TRANSPORTATION RESEARCH DIGEST

APRIL 2008

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TO: TRANSPORTATION PROFESSIONALS, MANAGERS, & POLICY MAKERS

FROM: ARIZONA TRANSPORTATION INSTITUTE

The volume of information on transportation issues, policies, technologies, and related topics is huge. Not even the most well-read professional can keep up with everything that might be useful to know. The *Transportation Research Digest* series is designed to expedite the transmission of information by condensing and summarizing significant documents. Busy professionals or managers may quickly obtain the gist of new developments and determine whether they need to see the full document.

The *Transportation Research Digest* is not meant to present definitive resolutions of scientific or policy controversies, but contributions to the pursuit of knowledge and the debate of issues. The intent is to be comprehensive rather than conclusive on the multitude of issues and topics of concern to those working in the field of transportation. Readers are encouraged to obtain the original document summarized in the *Transportation Research Digest* and subject the content to their own judgment.

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A "Topic" code in the Table of Contents will help readers more quickly identify items of interest. The topic codes are explained in the table below.

Code	Topic	Code	Topic
ADM	Administration	PLAN	Planning
AIRP	Airports	PRIV	Privatization
AVIA	Aviation	RAIL	Railroads
BIKE	Bicycles	RDSD	Roadside
CON	Construction	ROW	Right-of-Way
ECON	Economics	SAFE	Safety
ENV	Environment	STR	Structures
FIN	Finance	TECH	Technology
INOV	Innovations	TOLL	Toll Roads
MAIN	Maintenance	TRAN	Transit
MISC	Miscellaneous	TRF	Traffic
MVD	Motor Vehicle Dept	TRK	Trucking
PAVE	Pavement	VEH	Vehicles

Requests or inquiries may be made via e-mail (jsemmens@cox.net).

Thank you.

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FIN/ distance- based user fees	***So Simple It Could Work! The Oregon Road User Fee Concept: Lessons Learned from the Pilot Program*** by Jim Whitty, Betsy Imholt and Deborah Hart Redman *in Transportation Research Board, 87th Annual Meeting, January 13-17, 2008, Washington, DC.* (Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001; (202) 334-3213; http://gulliver.trb.org/bookstore). The main barrier to implementing a mileage fee is lack of agreement on strategy. It is already technologically feasible.	23-24
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Increased Reliance on Contractors Can Pose Oversight Challenges for Federal and State Officials (United States Government Accountability Office (GAO), 441 G Street NW, Room LM, Washington, D.C. 20548; JayEtta Z. Hecker at (202) 512-2834 or heckerj@gao.gov; http://www.gao.gov/new.items/d08198.pdf) (Jan 2008)

Highlights

- State DOTs also face challenges in conducting adequate oversight and monitoring in the use of consultants.
- Increased use of consultants has eroded in-house expertise, impairing the state DOTs' ability to adequately oversee the work.
- While the FHWA has identified these risks, it has not assessed how it needs to adjust its oversight to protect the public interest.

Pressure on state and local governments to deliver highway projects and services, and limits on the ability of state departments of transportation (state DOTs) to increase staff levels have led those departments to contract out a variety of highway activities to the private sector. As requested, this report addresses (1) recent trends in the contracting of state highway activities, (2) factors that influence state highway departments' contracting decisions, (3) how state highway departments ensure the protection of the public interest when work is contracted out, and (4) the Federal Highway Administrations' (FHWA) role in ensuring that states protect the public interest. To complete this work, GAO reviewed federal guidelines, state auditor reports, and other relevant literature; conducted a 50-state survey; and interviewed officials from 10 selected state highway departments, industry officials, and FHWA officials.

State DOTs have increased the amount and type of highway activities they contract out to consultants and contractors. State DOTs are also giving consultants and contractors more responsibility for ensuring quality in highway projects, including using consultants to perform construction engineering and inspection activities as well as quality assurance activities. Many state officials reported that they expect the amount of contracted highway activities to level off over the next 5 years, due to factors such as uncertain highway program funding levels.

State DOTs indicated that the most important factor in their decision to contract out highway activities is the need to access the manpower and expertise necessary to ensure the timely delivery of their highway program, given in-house resource constraints. Officials said that they must contract out work to keep up with their highway programs. Of the 50 departments that completed GAO's survey, 38 indicated that they have experienced constant or declining staffing levels over the past 5 years. While state DOTs consider cost issues when making contracting decisions, cost savings are rarely the deciding factor in contracting decisions, and none of the 10 departments that GAO interviewed had a formal process in place for systematically assessing costs and benefits before entering into contracts.

State DOT officials that GAO interviewed believe that they have sufficient tools and procedures in place to select, monitor, and oversee contractors to ensure that the public interest is protected. However, implementation of these mechanisms is not consistent across states, and state auditors reported weaknesses in several states. State DOTs also face additional challenges in conducting adequate oversight and monitoring, given current trends in the use of consultants and contractors. For example, while state employees are always ultimately responsible for highway project acceptance, they are increasingly further removed from the day-to-day project oversight. Officials from all 10 state DOTs that GAO interviewed said that current trends may lead to an erosion of in-house expertise that could affect the state DOTs' ability to adequately oversee the work of contractors and consultants in the long term.

Because states have broad latitude in implementing the federal-aid highway program, FHWA has a limited role in states' use of consultants and contractors. Typically, FHWA's focus is on ensuring that state DOTs are in compliance with federal regulations when contracting out, such as ensuring that federal bidding requirements are met. FHWA has conducted both local and national reviews that have also identified various risks related to the increased use of consultants, including weaknesses in state quality assurance programs and an increased potential for conflicts of interest. While FHWA has identified these risks, it has not comprehensively assessed how, if at all, it needs to adjust its oversight efforts to protect the public interest, given current trends in the use of consultants and contractors.

What GAO Recommends

GAO recommends that the Secretary of Transportation work with FHWA division offices in targeting their oversight activities to give appropriate consideration to identified areas of risk related to the increased use of consultants and to develop performance measures to help evaluate the effectiveness of state controls. The Department of Transportation did not comment on GAO's recommendation, but provided technical clarifications, which GAO incorporated as appropriate.

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Design Considerations for Flexible Pavement Widening by Stacy Hilbrich and Tom Scullion, Texas Transportation Institute, Texas A&M University System, College Station, Texas 77843-3135 (Texas Department of Transportation, Research and Technology Implementation Office P.O. Box 5080, Austin, Texas 78763-5080; 979.845.1734; http://tti.tamu.edu) (Apr 2007)

Highlights

- This study concluded with a site-specific approach to selection of proper material use and/or reuse, construction technique, and traffic control to warrant rapid construction and long term stability of the widened pavement.

