimed at improving the decision-making process, not only in allocating costs, but in improving tax collection and its enforcement.

Open Discussion

A discussion of the presentations, and of highway cost allocation studies since 1982 followed. Mr. Stowers defended the concept of a Federal study, asserting that it is more than just a sum of combining State studies. States are trying to conduct Federal-level analyses that apply only within State boundaries on a State-by-State basis, and their studies inform the Federal-level effort on an individual basis, based on their merits and not on a collective basis.

Mr. Stowers justified a design approach to allocate rehabilitation costs as being more rational in keeping with new, widely accepted design procedures. In this approach, fixed-cost elements are charged against vehicles in proportion to VMT, in contrast to the consumption approach which uses equivalent axle loads to allocate almost all rehabilitation costs. He also criticized the consumption approach for double counting by charging for both new pavement costs and rehabilitation costs based on the same axle loads over the same projection period. Tony Kane averred that the FHWA does not view the consumption approach as leading to double counting, in that outlays incurred for roadway rehabilitation are future-oriented. He also said that equity and efficiency implications exist for both design and consumption choices.

Mr. Stowers said that the role of alternative fuels in cost allocation has yet to be specified. He maintained that States are not looking at congestion pricing as a consideration. Mr. Mingo declared that congestion and peak pricing are different phenomena which are correctly kept separate.

Mr. Stowers remarked that SYDEC has not considered general sales or business-related taxes such as gross-receipts taxes because they are generally not uniquely applied to highway users. He said that SYDEC strives to get States to consider all highway user taxes in the analysis regardless of what they are spent for; if a tax is unique to motor vehicles as highway users, it should be credited to them in the overall tabulation of highway user taxes paid.

Mr. Stowers said that all of the recent studies have used special surveys that involve stopping trucks and recording their registered weights, configurations, and operating weights. This information is subsequently used to develop operating weight profiles as a function of registration weight for each important configuration. He emphasized the importance of getting registration weights which cannot be obtained with WIM, but that the procedure used is time-consuming. Mr. March added that, from the Federal perspective, with the demise of traditional truck-weight studies, such information is no longer available and must be synthesized from collected information and other available data. Lack of adequate data may require special surveys for the next Federal cost allocation study.

When queried about the impact that State highway cost allocation studies have had on State tax policy or the impact of Federal studies on Federal tax policies, Mr. Stowers responded that only when States conduct these studies on a regular basis will legislators begin to see cost allocation studies as having a base of credibility for tax policy. Repeat studies, he insisted, build credibility. Mr. March said that increases in Federal taxes on heavy trucks that were enacted after the 1982 Federal cost allocation study were not as great as had been recommended by the Administration, but clearly reflected findings of that study.

In response to a question, Mr. Stowers explained the rationale for moving in the direction of a design-based approach to the allocation of pavement rehabilitation, given that States have developed a rational approach to pavement design that did not exist when the prior Federal study occurred. At that time, he continued, it was widely perceived that pavement wear was a function of heavier axle loads and that trucks were not covering this cost responsibility. Today, this perception is no longer valid, as current pavement management systems incorporate good projections of pavement loadings. He argued for consistency in allocating costs on the basis of how the work is done, including both new construction and all aspects of actual rehabilitation and maintenance costs. Assigning costs on the basis of how pavements are actually designed and rehabilitated is a more logical approach today because both the theory and practice back it up. Mr. Kane added that using life-cycle analysis suggests lower overall costs with higher initial investment levels and may work to the advantage of the trucking industry.

Loyd Henion of the Oregon DOT, in citing the difference between 14 Federal-level truck-classification categories and Oregon's 19, called attention to the real gap in data needed to analyze different truck configurations. He recommended focusing attention on factors that contribute to the need for various highway expenditures, especially weight-related factors. Life-cycle cost analysis can lead to a greater long-term payoff if done correctly. The greater initial investment it requires, however, makes the public leery, and the question to be asked is how to convince the public of the merits of life-cycle costing.

Mr. Stowers remarked that much variation exists among States in the application of methodologies and the use of assumptions, that some studies have been very crude, and that there is little interaction at a fundamental level. Better studies have naturally gravitated toward the better methods, but there remains a strong need for technical assistance from the Federal government to facilitate a shared "state of the practice" among States. Mark Euritt of the Center for Transportation Research added that care must be used in thinking about costs on a life-cycle basis as warranting new investments without regard to the impacts on other modes.

Mr. Stowers asserted that States are primarily concerned with choosing the equity approach based on costs occasioned. He criticized the Federal highway cost allocation approach of focusing only on Federal revenues and expenditures instead of including user revenues and highway-related expenditures for all levels of government.

Gedeon Picher concluded the session by defining some issues for the workshop to keep in mind, such as the subject of vehicle pavement interaction, the possibility of changes to the 80,000-pound cap and the LCV freeze, the potential effectiveness of revokable permits, the relationship between poor pavement conditions and increased pavement deterioration, and the dynamics of pavement response. These are changes to consider implementing right now.

Emerging Issues In Highway Cost Allocation, Part 1

Highway Cost Allocation Implications Under ISTEA

Gary Maring, Chief of FHWA's Transportation Studies Division, gave the first presentation on, "Highway Cost Allocation Implications Under ISTEA." He opened his discussion by noting his pleasure at seeing a new generation of administrators and researchers becoming involved in highway cost allocation and other transportation issues. He said FHWA is working on a 2-year time frame for its highway cost allocation study and that a *Federal Register* notice will solicit comments and provide more information about the study.

In furthering the discussion begun by Mr. Kane and Ms. Bloom on the change that ISTEA has brought to the Federal-aid highway program, Mr. Maring covered six issues and their implications for highway cost allocation. They were **(1)** program changes that occurred in ISTEA, **(2)** transit funding, **(3)** deficit-reduction taxes, **(4)** temporal equity (whether to allocate past, current, or future expenditures), **(5)** revenue implications of alternative fuels and tax evasion, and **(6)** toll and congestion pricing provisions. Mr. Maring sought to raise questions for participants to discuss during the workshop that would lead to specific recommendations.

Program Changes

National Highway System

The NHS is still evolving, but hopes are that it will be enacted by the ISTEA deadline of September, 1995. The NHS focuses Federal resources on a leaner system, which has implications for highway cost allocation. "What does the focusing of Federal responsibilities on a limited system of major roads imply for the accuracy and extent of roadway, bridge, and vehicle stream data requirements?," asked Mr. Maring. The HPMS is moving toward a 100% sample on the NHS in the 1995–96 time frame. Do we need more and better data for this select group of roads? If different investment principles are applied to the NHS, e.g., life-cycle cost analysis as proposed in the House NHS bill, what are the implications for cost allocation?

Surface Transportation Program (STP) Flexibility

Mr. Maring expressed concern from a cost allocation standpoint about the estimation of STP expenditures since detailed reporting will not be required and since improvements may be funded through a variety of public agencies.

Programs under ISTEA allow a 10 percent set-aside for enhancement components. Although some enhancement-type STP projects have been encountered in previous studies (such as pedestrian and bicycle projects and aesthetic enhancements, little cost allocation experience exists for the wider variety of projects that are possible under ISTEA, such as wetland banking, wildlife habitat, and scenic enhancements. Because the relative importance of these projects has increased in recent times, expenditures in these areas also are likely to increase. These kinds of programs have been treated as common costs in past studies, with VMT typically used. Should STP program expenditures now be broken out and treated as "uniquely occasioned" costs?

CMAQ Program

Innovative projects to improve air quality under the CMAQ program will represent a $6 billion investment over the life of ISTEA. CMAQ projects must show air quality benefits to qualify for funding. Eligibility appeals for this funding

are pushing the envelope: telecommuting projects and day care centers at park & ride transit stations for example. "It is doubtful," observed Mr. Maring, "that we can get down to individual projects and their air quality analyses and justifications in order to allocate funding." Appropriate allocators for CMAQ expenditures will have to be evaluated.

Interstate Maintenance

It is an accepted tenet, noted Mr. Maring, that preventive maintenance helps to extend the service life of pavements. The ISTEA explicitly makes preventive maintenance on Interstate Highways eligible for Federal participation. The list of specific work elements that may be classified as preventive maintenance is extensive. No explicit analysis of preventive maintenance types of expenditures was included in the 1982 HCAS. How do we treat preventive maintenance expenditures? Can preventive maintenance be treated and allocated the same as 3-R expenditures?

Transit Expenditures

The 1982 Federal highway cost allocation study did not consider funding for transit capital expenditures. Mr. Maring observed that since transit costs are incurred to deal with the congestion caused by urban peak period travel, perhaps costs should be allocated to those using the highway during this period, based on peak VMT. Although passenger car equivalent (PCE)-miles on urban roads may be an appropriate allocator, PCE-based measures were rejected in previous studies because of gaps in information and other considerations. The next study may need to confront the issue of appropriate allocation measures, which may include consideration of urban peak hour users. To whom should we attribute transit expenditures?

Deficit Reduction Taxes

Traditional highway user revenues are going to other sources, observed Mr. Maring. Historically, highway user charges have been defined as payments that flow into the HTF. Should fuel taxes that do not flow to the HTF be considered general taxes? The 1990 Deficit Reduction Act assigned 2.5 cents of fuel tax revenues to deficit reduction, although this will come back into the Highway Trust Fund in 1995. The 1993 Budget Reconciliation assigned an additional 4.3 cents transportation fuel tax to deficit reduction. The 1993 deficit reduction fuel tax started out as an energy-based tax (BTU), but was narrowed to a transportation fuel tax by the time of enactment. States facing the issue of how to treat highway user taxes that are dedicated for non-highway purposes have handled it in different ways.

Temporal Equity

Temporal equity concerns the issue of whether highway costs upon which user fee equity is estimated should reflect past, present, or future program expenditures, i.e., basing today's user fees on costs that were either incurred in the past or will not be incurred until the future. User fee equity can vary depending on the time frame of the study, whether the program level is expanding or contracting, and the likely composition of the future program. The trend is to increase focus on infrastructure investment, in line with Executive Order 12893 that calls for a more idealized investment pattern based upon cost benefit analysis, life-cycle costs, and consideration of the full range of program costs and benefits.

Alternative Fuels and Fuel Tax Evasion

The effects of alternative fuel use and evasion of highway user taxes, not previously considered in cost allocation studies, could be significant in the future. The Clean Air Act Amendments mandate use of alternative fuels, but some believe that gasohol, electricity, compressed natural gas, and other alternative fuels should be exempt from taxation for highway use since they may be more expensive than gasoline. How to address these kinds of alternative technologies is a long-range tax issue similar to the present issue of gasohol exemption which could lead to substantial transportation revenues losses. Additionally, fuel tax evasion is estimated to be over $1 billion a year. The ISTEA fuel tax evasion program, including diesel dying, should help stem evasion. "Should we assign unrecouped revenues as other user costs?" Mr. Maring asked.