The purpose of TxDOT Project 5429, "Considerations for Flexible Pavement Widening Projects," was to address design considerations in selecting the appropriate technique when widening an existing pavement. The major pavement-related issues with widening are as follows:

- Widening can be fairly narrow, say 2 to 4 feet on either side of an existing highway. It is often difficult to get normal compaction equipment to compact this narrow of a strip. Guidelines are required on what equipment is required to adequately complete compaction.
- How can the quality of widened sections be inspected?
- The widened section often becomes the place where trucks outer wheels run; any variations in density/quality will be quickly exposed. The widened area should have equal or better structural strength than the existing pavement.
- The widening often leaves a vertical construction face between the old and new structure, which trucks run directly over.
- Some districts have experienced problems with widening sections with different base materials. This method can cause a situation where moisture can be trapped in the original structure. Some districts have adopted a "matching cross-section" philosophy; others have not.
- Where and when should stabilization of the existing subgrade be performed? Which stabilizer and what percentage should be used?
- When full-depth reclamation of the existing roadway is used as the first step in the widening process, some districts have reported problems with severe longitudinal cracking. These problems have been studied, and some districts have adopted practices to minimize these problems.

Several other design and safety issues exist, such as: tying into existing structures and widening steep side slopes.

A large portion of this project involved an extensive literature review, in which researchers obtained information regarding the various design and construction issues in pavement widening. This chapter provides a detailed summary of the literature review. The review is organized according to the following key areas:

- Stabilization,
- Pavement Edgedrains and Subsurface Drainage,

- Longitudinal Construction Joints,
- Pavement Edge Drop-Offs,
- Construction Equipment, and
- Embankment Widening.

A survey of TxDOT pavement engineers and maintenance personnel was also conducted to catalog the various strategies for widening flexible pavements. The survey primarily focused on strategies used when widening under different circumstances, such as: widening a flexible pavement in good condition, widening a flexible pavement in poor condition, and widening a jointed concrete pavement; and typical construction drawing were obtained for each case. This survey is included in the Appendix. More specifically, this survey sought to identify strategies regarding:

- structural evaluation;
- pavement coring and field testing;
- typical sections used; and
- inspection methods and quality control.

This study concluded with a site-specific approach to selection of proper material use and/or reuse, construction technique, and traffic control to warrant rapid construction and long term stability of the widened pavement. These findings are summarized into a flexible pavement widening guideline, which is provided in TxDOT Product 0-5429-P2.

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Guidelines for the Use of Ground Penetrating Radar (GPR) and Portable Seismic Property Analyzer (PSPA) in Full Depth Reclamation Projects by Rajib B. Mallick; Kenneth Maser, Soheil Nazarian, Worcester Polytechnic Institute (WPI), Civil Environmental Engineering Department, 100 Institute Road, Worcester, MA 01609 (Maine DOT, 16 State House Station, Augusta, ME 04333-0016) (Apr 2007)

Highlights

- Guidelines for the use of GPR and PSPA for design of full depth reclamation projects are provided.

Full Depth Reclamation (FDR) of existing asphalt pavements into base courses has become an attractive option of rehabilitation for state Departments of Transportations (DOTs). In the FDR process, the properties of the constructed foamed asphalt (FA) and plant mix recycled asphalt pavement (PMRAP) layer are significantly dependent on the existing materials. At present, accurate information regarding moduli of FA and PMRAP are not available to Maine DOT.

The objectives of this study were to develop and recommend practical methods to: 1. Determine stiffness of foamed asphalt and PMRAP layers with the help of the Portable Seismic Pavement Analyzer (PSPA), 2. Determine the pre-construction pavement layer structure, and the variations of that structure throughout the project with the help of Ground Penetrating Radar (GPR) and 3. Check the post-construction thickness of the reclaimed layers with the help of GPR. The scope of work consisted of using a GPR and a PSPA in several MDOT recycling projects, before and after recycling, analyzing the data, and developing conclusions and recommendations.

GPR works using short electromagnetic pulses radiated by an antenna which transmits these pulses and receives reflected returns from the pavement layers. In this study the GPR had a dual role, first to determine thickness of different layers prior to recycling, to help take cores at significantly different areas, to conduct a proper mix design, and second, to check the depth of reclamation, immediately after recycling. GPR testing was carried out on projects prior to rehabilitation and on projects just after rehabilitation.

GPR testing was carried out using a vehicle-mounted 1 gigahertz (GHz) horn antenna GPR system. The data was analyzed to develop thickness profiles. The depths, as recorded by borings show the utility of the GPR data for segmentation of a project on the basis of correct pavement layer thickness, for mix design and construction. .

The data of pavement depth obtained from both the GPR and the boring data show that while the average values are generally similar, both sources of data show high variability, a fact that suggests that the GPR (analyzed at every foot) is more able to capture the details of this variability. The analysis clearly shows the need of using GPR, to get continuous and accurate depth data, at traffic speed, to make sure that the designs are appropriate for specific rehabilitation projects.

As part of this project, an automated GPR analysis technique has been investigated. This automated technique seeks to simplify the data analysis by highlighting the predominant pavement features over a length of the pavement section. This process has also been structured to eliminate the need to directly interact with the GPR data, and thus could be available to a wider range of DOT personnel. Finally, the automated processing technique provides a means for characterizing the pavement layer structure prior to the availability of core data. The layer structure determined from the automated processing can then be finalized when core data becomes available.

The PSPA is a rapid nondestructive testing device that provides the modulus of the top pavement layer in real-time. The data analysis procedure uses. the surface wave energy to determine the variation in modulus with wavelength.

In this study, two tasks were accomplished: 1. The use of PSPA for rapid determination of modulus of reclaimed layers during construction was demonstrated, and 2. A procedure was developed to utilize the PSPA to determine the modulus of Full Depth Reclaimed base layers underneath HMA.

Testing of projects during reclamation behind the reclaimer (for FDR)/paver (for PMRAP) showed that the procedure is fast, nondestructive and can be conducted by one person. Testing was done and the data was corrected and reduced in terms of temperature and seismic-to-design modulus. The variation in the collected data can be used as an indicator of the quality of the recycling operation, and any out of the ordinary test data would indicate a potential problem. Since in base recycling with foamed asphalt or emulsion there is sufficient workability of the material to allow for reworking, any deficiency can be corrected before the application of the HMA layer. This method should be followed for continuous monitoring of the pavement during recycling work.

The modulus versus wavelength plot (dispersion curve) provided by the PSPA is used to estimate the modulus profile versus depth. The actual modulus profile differs from this approximation, and previous researchers have used a back-calculation process to recover this true variation. To eliminate the back-calculation process, an innovative method was developed in this study. A series of simulations was carried out to relate the ratio of the composite modulus of the top two layers to modulus of the top layer to the ratio of the actual surface wave velocities of the top and second layer. In these simulations, the velocity of the top layer was maintained constant and the velocity of the base was varied from 20% to 100% of the velocity of the top layer. The resulting best fit curve was used to directly estimate the actual modulus of the base, knowing the modulus of the top layer and the composite modulus of the top two layers.

The developed procedure was evaluated with extensive testing and analysis of data. The evaluation program consisted of performing Falling Weight Deflectometer tests on a selected uniform section (ascertained through the use of GPR and MDOT data) of each route at multiple load levels, and with PSPA.

From the analysis of data obtained from FWD, GPR and PSPA the following conclusions can be made: 1. The seismic testing and a proposed analysis method can provide reliable estimates of moduli of reclaimed layers in HMA surface pavements. 2. The process is fast and hence can be used to collect a large number of data - something that is very important for layers which exhibit a large variation in properties. 3. The predicted moduli can be used effectively in mechanistic empirical design of pavement structures. 4. The seismic method presented in this study should be used on a regular basis to develop a large database of in-place layer moduli for pavements with thin HMA surface for use in mechanistic-empirical design methods.

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Air Quality in America by Joel M. Schwartz & Steven F. Hayward (American Enterprise Institute, 1150 Seventeenth Street, N.W., Washington, DC 20036; phone 202-862-5800; http://www.aei.org/books/bookid.918,filter.all/book_detail.asp) (Dec 2007)

5 Key Findings

- The nation has sharply reduced air pollution levels, despite large increases in nominally "polluting" activities.
- Areas of the nation with the highest pollution levels have improved the most.
- Air quality will continue to improve.
- Regulators and environmental activists exaggerate air pollution levels and obscure positive trends.
- Air pollution affects far fewer people, far less often, and with far less severity than is commonly believed.

Opinion polls routinely find that a majority of Americans believe air quality has deteriorated and will worsen in the future, and that most people face serious risks from air pollution. Public and elite perception of air pollution levels, trends, and health risks, however, is virtually the opposite of reality. America reduced air pollution dramatically throughout the 20th century to only a fraction of past levels, and the country now enjoys relatively good air quality. Even the worst areas have far better air quality than was typical of American cities during the 1950s, '60s, or '70s.

A wide array of data attests to our success in getting rid of most air pollution and to the continuing decline in emissions from motor vehicles and industry. Already-adopted measures ensure the elimination of most remaining emissions during the next two decades. Furthermore, Americans were improving air quality in their communities for decades before the federal government nationalized air regulation with the Clean Air Act Amendments of 1970.

Several factors account for public and media misperceptions about air quality. Air pollution comes in many forms, from many sources, and varies over time and location, even within a given metropolitan area. Regulatory standards and requirements are complex and arcane. Progressive tightening of standards for some pollutants can make pollution seem to be increasing even when it is declining. These intricacies can make the topic a difficult one for the layperson to follow.

However, the most important factor in public misperception is the role of environmental groups and regulatory agencies, which exaggerate air pollution levels and health risks and often obscure positive trends, and news media that report these misleading representations with little or no critical review.

One might ask why it matters if Americans' pessimism and fears about air pollution are groundless. After all, regardless of the size of the risks, doesn't every reduction in pollution make people better off?

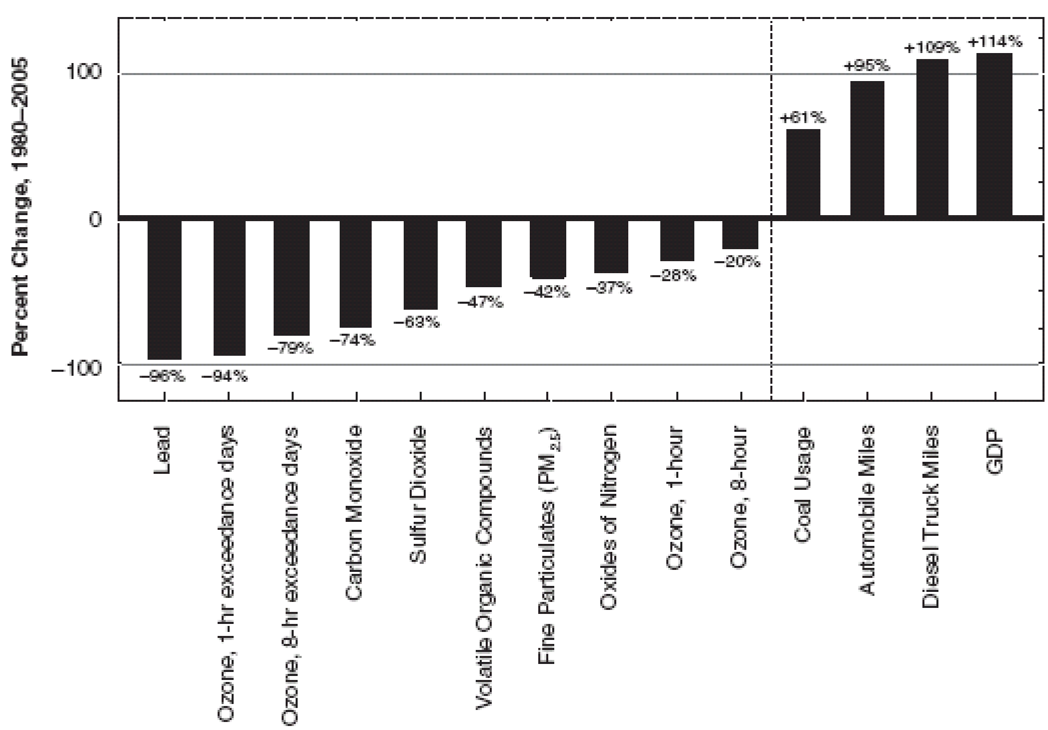
This would be true if air pollution were the only risk we faced, and if reducing it were free. We face many threats to our health and safety and have limited resources with which to address them. If we devote excessive resources to one exaggerated risk, we are less able to counter other, genuinely more serious risks, or to spend our resources on other important needs and desires, such as health care, education, and housing.

Indifference to public misperceptions about air pollution would also be reasonable if the Clean Air Act (CAA), which created our current system of federal control of air pollution policy, were a resounding success. Such a view is mistaken. Air quality has indeed improved since the 1970 passage of the CAA. But it was improving at about the same pace for decades before the act was passed, and without the unnecessary collateral damage caused by our modern regulatory system.