Toll and Congestion Pricing Provisions

Potential exists for double taxation, with the user paying both tolls and fuel taxes, although given current under-investment, this may not be a problem. In terms of leveraging funds, Federal-aid grants and loans can leverage many more projects through revolving fund concepts that traditional accounting methods do not capture. Federal-aid funds can also increase debt financing and enlarge current programs at future expense. Mr. Maring contended that public-private partnerships are creating a blending of roles and bringing private equity or debt to the table. "What are the cost allocation implications of that?" he asked. "Will we charge for certain externalities, such as congestion externalities that traditionally have not been included?" Congestion charges, however, are not likely to be a part of Federal revenue streams for site-specific projects. "These types of projects are a small piece of the pie now," continued Mr. Maring, "but what are the future implications?"

Conclusions

Mr. Maring concluded his presentation by noting that although ISTEA raises a number of new issues and enlarges some old ones, none are irreconcilable in a cost allocation context. Some, such as congestion pricing, will take a long time to play out, allowing time to develop modified approaches. Mr. Maring observed that although ISTEA may complicate some issues, it has also provided several pluses for improved investment decisions. These additional benefits include:

- Improvements in data and performance monitoring through ISTEA management systems.
- Improved investment decisions, through such tools as life-cycle cost analysis.
- The leveraging of greater investment through innovative financing, such as tolls, loans, debt financing, and potential pricing.

"As we look toward a next reauthorization, updated cost allocation will be important to any decisions on user fee charges," Mr. Maring concluded.

Panel Discussion

Need A Holistic Approach

Responding to Mr. Maring's presentation, **Loyd Henion, Oregon Department of Transportation,** noted that cost allocation has been important to Oregon since the 1930's. He described an evolution in studies the State has conducted, which have moved it in the direction of cost responsibility, the focus of its current study. He explained the State's use of an advisory committee to help in convincing users that there is an equitable justification behind the user charges it imposes. To him, "efficiency equals equity" where user charges are concerned.

The current Oregon study is using a prospective method of analysis to determine the impact of the State's forecasting accuracy, specifically the accuracy of its State Transportation Improvement Program (STIP). He recommended that the Federal level should undertake a similar comparison. "We don't do what we said we were going to do," he contended. The Oregon DOT will be looking for interaction with Federal studies.

Mr. Henion called for several improvements to State and local systems, including the need for more in-depth analysis of data at the local level. He also advocated going to full cost responsibility by using life-cycle cost analysis and, beyond that, taking a marginal cost approach to cost responsibility. He said Oregon also plans to look at the relationship between highway design and cost responsibility. "Can we get long-term benefits if we do what the pavement design engineers tell us to?" he asked.

Mr. Henion rebuked the Federal strategy for focusing on traditional issues and largely suggesting "the same old approach," which he contended does not adequately address the issue of needed data on heavy truck weights or specific data on expenditures. These are not broken out by project definition, he complained. "We must always ask, 'Why are we making this expenditure.'"

Mr. Henion continued his commentary, arguing that no deficit reduction tax belongs in a cost allocation analysis, calling it "just another tax on

Americans." He called for more attention to pavement design issues and user charge structures to capture costs identified in studies. Advocating a "holistic approach" to cost allocation, Mr. Henion said that identified subsidies should be made explicit so that everyone understands their cost responsibility.

What Have We Left Out?

Ray Chamberlain, American Trucking Associations, began his comments by asking, "How can we conduct highway/transit cost allocation with such elegant simplicity that results can be used by legislators?" He contended that highway cost allocation has always served a purpose and that now it must address social objectives such as those reflected in ISTEA and the Clean Air Act Amendments. Dubbing these externalities "diversions," he called for consideration of how they relate to transportation issues, specifically, how to determine appropriate expenditures for transportation.

Mr. Chamberlain cautioned that "we will have missed the point if we don't go back and ask ourselves what are the three to five most important problems we want a highway model to solve?" This, he said, cannot be done without first narrowing the focus, which requires consideration of certain questions and a redefinition of what is meant by costs. Do ISTEA systems supplant historical interstate-era highway cost allocation tactics? What is to be the definition of costs—highway costs, transportation costs, social costs—what's in it? He contended that highway users on the revenue side see costs only as user fees.

To make a new Federal cost allocation model productive, it must incorporate an ISTEA-era conceptualization, of which highway cost allocation is a subset. Mr. Chamberlain called for the development of new tools to account for these ISTEA-era considerations, e.g., pollution, deregulation, etc. An invigorated ISTEA management system can be better utilized than the current Federal system, he maintained. "We can strive to make a paradigm shift, rather than reconfigure existing incremental 'buggy whip' tools."

Concept Changed of Highway Cost Allocation

Brian Vogel, Association of American Railroads, said he sees an unfortunate movement toward a study similar to the 1982 study, which may offer only an unproductive exercise that does not reflect the dramatically changed concept of highway cost allocation since that time, or the real information needs of FHWA and other policy makers. He referred to Executive Order 12893, which mandates a new set of principles for infrastructure investment and management, and requires that a different kind of study be undertaken. Legislative goals include the following:

- To ensure that scarce Federal dollars are spent efficiently.
- To design systems that maximize social returns on highway and transportation investments, with non-market costs identified by user class.
- To include pricing alternatives, which speaks to the need to conduct a full marginal cost–based study.

These factors underscore the need for a comprehensive, economically-based study whose outcome is not dictated by a series of judgment calls, is unconstrained by agency budget levels, includes external costs not reflected in highway agencies' budgets, and whose results are not ignored by legislators. Mr. Vogel called for a new study that would include, among other things, user-borne environmental, pavement wear, and congestion costs, and advisory committees of economists and government representatives to give advice on the study's methodology.

Mr. Vogel also agreed that non-highway payments should be excluded from the study, calling them general overhead payments that are properly excluded from a highway cost allocation study.

Open Discussion

In the general discussion following these presentations, participants questioned the goals of cost allocation. One said he sees the goal as getting private sector decisionmakers to make decisions as easily as possible. A Federal highway representative commented that although there is a connection between cost allocation and investment decisions, they are not the same and are not necessarily connected to procedures for a cost allocation study.

The new Executive Order 12893 mandating the use of market-based mechanisms implies that cost allocation must include the full panoply of user, environmental, and congestion costs in order to promote maximum social return from investment, said another participant. Costs are used by everybody, commented another, whether doing an indirect, external, or cost-benefit analysis. "Should we also be thinking of external benefits," he questioned.

FHWA commentators noted that although the panelists agreed that studies should use other than traditional methods, they recommended two very different alternatives. Some said to use a multimodal study, and others said to ignore factors other than those having direct highway implications. Mr. Chamberlain responded that even with a highway emphasis, the study must somehow account for the social value every citizen accrues relative to highway use. Mr. Kane asked how the Federal Government should pursue a new approach, whether it should use a marginal cost basis, for example, and at which level to do it, Federal or local.

Another participant noted a distinction between cost allocation and cost-benefit analysis. He said that to create a practical bridge, a cost allocation study must "take a crack at the marginal cost approach." Without going that route, he continued, we cannot pretend we are taking a holistic approach.

Alternative Approaches To Highway Cost Allocation

Three things must be considered, began moderator Dick Mudge of Apogee Research, in any discussion of cost allocation: (1) theory, (2) policy, and (3) practice. The first two feed into the third and help make a study that is understandable and usable from both policy and practical standpoints. Mr. Mudge then introduced the members of this panel, who would discuss various aspects of and approaches to highway cost allocation, including the evolution of Federal cost allocation methods and marginal cost pricing and benefits-based approaches.

Evolution of 1982 Federal Cost Allocation Methods

Roger Mingo of R.D. Mingo and Associates addressed the evolution of 1982 Federal cost allocation methods. He remarked that studies between 1961 and 1975 were based strongly on engineering considerations, were oriented toward new construction, and looked only at vehicle weight as a variable. The 1978 study represented a new approach and formed the basis for legislation while accenting the need for new data.

The STAA of 1978, which advocated a cost-occasioned approach, drew heavily from this 1978 study. The cost-occasioned approach looked at design, construction, rehabilitation, and maintenance factors, and suggested that costs of these activities be assigned to users according to their relative responsibility for those costs. The legislative mandate for the 1982 Federal HCAS and the study guidelines developed by the Congressional Budget Office (CBO) limited the scope of the study as did available staff and other resources.

In its new study, Mr. Mingo recommends that FHWA use both design and consumption approaches, in recognition of the changing nature of pavement costs. Formerly, a design approach was used for new pavements and a consumption approach was used for rehabilitated pavements. Current prominent issues in pavement costs include the enormous allocation impact of the investment/maintenance tradeoff, the need to include user costs, and the need to improve distress models.

Several current bridge cost issues are potential fodder for study analysis, according to Mr. Mingo. Use-variable bridge deck wear is caused by salt and exacerbated by traffic, but quantifying this process as a use-related component is difficult. Getting a handle on other known bridge-fatigue costs, also hard to quantify, should be a high priority, he said, adding that a need exists to develop a better replacement bridge cost function.

Another analytical method suggested was unique occasion costs. These deviate considerably from CBO, and FHWA has argued against the theory. For example, offered Mr. Mingo, special truck lanes going uphill are used by cars as well.

Capacity-related costs are another issue. Defining capacity-related costs is a complicated matter, observed Mr. Mingo, but a starting point could be analysis of the contribution of off-peak traffic. Difficulties in estimating capacity-related costs include the accuracy of temporal travel data and the calibration of PCE-value estimates. The CBO suggested using PCE-weighted peak travel to allocate capacity-related costs, and FHWA evaluated PCE-weighted travel as an allocator for other costs as well, but data inadequacies deterred implementation.

A continuing and sizable piece of unfinished business concerns common costs, which CBO defines as untraceable costs that benefit all. By definition, they are not occasioned costs. The question is whether all costs cannot be traced in

some way. If, however, there is no such thing as common costs, then how can differential incidence be accounted for?

Other issues affecting cost responsibility include vehicle classification. There are possibly 200 distinct classes of vehicles, each of which contains even more differences. Variables include the annual mileage of the vehicle, the time of vehicle use, and the primary road usage of the vehicle (interstate or local). Vehicle characteristics include axle load and suspensions. There is no way to characterize vehicles homogeneously in relation to affecting cost, Mr. Mingo contended.

In conclusion, Mr. Mingo allowed that these other options are worthy of consideration, that the evolution of cost allocation methods must continue, and that FHWA must take an active role in helping new methods evolve. Improved data offer new approach options, and a broader approach is needed—going beyond mere inclusion of Highway Trust Fund expenditures for cost allocation. The FHWA should also draw upon the fields of economics and engineering.

A Marginal Cost Pricing Approach

Gerard McCullough of Putnam, Hayes and Bartlett presented his paper, "Marginal Cost Pricing Approach to Federal Highway Cost Allocation." He defined the issue as the convergence between economics and engineering, advancing the concept of marginal cost as: **(1)** relevant—marginal cost analysis answers questions being asked by policy makers; **(2)** feasible—the techniques and data are becoming more available; and **(3)** essential—marginal cost estimates play an essential role in any highway cost attribution. Highway marginal costs, even if they are not implemented nationwide, should be studied and estimated.