While air quality has greatly improved over the last few decades, we've paid far more than necessary to get there. A few emission-reduction requirements—mainly for motor vehicles and power plants—account for the vast majority of improvements since passage of the Clean Air Act. Yet most regulatory activity involves creating and complying with administrative and other process requirements. Furthermore, our regulatory system often devotes great resources toward small, expensive, slow, and ineffective pollution-reduction measures, while ignoring opportunities for large, cheap, and rapid improvements. And as the potential health and other benefits of each increment of pollution reduction have become ever smaller, the incremental costs have continued to grow.

The book concludes with an analysis of how conflicts of interest inherent in federal air regulation have resulted in a regulatory system that harms the people it claims to be helping. The public's interest lies in sufficiently clean air, achieved at the lowest possible cost. But federal air quality regulation suffers from incentives to create requirements that are unnecessarily stringent, intrusive, bureaucratic, and costly.

TRENDS IN MILES DRIVEN, ENERGY PRODUCTION, AND ECONOMIC ACTIVITY VS. TRENDS IN AIR POLLUTION LEVELS, 1980–2005



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Highway Public-Private Partnerships: More Rigorous Up-front Analysis Could Better Secure Potential Benefits and Protect the Public Interest (United States Government Accountability Office (GAO), 441 G Street NW, Room LM, Washington, D.C. 20548; JayEtta Z. Hecker at (202) 512-2834 or heckerj@gao.gov; http://www.gao.gov/new.items/d0844.pdf) (Feb 2008)

Highlights
- Public-private partnerships have resulted in advantages for state and local governments, such as obtaining new facilities and value from existing facilities without using public funding.
- Highway public-private partnerships protect the public interest largely through concession agreement terms prescribing performance and other standards.

The United States is at a critical juncture in addressing the demands on its transportation system, including highway infrastructure. State and local governments are looking for alternatives, including increased private sector participation. GAO was asked to review (1) the benefits, costs, and trade-offs of public-private partnerships; (2) how public officials have identified and acted to protect the public interest in these arrangements; and (3) the federal role in public-private partnerships and potential changes in this role. GAO reviewed federal legislation, interviewed federal, state, and other officials, and reviewed the experience of Australia, Canada, and Spain. GAO's work focused on highway-related public-private partnerships and did not review all forms of public-private partnerships.

Highway public-private partnerships have resulted in advantages for state and local governments, such as obtaining new facilities and value from existing facilities without using public funding. The public can potentially obtain other benefits, such as sharing risks with the private sector, more efficient operations and management of facilities, and, through the use of tolling, increased mobility and more cost effective investment decisions. There are also potential costs and trade-offs—there is no "free" money in public-private partnerships and it is likely that tolls on a privately operated highway will increase to a greater extent than they would on a publicly operated toll road. There is also the risk of tolls being set that exceed the costs of the facility, including a reasonable rate of return, should a private concessionaire gain market power because of the lack of viable travel alternatives. Highway public-private partnerships are also potentially more costly to the public than traditional procurement methods and the public sector gives up a measure of control, such as the ability to influence toll rates. Finally, as with any highway project, there are multiple stakeholders and trade-offs in protecting the public interest.

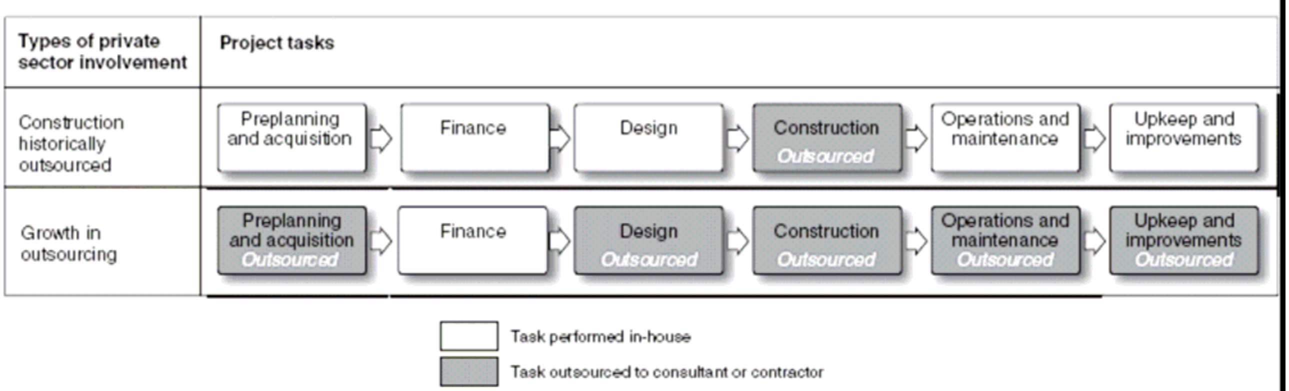
Highway public-private partnerships GAO reviewed protected the public interest largely through concession agreement terms prescribing performance and other standards. Governments in other countries, such as Australia, have developed systematic approaches to identifying and evaluating public interest and require their use when considering private investments in public infrastructure. While similar tools have been used to some extent in the United States, their use has been more limited. Using up-front public interest evaluation tools can assist in determining expected benefits and costs of projects; not using such tools may lead to aspects of protecting the public interest being overlooked. For example, while projects in Australia require consideration of local and regional interests, concerns by local governments in Texas that they were being excluded resulted in state legislation requiring their involvement.

While direct federal involvement has been limited to where federal investment exists, and while the Department of Transportation has actively promoted them, highway public-private partnerships may pose national public interest implications such as interstate commerce that transcend whether there is direct federal investment in a project. However, given the minimal federal funding in highway public-private partnerships to date, little consideration has been given to potential national public interests in them. GAO has called for a fundamental reexamination of federal programs to address emerging needs and test the relevance of existing policies. This reexamination provides an opportunity to identify and protect potential national public interests in highway public-private partnerships.

What GAO Recommends

Congress should consider directing the Secretary of Transportation, in consultation with Congress and other stakeholders, to develop objective criteria for identifying potential national public interests in highway public-private partnerships. The Department of Transportation raised concerns and disagreed with several of the findings and conclusions, as well as one of the recommendations. GAO clarified the report and continues to believe more rigorous up-front analysis could better protect public interests.