Mr. McCollough noted that The Nation's highway system presents two challenges to administrators. One is the traditional investment problem of how to guarantee the physical integrity of the system. The other is the problem of how to assure that households and firms use it most efficiently. The current system wastes billions of dollars in congestion costs, freight misallocation, and pollution. Traditional cost allocation methods—benefits, incremental, Federal—are irrelevant to these problems.

Mr. McCullough argued that the best way to manage highways would be for Government agencies to allocate highway use in the same way that private markets allocate other goods and services — on the basis of marginal cost. To make this work, public managers would determine the full social marginal costs of highway use and provide access to those willing to pay user fees to cover that cost. Fees would include, at a minimum, a maintenance charge for consuming highway pavement and a capacity charge for contributing to congestion.

Mr. McCullough said that a highway system priced at marginal cost would be relatively uncongested because users would find it in their best interests to increase the auto occupancy rate. There would be less noise and air pollution, and the roads would be less threatening because some truck traffic would divert onto the intermodal rail system. A marginal cost-based system would also place less burden on the revenues of State and local governments.

In the 1991 ISTEA, Congress stressed that Government agencies must be concerned with efficient highway use and rational investment. Efficient use of highway infrastructure is also a theme in the U. S. Department of Transportation's report on the National Highway System (December 1993), and in President Clinton's Executive Order 12893 (January 1994).

None of these policies can be fully implemented unless highway agencies are willing to identify and impose efficient user fees based on marginal costs.

The critical step in identifying marginal costs is to distinguish between the fixed and variable components of total highway cost. Fixed costs are the costs of productive factors which, once installed, are not consumed by use. In the highway case these typically include expenditures for the right-of-way, grading, debt service, and signals. Variable costs are costs that vary directly with use. These include pavement costs and other agency costs absorbed by Government, interference costs absorbed by highway users, and environmental costs absorbed by the general public.

Marginal cost is the change in variable highway costs attributable to changes in the rate of highway use. Future realizations of variable cost, attributable to current use, are part of marginal cost. Thus, the cost of new pavement should probably be included in marginal cost since the U.S. network is complete and new pavement is installed to maintain current performance.

The FHWA has improved its ability to estimate highway marginal costs since its pioneer effort in Appendix E of the 1982 HCAS.

Improved pavement models (NAPCOM) allow FHWA to develop much more detailed estimates of pavement marginal costs using the HPMS database. The FHWA is also able to combine NAPCOM with economic investment models to estimate the incremental cost effect of damaged pavement on vehicles.

Detailed traffic simulation models such as FRESIM and INTRAS allow FHWA to model interference effects on HPMS highway sections. These models evaluate congestion in a variety of terrain settings and volume/capacity situations.

The FHWA has made extensive efforts to update the environmental externalities estimated in Appendix E of the 1982 HCAS.

Three categories of costs were excluded from the marginal cost-based user fees in Appendix E, but should be considered in an updated study: **1)** maintenance costs that the States absorb, **2)** bridge costs, and **3)** marginal accident costs. Appendix E identified marginal bridge and safety costs, but did not quantify them. On the other hand, while it probably makes sense for FHWA to estimate the marginal environmental effects of highway use for policy purposes, these costs should not be folded directly into highway user fees. Pollution "technology" is separate from highway technology and should be dealt with as part of the broader pollution control framework.

Finally, there is no inherent conflict between the efficiency approach and that equity approach. It is true that highway fees based on marginal cost might not balance the highway budget, but this is no reason to give up on efficiency. Economists have devised solutions balancing the demands of efficiency and revenue adequacy. Another approach to covering highway costs is a two-part tariff in which the fixed portion is covered by an entry fee, and the variable portion by a user fee based on marginal cost.

Other Approaches to Highway Cost Allocation

Arlee Reno of Cambridge Systematics followed with a presentation on other approaches to highway cost allocation. Many decisions remain as far as designing methods of allocating highway costs, he maintained. Previous studies have used the incremental method and the Federal method. A benefits method, seen in 1965, was not used in the 1982 study or in recent State studies, and only a partial allocation of marginal costs occurred in the 1982 cost allocation study. There is a "state-of-the-practice" issue for benefits-based and marginal cost approaches since they have not been applied, although research has been done on both methods. Arriving at a marginal cost of congestion requires a more complex effort than getting marginal costs for individual firms, and uncertainties need to be narrowed before fees could actually be set according to marginal costs. Mr. Reno maintained, however, that these alternative methods still have theoretical and practical benefits:

- A benefits-based approach lends itself to cross-modal analysis, is consistent with economic-based principles, and shows returns per dollar spent. In taking account of transit's impact on highway costs, this approach provides a basis for allocating benefits across two vehicle classes. A benefits-based approach is based upon one integrated idea—benefits versus cost—as opposed to picking out different allocators for different items of expenditure.

- A marginal cost approach accurately reflects economic principles. Mr. Reno commented that marginal cost pricing would not be implemented at the Federal level and recommended combining a marginal cost with a benefits-based approach.

- The incremental method's advantages are that it provides a historical basis for comparison

and, as opposed to the consumption method, is based on one principle in terms of how costs are allocated.

- A willingness-to-pay approach has a very serious theoretical shortcoming according to Mr. Reno: it treats similar vehicles and similar users differently. This kind of practice affords an element of inequity. It is not a good idea to price highways in different ways for similar users, he advised.

A valid reality check to these alternative approaches is in the practical application. The benefits-based and marginal cost approaches, for example, require additional data—estimates of private operating costs and more detail such as time-of-day of travel—that are not needed for Federal or incremental methods. The existence of HERS, an analytical tool created after the 1982 study, makes the benefits-based approach more practical. The marginal cost approach not only has never been fully applied in any previous cost allocation study, but is also a method very sensitive to data about volumes, speed, and costs of congested and uncontested conditions, data areas that currently harbor significant shortcomings. On the other hand, a marginal cost approach provides a framework for incorporating external costs. In applying a marginal cost approach, it should be noted that relationships between marginal costs of bridge-related elements are not as well established as those between pavement-related elements.

The FHWA and DOT must do the best they can, Mr. Reno concluded. Useful information can come from application of a benefits based/ marginal cost approach structure, which offers more potential than theFederal/incremental approach. This information could also have applications other than that of user cost implementation. To the extent the two new approaches can be integrated, it will be beneficial.

Open Discussion

A discussion of the presentations and of the alternatives to highway cost allocation followed.

The marginal cost approach requires more precision than the benefits-based approach, in that establishing marginal costs correctly is more difficult than estimating benefits from improvements. Neither approach is free of data problems, but the marginal cost method involves greater difficulty on pricing decisions. The marginal cost approach presents analytical questions, but it does have the benefit of providing a means for adjustment.

Questions were raised about the sensitivity of data in the context of cost allocation analysis, and about the relevance of marginal costs, which have little to do with municipal funding. In the realm of practicality on the State level, it was admitted that marginal cost pricing is still a ways off. But the value of the marginal cost approach, a defender maintained, is that it would help officials to better understand the costs of highway use. In the context of a highway cost study, it makes sense to find out what the marginal costs are.

One commenter criticized the comparison of marginal cost analysis for highway cost allocation with the railroad industry's use of marginal cost analysis, in that the railroads own their rights-of-way, as opposed to the highway network, which is publicly owned. A more useful analysis would be with a public-utility industry. In response, it was mentioned that an awareness of interactive effects is what is being pursued.

A comment was made that the history of cost allocation is one of principles based on practicality, whereas marginal cost is more of a theoretical principle. The tradeoff, then, needs to be more clearly defined. In response, the marginal cost approach was defended as having a consistent set of principles.

Emerging Issues In Highway Cost Allocation, Part II

Paper Presentations

Effects of Highway Finance Changes

Presenting the paper he co-authored with Dick Mudge, "Cost Allocation Implications of Changes in Federal and State Highway Finance Since 1982 and the Outlook for the Future," **Porter Wheeler, Apogee Research,** highlighted the importance of communicating complex issues to legislators. Because changes in the use and financing of the transportation system have important implications for cost allocation, new and on-going research must be conducted and its results communicated to and understood by policy makers.

Stepping back nearly 40 years, Mr. Wheeler discussed several generic policies surrounding transportation expenditures and receipts that led to the creation of the 1956 Act, the Highway Trust Fund, and an ever-deepening focus on highway cost allocation methods.

Previously, he said, there existed a fairly strict linkage between highway fees/revenues and expenditures, i.e., receipts equal expenditures. A trust fund was created to take in taxes and, based on rough calculations, apply them to highway programs; however, there was no explicit statutory link requiring a receipts equals expenditures equation. The Federal-aid Highway Act of 1956 and the Byrd Amendment provided this link by mandating that trust fund expenditures not exceed receipts in an annual accounting. Further statutory tightening occurred by stipulating that the distribution of the tax burden imposed across users be proportionate to the cost attributable to those users.

Enter cost allocation studies. Cost allocation studies gave important inputs to highway financing decisions during this time, recalled Mr. Wheeler, and represent a linkage that needs strengthening today because of deterioration caused by interest groups trying to deflect costs assigned to them.

Mr. Wheeler went on to discuss two other historic periods and their contribution to the greater prominence of cost allocation methods for highways—the mid-80's and the early ISTEA-1990's. The mid-80's, he recounted, saw a fairly stable tax level and slow growth in fuel use. The 1982 Act diverted funds for transit uses in an attempt to bring all infrastructure into the highway finance scheme and in recognition that highway financing could not solve all urban congestion problems.

Economic growth in suburban/urban areas caused transportation needs to be driven by factors outside highway financing issues, he continued, and by the mid-80's, a rapid burst of commercial and residential development focusing on the city center, highrises, and suburban development put great demands on the transportation infrastructure that are still with us. Much of this development/construction is attributable to tax credits and accelerated depreciation and not to underlying economics.

In light of a new transportation environment, asked Mr. Wheeler, how relevant are old methods of distributing the tax burden? He advocated the need for a new consensus on how to fund transportation infrastructure and programs in the future, balancing the financial challenges related to doing so. He suggested that perhaps policy issues emerging from the new study will offer a chance to move away from partisan interests and build a new consensus.

Mr. Wheeler identified the following changes to our transportation system that have prompted new views and policies.

- How we finance highways.
- How highways are used, relative to urban/suburban growth.