Figure 2: Evolution of Private Sector Involvement with Highway Projects



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I'll Tell You What I Think! A National Review of How the Public Perceives Pricing by David Ungemah and Tina Collier *in Transportation Research Record 1996* (Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001; (202) 334-3213; http://gulliver.trb.org/bookstore) (2007)

Highlights
- Positive post-implementation feedback indicates broad public acceptance of value pricing.
- Negative reactions to the concept of tolling can be overcome through careful and deliberate planning, documentation, and public education on the specific characteristics of proposed projects and pricing policies.

The concept of tolling is new in many states, and proposed road pricing projects have inevitably been at least somewhat controversial everywhere they have been considered. It has taken a considerable amount of time to nurture public and political support in states in which such projects have been implemented. At the beginning of each project, public opinion has generally been lukewarm at best. It is only through the congested efforts of agency champions, project managers, and political leaders that public opinion on pricing programs has grown progressively more positive.

Public acceptance of toll roads, managed lanes, and other such programs is often more elusive than expected. One explanation for the low levels of acceptance is that the nature of government in the United States makes it inherently biased against significant policy changes. The closer any agency is to implementing a new toll facility, the greater the risk of a last-minute withdrawal of political support due to public opposition (5). This scenario can be found to have played out in certain cases in almost every state, whether in areas with or without existing toll roads. In Texas, for example, toll roads and managed lanes have been implemented with relatively little controversy in Houston and Dallas, while significant public opposition in San Antonio, Austin, and Waco has made political support for such programs tenuous at best.

A variety of factors contribute to the controversy that often surrounds road pricing and other toll programs, including concerns over equity for low-income individuals, geographic distribution of toll benefits and burdens, privacy issues related to electronic toll collection, and charges of double taxation of the public highway system. Every proposed toll corridor will have dedicated user groups (including commuters, transit riders, and truckers) that expect their own interests to be protected at all costs. Experience across the United States has shown that toll projects are easy targets for critics, which exacerbates the problem of last-minute withdrawal of support. Headlines are often critical of new concepts, while lead stories countering misperceptions about tolling and road pricing programs are rare. Similarly, it is often easy for a politician to make a name for him- or herself by criticizing and even legislating against toll roads and managed lanes, as has happened in the past in Minnesota and Maryland.

Conclusions

The value pricing and tolling projects discussed in this paper have used various methods to measure public acceptance. The I-15 evaluation study pioneered efforts in evaluating public perception of value pricing, placing particular emphasis on the attitudinal and behavioral aspects of both users and nonusers of the program. As the data gathered provided important insight into the public acceptance of HOT lane projects, this has also become a standard evaluation technique for Minnesota and Colorado. These projects provide a significant lesson in public acceptance of value pricing: initial skepticism and open opposition to the pricing concept did not prevent the planners from carefully and judiciously moving forward. In the end, positive post-implementation feedback in all three states revealed a general reversal in public opinion regarding the concept of pricing in HOV lanes.

New toll roads, lanes, and bridges often face a different type of scrutiny from the public-a debate over whether such a facility should even be built. Ideally, the questions surrounding this issue should be addressed in the purpose and need analysis, alternatives assessment, and environmental documentation. Tolling may emerge in this process in multiple roles--first in the alternatives assessment, in which congestion pricing may influence the need for new capacity; and then again in the environmental documentation, in which tolling can be used to help finance roadway improvements (either retrofits or new construction). This distinction may make sense in the context of comprehensive transportation planning, but the realities of moving toward implementation are likely to make the situation more complicated. Proponents of tolling as a means of controlling congestion may become opponents of tolling if it is seen as a means to fund new capacity. This distinction can be confusing to the public and to policy makers. Again, negative reactions to the concept of tolling can be overcome only through careful and deliberate planning, documentation, and public education on the specific characteristics of proposed projects and pricing policies.

The political nature of a community and its interest groups should be considered, but it should also be noted that political climates can change rather drastically in the right circumstances. In 1978, the California State Transportation Board suggested that "users should be required to pay a fair share of the costs that occur from their use [of transportation facilities]." But at the time, this idea was strongly opposed by interest groups. Tolling in this part of California has since come to receive wide support, as evidenced by the success of the SR-91, I-15, and SR-125 projects.

According to the authors of *Road Pricing for Congestion Management*, to be politically acceptable, projects should

- Be fairly simple in design,
- Build incrementally on previous arrangements or experience,
- Address clearly understood and widely supported objectives, and
- Be characterized by transparent financial flows that facilitate public trust in the use of the revenues generated.

Projects that have failed to become reality, or are experiencing high levels of controversy, generally fail to meet one or more of these criteria. The successful tolling and value pricing projects implemented thus far exhibit these qualities and consequently enjoy a high level of public support.

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APRIL 2008

Measuring the Impact of Fuel Tax Exemptions on the Highway Trust Fund by William McDonald & Jeffrey Short *in Transportation Research Board, 87th Annual Meeting, January 13-17, 2008, Washington, DC.* (Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001; (202) 334-3213; http://gulliver.trb.org/bookstore).

Highlights

- Combined, revenues lost due to fuel tax exemptions and refunds total, at a minimum, $907 million and estimates place the figure closer to $1.5 to $2 billion.

Much of the current debate on transportation in the United States has focused on the means of funding the increasingly complex, urban, and expensive highway infrastructure that will be necessary for the nation to remain economically competitive over the next half-century. One belief often voiced in this debate is that the federal Highway Trust Fund (HTF), the principal federal funding mechanism of highway infrastructure improvement, maintenance and construction, is outmoded and will be unable to meet the ensuing demand for highway capacity over the coming decades.

The HTF, established through the Federal Highway Act of 1956, provides revenue to states for building and maintaining transportation infrastructure. Approximately 90 percent of the federal Highway Trust Fund (hereafter referred to as the federal HTF) is derived from excise taxes on gasoline, diesel and other fuels. Unlike many other taxes levied on the sale of goods, the motor fuel tax is based on the quantity purchased and is not determined by calculating a percentage of the sale price. Current tax rates have remained unchanged since 1993, at $0.184 per gallon of gasoline and $0.244 per gallon of diesel fuel. In addition to the federal HTF, each state operates a state highway trust fund for maintenance of state roadways. These programs mirror the federal HTF to greater or lesser degrees, but each is funded primarily by state taxes on motor fuels, the rates of which vary by state.

As part of a larger study of highway funding in the United States, the American Transportation Research Institute (ATRI) conducted an intensive investigation of how the Highway Trust Fund is administered in its current form and what changes could be made to improve its revenue collection attributes. Central to this analysis was an investigation of the value of revenue lost from system users not paying into the HTF and diversions from the HTF for non-transportation uses. The former group includes federal, state, and local governments, public transit agencies, school districts, the US Postal Service and select charitable organizations; the latter includes diversions to the Mass Transit Account, the Leaking Underground Storage Tank (LUST) Trust Fund, and other non-highway programs.