- Sources of funds. There has been a shift away from Federal funds to State funding mechanisms, which are growing faster than highway trust funds.
  - States tap into a broader revenue base and are more aggressive in getting fees (e.g. registration and development impact fees) for their local transportation needs.
  - Federal reliance on fuel tax revenues is encountering a growing concern for energy use and improved fuel economy within the vehicle fleet, restricting the use of a Federal trust fund as a financing alternative.
  - New financial support mechanisms have been introduced, some of which are still in the developmental phase: these include credit support, revolving funds authorized under legislative proposals (including ISTEA), and highway development partnerships with the private sector.
  - The FHWA has been aggressive in trying to find ways to encourage partnerships for the construction of infrastructure facilities, but States have necessarily taken the lead in this area, with Federal guidance.
- Increased use of bonding for facilities. This use has temporal equity implications and also departs from the Byrd philosophy of "pay as you go."
- New and different uses for highway funds, e.g., for non-highway purposes. Federal highway tax receipts have begun to be treated as general revenues for a number of purposes: deficit reduction (gas tax), set-asides for transit, highway-related (but non-highway) projects under ISTEA (e.g., enhancement and safety programs), and interstate transfer provisions. Implications for cost allocation and the future of highway finance may include setbacks in revenue streams.
- Special energy treatments to achieve non-transportation objectives. These need to be worked into a cost allocation scenario, along with a concern for fuel tax evasion. How is fuel tax evasion undermining fuel tax collections? Premised on solving externalities and other problems on the social agenda, these energy programs pose problems for highway cost allocation. The focus is no longer just a highway program, but a transportation program with funding for the entire transportation infrastructure.

Even though the changing transportation environment raises difficult challenges and encourages a tunnel vision on negative externalities, ISTEA has positive implications that could serve to enlarge the view. ISTEA has made intermodalism a goal, said Mr. Wheeler, adding more transit options and a better chance to pursue the most cost effective solutions. When more flexible programs are combined with accurate user fees, a more effective transport infrastructure can be developed. We need to focus on these positive benefits, he urged, for while they may not enter directly into a cost allocation process, they are necessary in terms of program justification and progress towards cost-effective infrastructure development.

How to Handle Externalities

Harry Cohen, Cambridge Systematics, sought to answer the question his paper asked: "How Should Environmental and Other Externalities be Treated in Federal Highway Cost Allocation?" He noted several reasons for including external costs (non-agency costs) in highway cost allocation:

- The importance of considering the economic efficiency of transportation: if highway users are required to pay highway user charges equal to the cost they impose on others (including other highway users, non-users, and public agencies), then trips that are valued less than these costs will not be made.
- The need for a highway cost study rather than a highway cost allocation study, and the need to address related social issues.
- The fact that external cost considerations may also affect equity judgements: is it fair that vehicle X pollutes less than Y, yet they share the same tax burden?

- The potential of externalities to offer important evaluation criteria for new and novel expenditures for highway user taxes allowed under ISTEA.

Mr. Cohen went on to note the vagaries inherent in estimating the costs of externalities. He contended that trying to set tax rates based on marginal costs could lead to under- or over-charging, because of external cost variability related to differences in vehicle types and driving patterns (such as the level of congestion). Determining the cost of accidents, for example, poses a difficult conceptual problem, namely, how additional highway use affects safety costs.

In addressing the problem of how to assign dollar values to cost, Mr. Cohen identified several approaches that past studies have used to value externalities:

- Control or mitigation costs (for example, air pollution costs might be set based on how much it costs to eliminate a certain amount).
- Damage costs.
- Market prices (if they exist).
- Revealed preferences based on willingness-to-pay. (One difficulty is that willingness-to-pay is based on income. Hence, valuations based on willingness-to-pay may be biased in favor of people with higher incomes.)
- Expressed preferences in which people are asked in a survey about costs of impacts. (People may fudge their answers if they think they are influencing policy.)
- Preferences expressed by jury awards. (Awards are usually in the form of financial damages that convey an underlying premise that something was done wrong, leading to higher costs than are appropriate for pricing).

Mr. Cohen noted that the scope of external cost analyses will differ depending on the purpose of the analysis. Economic efficiency analyses should consider all costs of highway use not paid by the individual highway user. Analyses of user versus non-user equity should consider all costs of highway use not paid by highway users collectively. Analyses of equity among vehicle classes should consider the extent to which a given vehicle class gives rise to external costs, and the extent to which these costs are incident on the class.

Mr. Cohen continued by describing some key uncertainties affecting estimates of costs for externalities:

- **Incidents:** Delays due to crashes, disabled vehicles, and road work are generally recognized as a major element of the congestion problem. However, estimates of congestion costs seldom take such incidents into account. Further, little information is available on the frequency, severity (e.g., reduction in capacity), and duration of delays due to incidents.
- **Emissions and fuel consumption:** Available emission and fuel consumption rates do a poor job of accounting for the effects of congestion. Emission rates from the Environmental Protection Agency's MOBILE model do vary with average speed. However, no distinction is made between, for example, emissions from a vehicle traveling on a low-volume road at a relatively constant speed versus emissions from a vehicle traveling on a congested highway (with frequent accelerations and decelerations) at the same average speed.
- **Internal versus external costs of crashes:** There are important conceptual difficulties in determining what should be included in the costs of crashes, and whether specific costs should be viewed as internal or external in nature.
- **Range of pollution cost estimates:** A review of published studies of air pollution costs found damage costs to differ by several orders of magnitude. Some variation is due to differing locations, methods, and assumptions. Comparing the "lowest of the low" to the "highest of the high" leads to very different conclusions about air pollution damage. This variability should be considered when assessing possible costs, urged Mr. Cohen.

In conclusion, Mr. Cohen offered the following recommendations for how to treat external costs in the next Federal study.

- Include estimates of the external costs of highway use.
- Include estimates of the relative contribution to these costs by different vehicle classes.
- Present the marginal costs of highway use for different types of vehicles, pointing up the difference between marginal and average costs, e.g., when considering the marginal cost of congestion, determining what that last vehicle costs, rather than calculating a mean assessment.
- Emphasize the high degree of uncertainty and variability surrounding these costs, which depend on many factors, such as conditions of use. "State-of-the-art for marginal cost analysis is just not there yet," cautioned Mr. Cohen, as far as affording clear comparisons of revenue/cost responsibility. More guidance is needed.
- Net out benefits before comparing tax rates with marginal costs. Discussions should note nonuser benefits and costs associated with highway use.

Panel Discussion

Complex But Worth Exploring

In commenting on the complexities reflected in the foregoing paper presentations, **Damian Kulash, National Research Council,** noted the presence of many interacting variables. Marginal cost-based allocation is fine in concept, but ambiguous in practice. "No matter how large a circle is drawn around the problem," he commented, "multiple margins emerge." Different variables held constant produce different and countless answers, he added, underscoring the complexity of this problem. For example, the costs of extra road lanes may be attributable to rush-hour cars, while the costs of extra pavement depth are attributable to trucks. Who, then, is responsible for the extra depth under the extra lanes.

Determining the physical costs of highways presents inherent ambiguities that make this a difficult task, he continued, but one worth exploring. Even though the infinite variety of marginal cost computations will lead to different estimations for safety analyses or pavement costs, Mr. Kulash still believes it worthy of consideration, particularly with regard to physical costs of highways. "In cost allocation," he said, "we can make a greater contribution by sticking to the issue of physical costs of the highway, taking on other issues more resistant to resolution after that." The traffic component of the Long Term Pavement Performance project, begun as part of the Strategic Highway Research Program, offered Mr. Kulash, will afford better data than the AASHTO road test on the pavement effects of vehicle usage by different vehicle classes.

In commenting on Mr. Wheeler's discussion of the balance between highway revenues and expenditures, Mr. Kulash noted the existence of an implicit relationship between highway revenues and user fee collections, historically understood as an agreeable way to pay for roads. At the dawn of motorized transport the gas tax proved to be surprisingly popular, he related, because it was seen as reflecting fairness between use and consumption. By the coming of the Interstate Highway age, the public knew this kind of tax was no longer quite so fair, given the differential costs of vehicle weights. Nevertheless, the historic culture of allocating costs to the groups that occasion them continues to provide a good starting point.

He said that although much of Mr. Cohen's paper focused on negative externalities relating to such things as pollution, congestion, and safety, positive externalities can actually serve to dominate the discussion and even drive the equation. These positives, such as broad economic payoffs, will need to be mentioned more, he asserted.

On the topic of income effects, Mr. Kulash agreed that there is a difference in willingness-to-pay based on income, but that willingness-to-pay is not the end-all. There is also a willingness-to-wait, he said—we all start the day with 24 hours. He finds a fundamental question at the core of the congestion pricing debate that asks which assets people will assign greater credit to—time or money. The social classes rich in one are not the same as those rich in the other.

Mr. Kulash offered his own recommendations for the Federal study, including using it to raise

broader social questions in the consideration of positive and negative externalities. He noted that obtaining statistical/quantitative data, central to analyzing broad social issues, could prove prohibitively expensive, and these broader studies are apt to be illustrative rather than definitive.

Externalities Must Consider Broad Range of Issues

Adding her remarks on suggested approaches to highway cost allocation **Mary Lynn Tischer, Virginia DOT**, noted that two general approaches were already presented—equity and efficiency. The equity approach and criteria, she continued, assume that same vehicle types pay the same fees. Where revenues do not match costs, a subsidy would kick in. Equity assumes that the highway system is user-financed, with direct costs of highway design assigned to vehicle groupings that occasion them. This system does not accommodate externalities, she asserted, adding that legislatures have a hard time dealing with shares of costs and revenues with no absolute cost responsibility.

The efficiency approach, on the other hand, does not tie user-based pricing to the cost of producing the highway system. This approach takes into account costs in consideration of traffic volume, congestion, etc., and is used at both Federal and State levels. She contended that efficiency is promoted in a context of providing a handle on externalities and includes no absolute cost responsibility. The focus is on using shares of both cost and revenue to determine the fairness of costs. Ms. Tischer cautioned that the equity structure may not easily accommodate fees that seek to force a mode shift or VMT reduction. "Should it?" she asked.

In terms of ameliorative damages, Ms. Tischer said these could be considered as a cost if defined and allocated in the framework. "But is this dealing at the margin?" she asked. Few externalities could be costed in this manner, and we need to get at more global societal degradation. She did suggest that environmental penalties could be based on vehicles and vehicle classes and shared out. Environmental cleanup costs could be allocated, based on a reasonable relationship to vehicle classes. "You can share anything out as long as it makes sense," she commented.

Regarding congestion pricing, Ms. Tischer commented that it makes sense in theory, particularly in the use of additional funds to provide alternatives to those priced out of the market. But once you get past the concept, she said, the consensus breaks down. There is no universal acceptance of externalities for which to charge or of environmental measures and data collection requirements that should be invoked. (States use their own data; Feds use State data, so they can be more cavalier!)

Commenting on tax policy development, she said it offers conceptually interesting ideas, but must be pursued more from a research context, because "legislatures will not be advised on this stuff in taxing policy." Tax mechanisms offer a small number of taxing possibilities, she continued, with thresholds above which it is difficult to charge. A fuel tax rate that is too high will not work.

Speaking to Mr. Wheeler's ideas for accommodating user fees in new approaches, Ms. Tischer commented that he brought good ideas to the discussion of blending finance and cost allocation issues. New approaches still suggest implications for user-fee concepts, she added, no matter how applied. "So how do you accommodate this?" The link between cost allocation and financing does not have to be completely rigid, but should be strengthened to provide guidance on taxing mechanisms.

Ms. Tischer called for changes in viewing highway cost allocation, including the need to expand its focus beyond a small range of issues and needs. She cautioned that because it is almost impossible for cost allocation to address all problems, it is best viewed as just one tool in the toolbox. She agreed that new taxing mechanisms should be developed, based on new transportation systems. Additional relationships are weakening, she said, and fuel taxes and registrations no longer accurately reflect underlying principles.

With an eye to future costing modes, Ms. Tischer contended that Intelligent Transportation System (ITS) technology as a method of costing is still a ways off. Transportation programs in the future

will be costed in terms of many different variables, she said, adding that we need to think more globally about general financing issues in transportation.

Ms. Tischer concluded her remarks by urging a multimodal perspective in making decisions on projects and charges. She maintained that even though charging in this way is still in the future, it is important for a cost allocation study to discuss issues, educate people, and work with methodologies that try to get a handle on externalities.

Open Discussion

Discussion among the audience and panel members centered primarily on the viability of marginal costing in various contexts, the difficulty of quantifying externalities, and other potential approaches to cost assignment.

A Federal representative noted that not much is known about marginal costs in terms of marginal maintenance effects and asked what areas the Government should focus on to get the knowledge it needs. Mr. Cohen answered that the most important research area is one that is not unique to transportation—pollution. He said it is difficult to place a dollar value on pollution effects by order of magnitude, questioning whether this should even be a DOT function.

Mr. McCullough noted that even while there are difficulties inherent in quantifying externalities, nearly every issue raised can be narrowed by further research. FHWA and others have made important progress in identifying the important elements of highway cost that vary with use. Strongly urging "some sort of cost assignment to users of the highway," one panel member said that equity and efficiency are not the only two objectives, and that a lack of precise information inhibits meaningful discussion of what constitutes highway user costs for either purpose.

Given this complexity, posited Madeleine Bloom, should laudable social goals be handled from a programmatic rather than tax-based approach? A panel member commented that Federal policy in transportation and revenue collection is too global a mechanism for matching variable and unique marginal costs. Another suggested using the income tax as a model for layering on individual variables "to hit one social objective at a time." This suggestion led to a discussion of summing marginal costs, one participant asking about the risk of eroding benefits by overpricing the highway system. Marginal pricing is clear, responded another, it is meant to bring everything in. He added that work is needed to achieve a comfort level with marginal costs by ensuring that more good than harm is being done.

Mr. Kulash said that because we do not possess the tools to examine the whole social equation, using the traditional, existing user-fee culture as the base is the best alternative. Another participant wondered how to address externalities at the Federal level to meet national objectives without taking them on individually. An FHWA official said that "command and control" solutions do not work, and that a market-driven approach is needed. He added that the FHWA is administering a pilot pricing program that contains the seeds of a market congestion pricing approach. A panel member advocated implementing such a program on a corridor-by-corridor basis, providing substitute mobility and avoiding broad-brush applications.

The FHWA official also noted that the Federal Government is interested in externalities on the investment side and is moving in the direction of extended cost-benefit analysis. Mr. Henion commented that we can make incremental improvements by getting a better handle on costs in order to allocate them instead of expenditures

Technical Issues In Highway Cost Allocation

Paper Presentation

Kumares Sinha of Purdue University presented his paper, "Technical Issues in Highway Cost Allocation. He began by saying that it has taken more than half a century to get to the current level of cost allocation understanding.

Highway cost allocation is conducted by identifying all costs of providing highway services, using expenditures as a proxy; vehicle miles traveled (VMT) by vehicle class and roadway class; all user charge revenues by vehicle class; cost responsibility and revenue contribution by vehicle class; and revenue/cost ratio and user-charge revision.

An important technical issue is highway classification, which involves data availability by road type, functional (traffic data) versus jurisdictional (revenue data) characterizations, local roads, and toll roads. Traffic and expenditure data are often not available at local levels.

Vehicle classification is according to function: passenger cars, buses, and trucks. Subdividing into smaller groups, by vehicle weights and axle configurations, brings difficulties. An important technical issue is what type of weight classification to follow. Use of registered weight facilitates computation of revenue contribution, but operating weights are necessary for assessing cost responsibilities.

Definition of cost can be by actual expenditures, gleaned from the recent past, versus needed expenditures, which are anticipations for the near future. Because there is no fixed criteria for what is "needed," the term offers a range of divergent scenarios. Other components in cost definition—the number of years and life-cycle costing—vary as well. Cost categories break down into major categories, expenditure items, and various disaggregations.

Cost definitions should be sensitive to weight or width of vehicles and the degree of detail in expenditure records.

There are two guiding principles in highway cost allocation—equity and efficiency. The common approach is equity based. Equity can be considered in terms of benefits, costs occasioned, or ability to pay. The equity approach based on costs occasioned, according to Dr. Sinha, is the most practical method. Other approaches are not applicable. For example, the uncertainties associated with the definition of benefits derived by different users would make the use of benefits, instead of costs, ambiguous and not directly implementable.

An efficiency approach, although discussed for a long time, has not been adopted because of various practical reasons, including the fact that instruments of varying user charges are not in place and that much more detailed data than those ordinarily available would be necessary. The validity of the approach would still be questionable. Dr. Sinha suggested that studies should be undertaken to investigate how both the benefit-based equity approach and the marginal cost-based efficiency approach can be put to practical use, while continuing to improve procedures for the currently used cost-occasioned-based approach.

As pavements constitute the largest component of highway activities, pavement cost allocation is a large issue. Pavement design, construction, maintenance, and rehabilitation, though they involve different forms of activities and end results, are interdependent and closely related. A unified approach must be taken to the allocation of costs of new pavements and their rehabilitation and maintenance.

Developing this approach for new pavements centers around the issue of using a load-incremental approach versus a thickness-incremental approach. A challenge is in keeping the allocation scheme consistent with the design

and construction procedure. The economy-of-scale benefit assigned by the procedure to particular vehicle classes should also be known. The FHWA uniform removal technique of 1982 used a complex iterative procedure. The approach can be greatly improved by using a thickness-incremental method instead of a load-incremental method commonly used. The thickness-incremental method not only satisfies the design criteria, but also its application is direct without requiring an involved computational procedure. Furthermore, the amount of input data is considerably less. For example, only the proportional distribution of each vehicle class in the traffic stream is needed. ESALs are derived from the AASHTO design equation for minimum thickness plus each increment added cumulatively. Cost are computed for each increment and they are allocated among vehicle classes in proportion to the ESAL values determined. Utilizing the thickness-incremental approach eliminates the economy-of-scale problem, provides an algorithm applicable to any nonuniform linear or nonlinear thickness/cost relationship, and is conceptually in tune with design procedure.

A major technical issue in highway cost allocation is the procedure for the allocation of pavement rehabilitation and maintenance costs. In most previous studies, this was done tentatively and arbitrarily. The difficulty with maintenance and rehabilitation cost allocation is that it requires the estimation of relative responsibilities of load-related and nonload-related factors. Most HCASs used expert opinions to make the estimates. However, there is no definite agreement among experts as to the portion of pavement wear that can be attributed to environment and other nonload-related effects. The disaggregate damage-function approach developed by the 1982 Federal study considered environmental factors by relating them to pavement distresses.

Not only does this approach require a large volume of data, it is also dependent on subjective judgments regarding the necessary load and nonload-related importance factors.

Sinha presented an aggregate approach for the allocation of pavement rehabilitation and maintenance costs based on the concept of Pavement Serviceability Index (PSI)-ESAL loss as the overall representation of pavement performance. The total loss in pavement performance at any stage of a pavement's life can be estimated by the area between a theoretical no-loss line and zero-maintenance curve on a PSI-ESAL graph. Between the extremes of the no-loss line and zero-maintenance curve would be the actual performance curve depending upon the level of maintenance performed. A high maintenance level would force the actual performance curve upward, while a low maintenance level would force it close to the zero-maintenance curve.

As the AASHTO design equation is mostly load related, the area between the no-loss line and the design performance curve can be taken as a measure of load-related PSI-ESAL loss. The area between the no-loss line and the actual performance curve would represent the PSI-ESAL recovered by rehabilitation, and the area between the zero-maintenance curve and the actual performance curve would represent the loss recovered by maintenance. The performance curves and respective PSI-ESAL loss areas can be derived from historical performance and ESAL data from pavement management programs.

Zero maintenance curves can be derived by considering actual performance curves of structurally identical pavement sections and their corresponding maintenance expenditures. Dr. Sinha demonstrated how such curves can be developed by statistical regression analyses.

The total performance loss is due to load-related and nonload-related factors and their interaction. A proportionality assumption was used in the 1984 Indiana HCAS to estimate fractions of load and nonload-related cost responsibilities for the interaction effect. This assumption states that the larger the load effect, the higher its share of the interaction effect.

For the load-related portion of pavement rehabilitation costs, the thickness-incremental method can be applied to assign cost responsibilities among various vehicle classes. In this instance, the original pavement thickness is taken as the basic thickness with zero cost, and the thickness-incremental analysis is carried out for the overlay thickness added. The load-related portion of maintenance costs can be allocated to vehicle classes according to their ESALs.

The nonload-related portions of both rehabilitation and maintenance costs should be considered common costs. A major issue is how to assign common costs among vehicle classes. These costs cannot be attributed to any specific user class or group of user classes, such as expenditures resulting from nontraffic causes including environmental factors, safety, or aesthetic consideration. These costs should be distributed on the basis of VMT which is the most widely used common cost allocator. Such allocators as PCE-VMT or PCE-ESAL should be used only in those cases where there is a strong justification for using a width or load parameter to weigh the common cost allocator.

Dr. Sinha mentioned that while much attention is given to the details of cost responsibility determination, revenue attribution does not generally receive much scrutiny. Also, cents/VMT is often used as an index to compare cost responsibilities with revenue contributions. Dr. Sinha pointed out several shortcomings associated with the use of such an index. He suggested that cost responsibilities and revenue contributions of individual vehicle classes should be expressed as percentages of the total cost and revenue, respectively.

Periodic updating of the cost responsibility and revenue contribution factors is essential in order to keep abreast of the changing traffic distribution patterns, program emphasis, and technology. Dr. Sinha concluded by saying that a large volume of experience exists from studies conducted over a period of 6 decades and that now is the time to define the technical issues and establish the appropriate techniques for dealing with them.

Panel Discussion

Cost Accounting is Both Art and Science

Gedeon Picher of Maine's Department of Transportation opened the panel discussion by acknowledging that Dr. Sinha is an expert in his field and shows a great understanding of cost allocation issues, including the need to deal with interactions.

In doing his own computations of proportionality equations, Mr. Picher noted that Dr. Sinha's models worked. Costs occasioned seemed to be independent of the art of adding equal layers. Mr. Picher agreed with the need for continuing to update studies with easily adjustable inputs. Sizes and weights are changing, and modeling of pavement damage is changing as well.