This paper focuses on accounting for the revenues that are lost from federal and state HTFs on an annual basis due to entities being either exempt from paying fuel taxes or eligible for tax refunds. Combined, revenues lost due to fuel tax exemptions and refunds total, at a minimum, $907 million and estimates place the figure closer to $1.5 to $2 billion.

Total Annual Federal and State Fuel Tax Exemptions			
	Federal Exemptions	**State Exemptions**	**Total**
Government Use Vehicles	$363,000,000	$155,000,000	**$518,000,000**
School Bus Use	$146,000,000	$126,000,000	**$272,000,000**
Transit Use	$61,000,000	Unknown	**$61,000,000**
Federal Use	N/A	$29,000,000	**$29,000,000**
USPS	N/A	$27,000,000	**$27,000,000**
Charitable Organizations	Unknown	Unknown	**Unknown**
Total	$570,000,000	$337,000,000	**$907,000,000**

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So Simple It Could Work! The Oregon Road User Fee Concept: Lessons Learned from the Pilot Program by Jim Whitty, Betsy Imholt and Deborah Hart Redman *in Transportation Research Board, 87th Annual Meeting, January 13-17, 2008, Washington, DC.* (Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001; (202) 334-3213; http://gulliver.trb.org/bookstore).

Highlights

- The Oregon concept is designed to replace the fuel tax for participating vehicles.
- The main barrier to implementing a mileage fee is lack of agreement on strategy. It is already technologically feasible.

The 2001 Oregon Legislature established the Road User Fee Task Force "to develop a design for revenue collection for Oregon's roads and highways that will replace the current system for revenue collection." After considering 28 different funding ideas, the Task Force recommended that the Oregon Department of Transportation (ODOT) conduct a pilot program to study two strategies: (1) the feasibility of replacing the gas tax with a mileage based fee collected at fueling stations and (2) the feasibility of using this mileage fee collection platform for collecting congestion charges.

The Oregon Mileage Fee Concept is an alternative and new way to raise revenue for the state's road system that has recently been proven technologically. It has been demonstrated to be administratively feasible and affordable, and easy for the motorist. Furthermore, as Congressman Oberstar remarked following an ODOT staff presentation at the 2005 Oberstar Transportation Forum in Minneapolis, "It is so simple."

It is a simple system. An on-board unit identifies zones for the categorization of miles driven. Then, at the fuel pump, the stored mileage totals driven in each zone are electronically transferred to the station's point of sale system where the mileage fee rates are applied and the customer is presented with a bill for payment that includes both the mileage fee and the fuel purchase price. The seamless introduction of payment of a mileage fee at the pump requires nothing new from motorists. Drivers pay for road use the same way, but based on a different calculation.

The Oregon concept is designed to replace the fuel tax for participating vehicles, essentially to provide a stop loss for the predicted decline in gasoline tax revenues owing to increased fuel efficiency and use of alternative fuels over the next few decades. The platform employed, however, is also infinitely flexible and could facilitate easy transition to an entirely new road finance system, a paradigm shift that has commenced in Europe and is poised to begin in the United States. Not only can this platform accommodate pricing options at the county or city level, more important, this platform can accommodate congestion pricing without tolling or photographic infrastructure. The London or Stockholm cordon pricing structures are not the only options. There are even more creative structures such as time-of-day distance charges within a cordon (i.e. known as area pricing) or point tolls that can allow pricing of individual highways or on-ramps to existing freeways. The congestion pricing systems could be appropriately tailored to fit the individual natures of our urban economies and the varied, migratory patterns of motorists in the United States.

Additional development and testing need to take place in order to prepare for full implementation including: resolving technical issues, expanding the concept to include home fueling, tolling and multi-state integration, and developing cost estimates for full implementation. This will include an operational test, simulating a multi-state mileage fee and congestion pricing system.

The critical pathway to national implementation passes through the automobile manufacturers, the fuel distribution industry and the motoring public. Automakers must accept new vehicle technology. Fuel retailers must accept new electronic transactions. The motoring public must accept a new paradigm for generating revenue for our nation's road system.

The mileage fee is not yet ready for implementation on either a local, state or national basis. But this has more to do with lack of agreement on strategy than an absence of technological refinements for the vehicles, and fuel pump collections may take up to five years to develop. With massive commitment of resources and energy a mileage fee might be ready to implement in five to six years. Realistically, however, strategy agreement, public acceptance, industry acceptance and installation may take 10 years or longer. Implementation could therefore begin about 10 years from now, on a phased basis, with revenue benefits occurring immediately. Since retrofitting is not yet viable, a phased implementation is necessary as only new vehicles would contain the required technology. Complete implementation, meaning application to every vehicle, would occur over a 25 to 30 year period.

It is critical to note that while the mileage fee may not be ready for national implementation in the short term, the work necessary to prepare for implementation in the long term must begin immediately. The longer that preparation is delayed, the later national implementation and benefits to road users, communities and all transportation-dependent sectors of the economy are deferred.

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Evaluation of Ride Specification Based on Dynamic Load Measurements from Instrumented Truck by Emmanuel G. Fernando, Gerry Harrison, and Stacy Hilbrich, Texas Transportation Institute, Texas A&M University System, College Station, Texas 77843-3135 (Texas Department of Transportation, Research and Technology Implementation Office P.O. Box 5080, Austin, Texas 78763-5080; 979.845.1734; http://tti.tamu.edu) (May 2007)

Highlights

- This research report documented the efforts conducted in this project to provide an instrumented tractor-semi-trailer combination for measurement of dynamic loads and a high-speed inertial profiler for measurement of surface profiles.

The application of strain gages for load measurement was successfully demonstrated in a laboratory setting with a shear beam load cell experiment wherein a steel bar, instrumented with shear strain gages in a full bridge configuration, was used to measure the total weight of a known set of circular disks. The shear beam load cell gave a measurement within 0.33% of the known total weight of the circular disks.

Small-scale testing with an instrumented trailer verified the method for positioning, mounting, wiring, and calibrating the strain gages on the test vehicle. From the results of trailer calibration, researchers observed a strong linear relationship between tire load and strain over the range of loads at which the calibration was conducted. In addition, results of tests on a weigh-in-motion site showed that:

- the dynamic tire loads determined from the strain gages vary closely about the measured static tire load of 700 lb. on the trailer;
- the dynamic tire loads determined around the vicinity of the WIM sensor are in reasonable agreement with the corresponding WIM measurement on each repeat run; and
- the load measurements exhibit similar patterns between repeat runs.