Mr. Picher articulated some new factors that need to be accommodated. Although the size of benefits is hard to define, there is nonetheless the need to accommodate external benefits as well as costs. He warned that common costs will be larger in this study unless a means is found to reduce them. If costs are higher than expenditures, then revenues will have to be raised and cost allocation considered in this regard. Analyzing costs is fine, said Mr. Picher, as it allows consideration of future commitments. Using equity ratios to express results is understandable, and life-cycle costing is a good idea. Efficiency costing should be avoided. Peak-hour pricing data is not readily available, and certain classes of travelers do not have the choice on when they travel anyway.

Costs at the margins do not seem to take into account all variables and thus distort any attempt at setting basic relationships. In dealing with pricing and any resulting behavior deterrence, Mr. Picher advised against calling it marginal cost. Individuals have different amounts of money and are willing to pay at different times. Needs, which vary considerably, drive up prices, and this distorts basic relationships.

Mr. Picher concluded by saying that the direct-allocator method seems fairly good, although it may need fine tuning, that Dr. Sinha's approach can be used to get at the problem until the LTPP gets more data, and that "there is a lot of art as well as science in cost accounting."

Sophistication May Buy Worthless Results

Jack Deacon of the University of Kentucky followed, stating that Kentucky is among the most active States in cost allocation work. Because the primary client is the State legislature, Kentucky studies focus on the expenditures that

it controls and on the taxes and fees that it levies in support of those expenditures. User fees that are extracted for other purposes, such as general fund support, are ignored. From the Federal perspective, dimensioning the system of interest appears to be much more difficult, particularly as a result of ISTEA. As a result, a significant initial effort is needed to define the scope and context necessary for achieving success. Considering the many stakeholders, this is a daunting task.

In Kentucky, related Mr. Deacon, highway construction cost data are highly aggregated. The process of disaggregation involves estimating total replacement cost, which is then scaled back on a per-year basis to actual expenditures. Because data forecasts are unavailable for a variety of reasons, all analysis is based on historical data. The cost allocation models are updated every 2 years and, as a result, the present and immediate future can be examined from a time-series perspective. Alternative tax scenarios are also evaluated using historical travel and cost data.

Mr. Deacon expressed concern about the possibility of basing the next Federal study on 20-year projections. Uncertainties within such a time frame are extremely troublesome, and alternative future scenarios must be carefully constructed and valuated. Fortunately, the next Federal study will benefit from the relative accuracy of current data, particularly that dimensioning travel behavior.

Although sticky issues remain, particularly regarding temporal and seasonal effects, Mr. Deacon is enthusiastic about the current database.

Deacon remarked that consideration given by the panel to the equity-versus-efficiency issue was quite appropriate. However, future Federal efforts must find a way to build on past efforts, particularly the 1982 cost allocation study while, at the same time, being innovative and open to experimentation.

Among the many approaches to equitably allocate highway costs, none is intrinsically superior to the others. All have merit and are mutually supportive though sometimes yielding apparently contradictory measures.

Particularly significant are wear-based and relative-use allocators. Relative-use allocators are a common method of assessing fees generally and are especially effective in allocating highway costs.

"Reasonableness of results" is an important criterion in assessing the utility of any particular allocator.

Although benefits of highway travel are difficult to quantify, they must generally equal or exceed out-of-pocket costs. Accordingly, marginal user costs reflect the floor of user benefits. As a result, the need exists for improved data on marginal user costs.

Regarding pavement cost allocation, Mr. Deacon was unconvinced that the technical know-how exists to accurately separate load from non-load effects. It is often the case, he said, that fabrications mask key and very arbitrary assumptions. Perhaps there is a need to reconcile ourselves to uncertainties in this area, he said.

Although incremental procedures may be reasonable for pavement cost allocation, he maintained, they are not well suited to allocating structural costs. The analysis is difficult, and bridge costs are only marginally and indirectly linked to traffic volumes and weights.

Because common costs often comprise such a large percentage of total costs, their allocation is of critical importance. Most investigators use VMT for these allocations, apparently as a measure of relative use. However, passenger-car-equivalent miles does a much better job of measuring how vehicles use highway capabilities including both time and space. A critical dialogue on the allocation of common costs should be initiated.

Estimating revenue contributions from the various user classes has been at least as difficult in Kentucky as estimating cost responsibility. One particular problem has been the allocation of truck registration fees to the various truck types. According to Mr. Deacon, accurate fuel consumption estimates are essential.

For valid comparisons of the cost responsibilities and revenue contributions of individual vehicle classes, the ratio of percentage cost responsibility

to percentage revenue contribution is a useful measure. However, other measures, such as cents per vehicle mile, are extremely useful for quickly and effectively communicating differences among vehicle types.

Mr. Deacon concluded by noting that although the efficacy of cost allocation practices has been well established, technical and data limitations remain. Attempts to accommodate sophisticated economic concepts without the necessary data sometimes makes "assumptions questionable, models incomprehensible, and conclusions suspect. Elegant simplicity," he said is the key and the future of cost allocation.

Practice Builds Confidence in Cost Allocation

Chuck Sanft of Minnesota's Department of Transportation started by saying that cost-allocation studies need to be put into practice. Experts have designed the process, the necessary next step is building confidence in it. The one HCAS in his State was well done, he said.

Mr. Sanft remarked that Dr. Sinha's process was good, and that his report offered many possibilities for potential elaboration. Regarding common costs, questions to be asked include what is a minimum acceptable thickness and a minimum geometric design. There are many decision points and augmentations in realizing common costs. The interaction between weather and load requires more information as well, although the initial approximation is promising.

In looking at maintenance, although the methodologies seem good, more time to assess it is needed. Regarding steel bridges, the real fatigue factor from loads needs to be quantified, as does the relationship between fatigue and structure.

The operating weight question, in which the freight industry has an obvious interest, needs more attention paid to it, particularly regarding how to determine and distribute operating weight among axles.

Mr. Sanft next considered the issue of whether cost allocation can provide certainty where none exists. Transportation systems cannot stand alone from social programs; if it were not for the latter component, the interstate system would not go where it does today. Elements of transportation programs invariably entail a social element. The Federal effort, then, needs to define limits, and that must make up the core study. False expectations should not be built up. Only after core issues are covered is a move to externalities and potentialities proper.

It is not worthwhile to lament the lack of data, Mr. Sanft advised. There is never going to be enough data, and the possibilities for research are always going to be endless. Regardless, decisions on funding and user-fees will be made and policies implemented. There is never a perfect time to undertake this effort, Mr. Sanft maintained, so the time to do it is now. As there is little chance that user fees and charges will not be examined as an outcome of this study, Mr. Sanft advised that the group might as well get ready to provide advice on that topic to Congress.

Open Discussion

A short colloquy followed. Regarding common costs, there might be a variation of pavement base among jurisdictions, and this would impact minimum common thickness standards. As pavement failures are often structural section failures, further examination of minimum common thickness seems in order.

Jack Deacon remarked that heavy loads can cause bridge failures, but the design process for bridges does not accommodate truck weights and repetitions. When structural engineers are asked to come up with incremental costs of incremental increases in truck limits, he said, they do not have the answers. Mr. Deacon added that it is time to look at raising truck-weight limits.

Summary Of Breakout Group Presentations

Participants met in small group sessions at the end of both days to discuss issues and make recommendations for input into the next Federal highway cost allocation study. On Day 1, breakout groups were asked to identify from five to ten issues that are important to highway cost allocation. On Day 2 they reconvened and readdressed those issues, offering specific recommendations on data and research needs and highlighting the most important issues that should be addressed in the new Federal HCAS. These findings are summarized from breakout leader presentations to the general session on both days.

Group A-1— Porter Wheeler, session leader

The following issues were distilled from a long list brainstormed by the group as important areas for the next Federal cost allocation study to consider:

- More emphasis should be placed on developing and refining explainable and defendable methods, both analytically and in terms of presentation to policy makers, decision makers, etc.
- More explicit attention should be paid to examining the uncertainty inherent in different aspects of highway cost allocation and to the sensitivity of results to this uncertainty. Variations across States, such as in pavement conditions, and variations in cost of construction need to be directly addressed.
- Numerous data gaps must be filled in temporal data for traffic and use, the value of a life for safety and other issues, and in a host of issues connected to external costs.
- The study objectives should be more explicit. The study should directly address the sometimes conflicting criteria of efficiency versus equity in cost analysis, and the appropriate uses of each of these criteria.
- The study should examine issues related to evaluating and implementing a marginal cost approach. Economists have a particular penchant for marginal cost and marginal cost pricing. Moving forward in this area requires a close look at the implications and practicality of implementation.
- The context and scope of the cost allocation study and its methodology need to be reviewed. Regarding context, MPOs make certain decisions, for example, some of which may not be for highway projects, but for transit or other enhancements. On scope, should we count all expenditures, whether for highway facilities or not? What about taxes charged users but applied for deficit reduction?

The above six issues identified by the group on Day 1 were further compressed into five issues and prioritized by importance. Listed below are the major recommendations developed within each of these major issues:

1. **Identifying study objectives (efficiency vs. equity).**
   - Cost allocation should provide information upon which to base recommendations for user fees and road taxes in general. This goal will require a number of preliminary steps, including establishing cost responsibility, agency expenditures, and social and direct costs.
   - Respond to Executive Order 12893, which goes further in dealing with investment decisions, incorporating social benefits and costs.

- Begin to develop now a basis for future refinements. Develop a basis for dealing with externalities and marginal cost pricing.

- Provide guidance to the States. A cost allocation study has uses beyond setting Federal user fees and road taxes. It can also provide guidance and tools to the States, particularly for how they should integrate notions of highway finance and cost responsibility into their management systems.

2. Context and Scope.

- Direct an early effort toward establishing the over-arching principles to be applied in the cost allocation study.

- Look at the scope in terms of Federal, State, and local coverage, attempting to cover all the highway-related programs.

- Look at direct highway cost as the primary goal, but "go on and dive in" to external costs, and make it a chapter, not an appendix, also recognizing that the time is not right for a full integration into the quantification scheme.

- Include all highway user generated revenues. Some of the revenues may be social charges, but they may also be reflecting some political perception of externalities or environmental impacts, etc.

- Pay close attention to the time horizon. Make the time horizon longer while recognizing that to do so requires more scenarios, options, and uncertainties the further out you go.

- Incorporate all surface transportation, or at least the transportation network that will be incorporated into the National Transportation System.

- Address and give strong treatment to tax evasion and exemption items in the highway revenue base.

3. Explainable/defendable methods.

- Invoke principles understandable by a non-technical audience, but defensible to a technical audience, without a lot of added complications just for the sake of perfecting functional formats of models. Keep it as simple as possible within the realm of getting those costs allocated.

4. Filling data gaps.

- Give attention to filling as many data gaps as possible, including:

  - Temporal distribution.
  - Value of life.
  - Variability in quality.
  - Vehicle operating cost data.
  - Illegal overloads.
  - Operating weight and registered weight distributions.
  - Construction costs (by type of improvement).
  - Truck registration data.
  - Revenue data.
  - Fuel consumption.
  - Pavement expenditures.
  - What contributes to pavement deterioration.
  - External cost estimates.

5. More explicit attention to uncertainty and sensitivity.

- Deal with uncertainty and build in as many sensitivity analyses as seem viable, recognizing that there is a limit to what can be done.

- Establish a range for useful application of parameters. For example, a range of estimates from 1-1000 might be narrowed to a range of 10-100 and thereby become more useful. Based on results, look at scenarios for prioritization.

Group A-2—Arlee Reno, session leader

Policy Issues

The group began by stating the need for cost allocation studies to be transferable and applicable to the State level. Standardization of data collection requires the involvement of sub-State units of government. A question was raised as to whether funds are being spent in the way local governments are reporting. The study should stay focused on end use and not get ahead of itself. Simplicity is the guiding principle, as a simpler study could allow for several different perspectives.

In determining the scope of the study, questions to be answered include what funds should be included, and which are contributions as opposed to costs. The issue of pavement damage leads to a broader consideration of costs associated with highway use, such as congestion and pollution. As the study is being conducted, there will be an opportunity to try to calculate other social and external costs.

New techniques should be less of a priority, and fundamental questions should be the focus. These include equity, efficiency, and environmental concerns, and how user charges affect these concepts. Capacity expansion is a newer concern. Efficiency issues seemed less of a concern in the past than now.

As a general principle, more private sector involvement is needed, and advocacy groups need better representation. A large number of them—shippers, for example—are currently not represented. Greater private sector involvement will facilitate learning more about benefits and costs of highway investments which is important information for management decisions.

The group discussed the purpose of the HCAS. One perspective was that the primary purpose is to secure revenue streams to finance highway improvements. Discussion ensued as to whether a HCAS should address social issues such as environmental factors. Another potential role of highway cost allocation is to correct failures in transportation pricing and to foster productivity gains. Highway cost allocation studies play an important role in educating legislators so that they can make informed decisions about program levels and user charges.

Any question concerning the allocation of highway costs to various user groups leads to questions of equity. Economic definitions of equity are derived from market concepts of fairness, but equity can be recast as meaning "I can't make you better off without making someone else worse off." Taxes can be categorized as efficient or fair, but a fair tax may be inefficient.

For FHWA to do this kind of analysis, it needs such information as income distributional effects, cost responsibility, and benefits received.

Marginal Cost Approach and External Costs

The role of marginal cost was also discussed by the group. It is hard to make reliable estimates of marginal costs or to know where the revenues generated by marginal cost pricing might end up going. Marginal costs do provide a basis for intermodal comparison, and deviations from marginal cost can be used as a measure of inefficiency.

Data Needs

The need to improve highway cost allocation data applies to all levels of government. Data collection and analysis could be facilitated if a common definition of costs were adopted by all jurisdictions. Gaps exist both in cost data and vehicle-related data. Cost data needs include costs of environmental and other externalities, local highway improvement costs, and long term highway improvement costs based on life-cycle cost principles. Vehicle-related data needs include fuel efficiency, vehicle miles of travel by different vehicle classes, and operating weight/registered weight distributions.

Research Needs and Recommendations

The group identified the following areas for further research.

1. **Scope: Who's the Customer?**

   - The study's objectives and audience need to be clearly identified.
   - Make the study's scope broad enough to serve the multiple audiences interested in cost allocation and highway financing issues.
   - Look at both Federal cost allocation and cost allocation for all levels of government, but keep the results separate.
   - Take a prospective look at issues in surface transportation cost allocation. The issue of extending the analysis to all surface transportation systems is not an overriding priority, but given trends and variations in the audience, the study should at least look into it.
   - Examine the benefits approach and relationships between benefits and costs in the marginal cost approach.
   - Consider social costs, such as air pollution, noise pollution, and congestion. Consider local solutions to these problems.

2. **Methodology.**

   - Look at multiple methods and, if there is a lack of information, present a research agenda. A multi-method research agenda would include a comparison of strengths and weaknesses of various approaches.
   - Focus attention on the allocation of common costs and only classify as common those costs that truly are.

3. **Context of Presentation.**

   - Cost allocation should be consistent with provisions and the intent of the Clean Air Act Amendments of 1991.
   - Opinion polls are useful tools to collect otherwise unobtainable data.
   - Temporal equity is another issue to be considered.
   - Revision of relationships between various highway costs and highway use by different vehicle classes is needed. Pavement damage functions still require updating.
   - Pay more attention to maintenance, especially preventive maintenance, in the next study.
   - Define what data are needed. Better data on VMT are needed and methods for collecting VMT data should be reevaluated. This is a large task, but there is strong agreement that VMT is a fairly important component.
   - Another data need is an analysis of the accuracy and variability of various types of data. Study results likely will be more useful and credible if sensitivity analyses are conducted.

4. **Externalities.**

   - Analyze issues related to the vertical and horizontal equity of various highway user fees.
   - Consider alternative measures of equity, with respect to location and time, core criteria, and income distribution. There might be some convergence of economic efficiency and equity methods.
   - Evaluate the comparative advantages of alternative methodologies.
   - Strive for more efficient allocation and pricing.
   - Define more clearly the administrative issues with respect to tax collection.

Group B-1— Roger Mingo, session leader

On Day 1, the group spent more time raising questions than answering them; however they successfully addressed these issues on the second day, adding a list of recommendations and priorities for the next Federal HCAS to consider. The preliminary issues are summarized below, followed by specific recommendations.

Issues Raised

- How to deal with ISTEA program expansions and the extra revenues not necessarily dedicated to the Highway Trust Fund.
- Alternative methods of including various costs raised several possibilities.
  - Base inclusion of costs funded by ISTEA on whether they are acceptable to users.
  - Include costs if expenditures benefit users.
  - Include costs if they mitigate costs produced by users.

If the costs do not meet any of those criteria, they should probably not be included in a cost allocation study, regardless of whether or not they happened to be associated with Highway Trust Fund expenditures.

- Revenue inclusion. Similarly, revenues could be included based on whether they are exclusively or more-or-less exclusively incident to highway users with just a few other transportation modes, or are used for highway programs.
- Determining common or fixed costs, both what they are and how to allocate them or assign them to other users.
- Overall approach or methodology. Should we use marginal cost pricing or marginal cost analysis, and should we look at externalities as part of that? Should we set priorities in how to analyze costs, i.e., should more effort be put into certain categories, given limited resources? Should we use life-cycle costs and benefit-cost analysis as another general approach to cost allocation?
- Transportation cost or highway cost allocation study? Which one to do? How do we define costs and which ones to include? How do we determine what they are? Do we include all levels of government, all non-governmental costs? How far should we go in that direction?
- How to convey the findings of the complex process of highway cost analysis in a manner that is understandable and therefore usable. The study does not have to be "simple," but its results should be presented simply.

Research Needs and Recommendations

The group's discussion the second day revealed convergence between engineering and economics approaches, with a consensual call for cost occasioning. Engineers agreed that marginal cost analysis has value and needs to be applied, without fully accepting it as a potential basis for a complete set of highway user fees. The following identified research needs are based on the desire to do both kinds of analyses:

1. More information to help in applying a marginal cost approach, such as more knowledge of the marginal effect of accident costs. Earlier work does not contain adequate traffic variables to make needed judgments.
2. More information on marginal maintenance costs, such as the initial cost of traffic on pavement wear for snow removal, and on other maintenance costs_the extra cost of doing business under heavy versus lighter traffic conditions.
3. More research on how administration and other service costs vary at the State level (police services, etc.), especially how these costs vary with traffic.
4. How marginal costs vary over time, that is, under congested conditions and on weak

pavement sections as opposed to on uncongested, thick, pavement sections. A corollary might be to determine the marginal costs of incidents, which also relates to accident costs, since incidents are sometimes accidents.

5. More detailed cost breakdowns. One of the weak points of the Federal cost allocation approach, and to a lesser extent cost allocation at the State level, is that we are allocating categories of costs rather than specific costs. Using specific highway element costs is a far better approach. That might mean a case study approach, done lightly in the last study, or the use of breakdowns from States that have recently performed cost allocation studies.

6 A look at the highway user costs associated with highway agency repair and maintenance activities. NAPCOM is doing this to some extent, but more needs to be done, as the user costs of making repairs is an important component of costs.

7. More rational ways of allocating fixed costs through a marginal cost approach. Approaches might converge even more if we allocate fixed costs under a marginal cost approach.

8. Whether to allocate State and local costs as part of the Federal study. Under what conditions is it appropriate, and should it be an ancillary portion or a mainline of the study? One possibility to think about is a demonstration with one State, looking at that State's costs vis-a-vis the Federal program and at the different answers that result.

9. Making the "state-of-the-art" in cost allocation the "art-of-the-States." Find a way to transfer the methodology better than was done in 1982.

10. Analyze the distribution effects of user fees, that is, how user fees are passed on, e.g., who gets freight user fees? How fair is it and what are the elasticities associated with them? A whole range of issues exist here that seem necessary for feeding into a marginal cost approach or, further down, a look at productive revenues.

11. How to apply cost allocation to multiple modes. The group seemed to reach a consensus that although we may not be able to do it quite yet, an initial study in this regard might plant the seed, somewhat as Appendix E did for marginal cost pricing. "Maybe we need an appendix on how to do a multimodal cost allocation," said Mr. Mingo. It is not clear whether to include just surface transportation modes or all transportation modes.

12. How to enhance the allocation of residual highway costs. How to determine whether or not they are capacity-related. Is there a cost-occasioned basis for allocating these?

13. How to determine the optimum level of the budget (along Loyd Henion's adequate budget concept). If expenditures will be left out, forcing a view only of literal highway agency expenditures, how do you determine the basis of the budget, needs, and costs occurring regardless of expenditures.

Group B-2— Joe Stowers, session leader

With the funding flexibility that ISTEA provides, assumptions about how much funding for highways there will be can no longer be made with confidence. More players are now involved in the process, and funding is being diverted to other uses than received it in the past. This affects how State revenues are used. States often have to supplement support for projects that formerly were funded primarily with Federal money. In the current situation, cost allocation studies would require consideration of more than one level of government.

Current cost allocation models use a unimodal approach, but ISTEA, in asking for a multimodal approach, will require some analysis from a multimodal perspective, leading to the issue of the use of marginal costs. Intermodalism also raises the issue of the extent to which each mode assesses its costs: rail infrastructure is a private sector responsibility; whereas roads are publicly owned.

There is less constraint in choosing an approach for a new Federal HCAS, not only because there is more data available now than in 1982, but also because there is less of a Congressional mandate. This situation creates a climate of expectations about the study among the various parties endeavoring to influence it. Therefore, firm leadership is needed to develop a clear organizing focus for the study. The approach should include constructive, progressive interaction with engineering and economic specialists, and balanced stakeholder involvement to assure that stakeholders' reasoned arguments are heard without creating the danger that they might drive the process for their own benefit.