In view of the positive results, researchers proceeded with instrumentation and calibration of a tractor-semi-trailer combination following the same approach used for the small-scale trailer tests.

The calibration curves from full-scale laboratory tests of the instrumented tractor-semi-trailer exhibit a strong linear relationship between tire load and shear strain. The shear strains measured between the left and right sides of a given axle also show a difference in signs as expected from theory.

Researchers verified the instrumented tractor-semi-trailer combination by running the test vehicle on a weigh-in-motion site. Comparisons of the tire loads measured from the strain gages with the loads from the WIM sensors showed reasonable agreement between both sets of readings for each axle of the test vehicle and for the test speeds of 50 and 60 mph at which tests were conducted.

Researchers instrumented a test vehicle with an inertial profiling system and verified its performance based on TxDOT Test Method Tex-l00lS. The results obtained show that the profiler meets the certification requirements specified in the test method.

Test data collected on TxDOT paving projects with the instrumented vehicle showed that load variability, as measured with the coefficient of variation of the dynamic tire loads, goes up with increase in pavement roughness. In addition, examination of the patterns in the dynamic load variability revealed that the peaks in the computed CVs tend to recur at generally the same locations along the project for each axle of the test vehicle. This observation suggests that these locations will receive the most pounding from the trucks that use the road and will likely develop distress earlier than other similar locations where the dynamic load variability is less.

Analyses of the measurements with the instrumented vehicle also showed that the occurrences of high dynamic load variability are associated with defects found on the pavement surface from the measured elevation profiles along the given project. This work showed that the current bump template based on the individual wheel path profiles gave a better assessment of the locations of defects where peaks in the computed CVs of the dynamic tire loads were observed. Researchers found that evaluating the defects based on the average of the left and right wheel path profiles tends to mask the defects that exist along the individual wheel paths, particularly for pavement sections where there is a significant difference in the wheel path IRIs. Researchers also found that using the individual wheel path elevation profiles gives the correct magnitudes (heights or depths) of the defects found on the pavement surface compared to the magnitudes obtained based on the average profile.

Based on the findings from tests made with the instrumented truck on this project, researchers recommend that in lieu of locating defects based on the average profile, TxDOT should use the actual measured profile on each wheel path to evaluate localized roughness using the existing bump template. Researchers note that the average profile is a calculated profile, whereas the individual wheel path profiles are the measured data from the inert!al profiler. Thus, using the current bump template with the individual wheel path profiles should give a better assessment of the localized roughness that exists on a given project, in terms of where the defects are, and the magnitudes of these defects. Having the correct information is necessary to determine the proper corrections that need to be applied on a given project to remove features that detract from ride quality and increase the dynamic load variability.

To have the least impact on the existing pay adjustments that are made, TxDOT should continue using the existing 5-ft bump penalty gap in Item 585 with the gap applied on the test lane width (at least in the interim) instead of the length of each individual wheel path profile. Applying the bump penalty gap on the test lane width means that no more than ohe penalty will be assessed for all occurrences of defects found on both wheel paths over the 5-ft longitudinal distance of the test lane. In this way, no change will be required in the current language of the ride specification to implement the change recommended by researchers in this project. However, Section 7 of TxDOT Test Method Tex-l001S will have to be modified. In connection with this change, researchers prepared a draft of a revised section on localized roughness (see Figure 5.1) to replace the existing section found in the test method. Researchers recommend that TxDOT modify its Ride Quality program to permit the evaluation of localized roughness by wheel path.

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Long-Term Research on Bituminous Coarse Aggregate: Use of Micro-Deval Test for Project Level Aggregate Quality Control by Priyantha W. Jayawickrama, Shabbir Hossain, and Appa Rao Hoare, Texas Transportation Institute, Texas A&M University System, College Station, Texas 77843-3135 (Texas Department of Transportation, Research and Technology Implementation Office P.O. Box 5080, Austin, Texas 78763-5080; 979.845.1734; http://tti.tamu.edu) (Mar 2007)

Highlights

- The MD test is a more reliable indicator of changes in material quality than the MSS test.

This research was initiated with the objective of evaluating the feasibility of implementing the Micro-Deval (MD) test in the Texas Department of Transportation's Aggregate Quality Monitoring Program (AQMP) for bituminous coarse aggregate. In particular, the research investigated the possibility of using this test as a project level quality control tool. In the development of the research plan, it was assumed that the MD test was more likely to be implemented in the AQMP program as a surrogate to the magnesium sulfate soundness (MSS) test. In other words, the MSS test that had been an integral part of AQMP for a long time will remain as the primary benchmark for aggregate durability assessment, while the MD test will be used as an indicator test that detects material changes in an aggregate stockpile causing it to fail desired MSS specifications. In order to use the MD test in such a surrogate role, it is necessary that the MD test mimics the MSS test closely. In other words, there should be strong correlation between the two tests.

There were two primary phases in the research project. The first phase involved the review and analysis of existing data that have been compiled by the TxDOT Materials and Tests Labs as a part of the AQMP program. The database included data collected from 169 sources over more than a three year period. The analysis of TxDOT AQMP data examined the strength of the correlation between MD and MSS tests as well as the variability of MD and MSS test parameters over time. The ability of these two test methods to detect changes in material quality with time was quantified in terms of test procedure sensitivity. Regression analyses were also performed on the data obtained from TxDOT so that new Micro-Deval specification limits corresponding to the MSS specification limits can be established. Those aggregate sources that show contradictory behavior in the two test methods (pass one test but fail the other) were identified.

The second phase of the research involved a laboratory study. This laboratory test experimented with alternative variations of the MD test with the primary intent of developing a test procedure that will provide better correlation with the MSS test. These alternative variations included:

- using uniform aggregate gradation identical to that used in the MSS test,
- using increased soaking time (24 hours as opposed to I hour), and
- soaking aggregate in boiling temperatures.

It was expected that the modified procedures would be harsher on more absorptive aggregate, and therefore, the resulting correlation with MSS would be better.

The following are the important conclusions from this study.

Conclusions

In many ways, the data obtained and analysis conducted in this research reaffirmed the findings from Project 0-1771 and other previous research studies. Both MD and MSS tests yield higher losses for softer, more absorptive aggregates. However, the correlation between the two test methods remains fair with R2 values varying within the range 0.70 to 0.80. Different research studies that analyzed different data sets all came up with similar conclusions with respect to the strength of MD-MSS correlation. In the present study, other variations of the MD test were examined with the objective of improving MD-MSS correlation, but these efforts did not lead to any significant improvement in the R2 value. These alternative variations of the MD test included:

- using identical gradation as in the MSS test,
- increasing the aggregate soaking time to 24 hours, and
- using boiling temperatures during the aggregate soaking cycle.