Related issues include the mixing of funding in the post-ISTEA world, such as the flexibility between STP and NHS. ISTEA takes the Interstate-transfer program one step further and provides greater flexibility to make non-highway investments. With ISTEA, it will be difficult to foresee the future, requiring the use of alternative scenarios and sensitivity analysis. Studies should be done every two to four years rather than one every 10-15 years.

There is a lot more data currently available on environmental impacts and on productivity impacts of roads, key factors in determining the value of a given road investment. These externalities should be included in cost allocation studies. A contrasting opinion held that including negative and positive externalities might muddy the waters more.

There has been an expansion of demand for other uses of highway user fees traditionally allocated to highways. The user fee issue is not being addressed adequately in the context of current highway program policy. Cost allocation studies, while including revenue allocation, have paid scant attention to full cost recovery including the costs of deteriorating infrastructure; this is an inadequate approach. More attention needs to be paid to incorporating user costs and their recovery into cost allocation studies.

Technical Issues

Among the technical problems to address are the lack of LTPP results and uncertainties about how well pavements perform. Estimating pavement performance is still an art, not a science, and it would be a mistake to force it into a marginal costing approach. Sentiment was expressed that economists tend towards prematurely using data that just is not there. It was felt that any Federal study would have to look at maintenance costs, and, in fact, must include all costs at all levels.

The treatment of external costs is a significant issue. There is a strong wish not to regulate external costs, so any study would have to develop an analysis of costs; however, there are limited resources at the State level to do so, and the tools are not there to look at things from a larger perspective. A cost study, it was felt, would provide such a tool. There is more than one reason to look at external costs; not only can they no longer be ignored, but their value has been determined by political process.

LCVs represent another issue to be considered. The cost of highway access by LCVs to intermodal facilities is a user cost, both in terms of freight and passengers. The question is what to do with LCVs in terms of cost allocation. The problem of the design standard came up—how long will pavements last before needing rehabilitation, and to what standard are pavements being designed? There is no longer enough money to lay down a lot of reinforced concrete. This life-cycle issue has a direct relationship to cost, and there are still questions as to how to define a pavement's "design life," although the ability to predict it has improved.

There is a strong demand for prioritization of needs. With regard to cost allocation, does this mean allocating for aggregate needs, or allocating on a case-by-case basis? In performing cost allocation on needs, the user-fee structure should be determined. It was suggested that little relationship exists between cost allocation and needs. The traditional concept of "needs" is disappearing, and needs analysis is currently more strict. If needs are greater than expenditures, the difference is in depreciation of infrastructure, and that is a real cost.

There is a move toward more sophistication in estimating costs. Questions to be answered include what is the rate of return in estimation of future costs, and what is the right framework in which to estimate benefits?

Overall data on truck VMT does not match up well with fuel tax revenues. Data quality might

improve with ITS or use of transponders. With the increasing complexity of data, consideration must be given to how to record results according to breakdowns of variables. Much attention has been paid to how to transmit and communicate the results to legislatures. Transmission of data results needs to be done effectively.

There is a problem in data collection with mode-neutral measurements, such as passenger-car equivalents. The challenge is to quantify parallel facilities by finding comparable units of measurement. The validity of intermodal studies depend on units of measurement that have both commonality and neutrality between modes.

Estimating life-cycles of pavements is tied in with the need to build them with longer life spans by investing in resources that show return over the years, even if it means starting to charge for longer-life pavements. Without some kind of formal policy directive requiring States to do so, however, it will not get done. Federal incentives, if not orders, are required. Some cost allocation studies have a practical minimum pavement statement. A mistake is made when pavements are defined as a non-environmental factor.

Allocating Costs Among Vehicle Classes

User cost responsibility could logically be extended to include costs of transit, travel demand management, and ITS costs—those things that aim to get vehicles off the road. Reducing traffic reduces user costs, which would lead to a need to estimate resulting congestion. Estimates are not generally made of the effects of these programs in reducing traffic and user costs. Others question whether doing these things even leads to a reduction in congestion.

Research Needs and Recommendations

The group made the following recommendations for organization and research:

1. **Organization.** There should be a technical advisory committee that includes the States, and it should help shape the scope and direction of a new Federal study.
   - Involve industries, economists, engineers, State and local representatives, State DOT members, trucking and railroad industry representatives, and other interest groups.
   - Interest groups are defined as anyone who wants to be involved, including environmental groups, as well as everyday users of the highway system, including the Teamsters and the American Automobile Association.
   - The process should be open and supplemented by periodic review conferences to bring in more people.
   - Agreement should be pursued on study scope and issues to be addressed, but not taxes.
2. **Role of Marginal Cost and Marginal Cost Pricing.** Such costs should be known even if there is no specific way of implementing the results in Federal tax policies. It should therefore be an attendant part of any future study, but should not form its foundation.
   - Defining the scope of marginal costs depends on what is being done with the results. If marginal cost is a secondary issue, then the analysis does not have to be as thorough.
   - Focus on useful and transferable issues; the standard of relevance should be ease of implementation.
   - Too much attention to marginal cost pricing leads to social analysis having nothing to do with the transportation arena.
   - Marginal cost analysis is useful in making recommendations to Federal tax rates, to local level agencies in setting tolls, and to State and local governments implementing marginal cost pricing.
   - Although they are difficult to estimate, marginal benefits should also be analyzed in conjunction with marginal costs. If there are costs external to highways, there are external benefits as well.
   - Average costs should also be estimated, as they can be added up easily.

3. **Costs Occasioned.** This should form a major part of the study and should be performed in a way to facilitate comparison with the 1982 study. The methods should be better and the scope greater, and there should be a way to trace the changes resulting from improved methods, as opposed to changes due to societal differences.

   - One part of this study should be Highway Trust Fund expenditures.
   - Include all highway-related programs, including law enforcement functions.
   - Estimate all highway user charges, including those not used for highways. The question remains open as to whether to allocate these to vehicle classes. Highway user taxes need full evaluation.

4. **Required Research.** Needed research includes not only marginal cost pricing work, but also development of procedures for a maintenance/rehabilitation life-cycle approach, bringing future costs to present value. Areas needing research include:

   - Pavement and bridge cost responsibility.
   - Use of different methods and interrelationships affecting cost responsibility.
   - Searching for an optimal construction/maintenance/rehabilitation program mix.
   - Comparing alternative ways of costing out infrastructure, including the cost of underfunding initial work and subsequent reconstruction, as compared to the cost of replacement approach.
   - Considering the user-cost impact of neglecting the investment in infrastructure by deferring maintenance: who pays for the costs incurred? What is the impact of allowing deferred maintenance to grow?
   - Updating all 1982 procedures for allocating grading and drainage, right-of-way, cost allocation, and highway width to make sure the future study will be comparable with previous studies, so that changes in these areas can be accurately reflected.
   - Update the relationship between registered weights and over-the-road weights.

5. **Multimodal.** Multimodalism issues that should be addressed include intermodal connectivity and the impact of user fees on diversion to other modes and effects on other modes.

   - Estimating the cost of intermodal connectivity—containers going from rails to tractors, for example—elements of enforcement, pricing, and user costs. Analyze the impediments to intermodal transportation, and estimate the costs of providing access and of delays to users. What are the costs and how should they be allocated?
   - Cost allocations should reflect the diversions and cross-subsidies between modes due to tax structure and pricing, and the impact of diversion on the other modes.

6. **Flexibility of Funding.** ISTEA leads to funding uncertainties which require the use of alternative scenarios, including longer-run projections of programs.

   - In crafting short-range and long-range scenarios, survey the States to gain an understanding of what the likely ones will be.
   - Consider alternative revenue sources, such as tolls, impact fees, and private roads.
   - Analyze enhancements based on what is currently being done.

7. **Taxes.** The cost to the public and the private sector of paying (or avoiding) taxes needs to be analyzed, as road user charges must meet the standard of ease of implementation and the full costs of collection.

   - Marginal cost analysis should be used as a tool to determine the most efficient pricing system, while recognizing that the results cannot be implemented precisely today because there is no feasible tax collection structure for it.
   - The cost allocation study should include an analysis of ease of implementation.

Conclusion

The highway cost allocation workshop, sponsored by FHWA, in cooperation with AASHTO, was successful in bringing together individuals with a variety of viewpoints and perspectives and eliciting useful information and advice related to the next Federal highway cost allocation study. Participants heard paper and panel presentations that focused the issues and generated needed debate on the many factors that an updated cost allocation study must consider. Open discussion periods following the presentations prompted lively participation from the audience and ensured the workshop was an interactive one. Participants also met in small breakout groups on both days to identify issues and make specific recommendations with regard to cost allocation. These small group meetings were highly productive and resulted in specific steps and strategies that conference sponsors will consider in planning the next cost allocation study.

Several main focus areas guided this two-day dialogue and prompted useful analysis of cost allocation issues. Presentations reviewed past studies conducted at the Federal and State levels, highlighted emerging issues and alternative approaches, and made the audience mindful of the complex and interrelated technical issues that must be considered in a new transportation era. Issues raised included the cost allocation implications provided by ISTEA, competing equity and efficiency goals of cost allocation, the potential magnitude and breadth of the study, the range of government levels it should address, and various methods of approach, including consideration of incremental, marginal cost, and benefits approaches.

Several suggestions were made during general presentations that were refined during breakout sessions. A variety of practitioners urged that the next cost allocation study address the multiple levels of government and include all expenditures related to highways. Several participants mentioned as a real concern the lack of sound, reliable data needed to inform such decisions at the State level. The use of advisory groups at both State and Federal levels was strongly recommended as a valuable method for enhancing the study and improving its methodologies. Guarded recommendations were made for the study to use some type of alternative approach to cost allocation, whether marginal or benefits-based or a combination. The general feeling seemed to hold that the time is not yet right for a full integration of these approaches in the quantification of costs.

Breakout sessions reiterated many of the cross-cutting issues raised in the plenary sessions. They emphasized again the need for explainable, defensible study methods, the need to deal with elements related to ISTEA program expansions, and the need to determine how to integrate alternative costing methods. A common recommendation from the breakout groups was to ensure the Federal study's applicability and usefulness to individual States. They also called for standardized and improved data and study results that can be communicated to and understood by legislators and policy makers. Advisory groups would be helpful in this regard. The breakout groups also identified many research needs for the study to consider, including multimodal feasibility, the interplay of private sector facilities, the handling of social and political externalities, procedures for maintenance and rehabilitation, and the distribution effects of user fees and taxes.

Federal and State sponsors were gratified with the workshop's results and feel their work is "cut out for them" in planning the next study. The two-year time frame is ambitious, given the multiple and complex layers the study will seek to address, but all recommendations will be thoughtfully considered and, if not explicitly integrated in the next update, applied to future discussions of highway cost allocation.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1995 – 387 - 554 / 35771

Publication No. FHWA-PL-95-039
HPP-12/6-95(2.5M)E