Although slight improvements in the R2 value were observed in each case, the data suggested that no dramatic improvement in the strength of the correlation can be expected. All of these observations support the viewpoint that the absence of a strong correlation between the two test methods is largely due to the two fundamentally different degradation mechanisms used in the two tests. The MD test uses the mechanical impact on aggregates that have been soaked in water and, therefore, is similar to the wet ball mill test used by TxDOT for base materials. MSS uses internal pressure from the growth of salt crystals inside aggregate pores to cause degradation. While many aggregates respond similarly in both MD and MSS tests, others perform differently in the two tests. The MSS prediction capability based on MD can be improved if aggregate absorption is incorporated into the predictive model. This model has an R2 value of about 0.85.

Both MD and MSS test parameters increased with increasing aggregate absorptivity. Between the two test methods, however, the MSS test showed greater sensitivity to aggregate absorption. When MD and MSS test data for aggregate samples recovered from the same source but at different times were compared, it was evident that the variability in MSS test data was significantly higher. This variability represents the cumulative effect of material variability and the variability inherent in the test procedure itself. Therefore, the standard deviation calculated for the above variability was normalized by dividing it with the single lab standard deviation corresponding to the test procedure. This ratio of standard deviations was used as a measure of the "sensitivity" of the test procedure. In other words, the ratio provides an indication of the test method's ability to detect changes in the material when such changes occur. A comparison of "sensitivity" parameters calculated for both MD and MSS tests for all aggregate categories shows that the MD test is a more reliable indicator of changes in material quality than the MSS test.

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APRIL 2008

Superpave Mix Design: Verifying Gyration Levels in the N_{design} Table, *NCHRP Report 573* by Brian D. Prowell & E. Ray Brown, National Center for Asphalt Technology Auburn, AL (Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001; (202) 334-3213; http://gulliver.trb.org/bookstore) (2007)

Highlights
- Pavements appear to reach their ultimate density after 2 years of traffic.
- N_{design} levels could be reduced.
- The projects were very rut resistant.
- The criteria for $N_{initial}$ and $N_{maximum}$ should be eliminated.

The three objectives of this research were (1) to evaluate the field densification of pavements designed using the Superpave mix design system, (2) to verify or determine the correct N_{design} levels, and (3) to evaluate the locking point concept. A wide range of climates, design traffic levels, PGs, lift-thickness-to-NMAS ratios, gradations, and aggregate types was included in this study.

The general goal of previous studies has been to determine the laboratory compaction effort that matches the ultimate density of the pavement after the application of traffic. Previ¬0us studies to determine or confirm laboratory compaction efforts have indicated a great deal of variability between field and laboratory compaction; therefore, variability was expected in this study. The variability in this study may have been acerbated by three factors:

1. Field and traffic compaction are generally constant stress, while the SGC is a constant strain device.
2. The mixes sampled in this study contained a wide range of binder grades, which was not typical of previous studies.
3. The mixes in this study were designed under a tiered system of aggregate properties and N_{design} levels.

Conclusions

Pavements appear to reach their ultimate density after 2 years of traffic. The average in-place density for all of the projects was the same at 2 and 4 years (94.6% of G_{mm}). A fair relationship was determined between the as-constructed density and the density after 2 years of traffic. The majority of pavement densification, approximately 66%, occurs during the first 3 months after construction. Both the high PG and the high-temperature bumps between the climatic and specified PG were found to significantly affect pavement densification, with stiffer binders resulting in less densification. The ultimate in-place densities of the pavements evaluated in this study were approximately 1.5% less than the densities of the laboratory-compacted samples at the agency-specified N_{design}.

The number of gyrations to match the ultimate in-place density was calculated for each project in this study. The calculated values for the two compactors used in this study differed by approximately 20 gyrations. This was attributed to differences in their DIA. The predicted gyrations adjusted to a DIA of 1.16 degrees showed good agreement between the two machines.

Several analyses were conducted to evaluate the N_{design} levels. Combined, these analyses indicated that the N_{design} levels could be reduced.

A relationship was also developed to relate the 2-year percentage of laboratory density at 100 gyrations to as-constructed density, high PG, and accumulated ESALs. It was found that the predicted gyrations to match a given percentage of laboratory density represented a small range, with a standard deviation of 3.44 to 8.99 gyrations. A matrix of expected percentages of laboratory density was developed based on high PG, traffic, and an as-constructed density of 92%. The numbers of gyrations to match the percentages of laboratory density determined in the matrix were calculated for all of the projects. An equation was then developed to relate the average gyrations determined to match the in-place densities to high PG and traffic. The predicted gyrations were very similar to those determined using the first analysis. However, this analysis accounted for the low as-constructed densities of some of the projects and the use of PG 76-XX or stiffer binders. It was found that N_{design} could be reduced by approximately 15 gyrations when PG 76-XX was specified. This methodology was used to recommend new N_{design} levels.

The locking point concept was evaluated as an alternative to N_{design}. The locking point values determined for the Pine and Troxler compactors were almost identical; however, densities at the locking point value (without adjustment to account for differing DIAs) were different. The density at the 3-2- 2 locking point is weakly correlated to the ultimate density of the pavement. The locking point appears to be related to aggregate type, with softer aggregate producing higher locking point values.

All of the projects in this study were very rut resistant. The maximum observed rutting for the field projects was 7.4 mm, with an average rut depth for all of the projects of 2.7 mm after 4 years of traffic. Indications of durability problems suggested that increased asphalt contents would be beneficial.

The requirements for $N_{initial}$ were evaluated based on the field project data. AASHTO M35 specifies a tiered density requirement at $N_{initial}$ depending on traffic level. In the 300,000 to 3,000,000 ESAL range, 32% of the samples failed the $N_{initial}$ requirement. In the greater than 3,000,000 million ESAL range, 20% of samples failed the N_{initia}l requirement. The majority of the projects that failed the $N_{initial}$ requirement were fine-graded. All of the projects are performing well in terms of rutting resistance. Only one project failed the $N_{initial}$ and was tender in the field. There is no strong evidence to keep the requirements for Ninitial.

The requirement for $N_{maximum}$ was evaluated based on the field project data. AASHTO M 35 specifies a density requirement of less than 98% at $N_{maximum}$ to guard against the potential for rutting. Thirty-six percent of the samples tested with the Pine compactor and 40% of the samples tested with the Troxler compactor failed the density requirement at $N_{maximum}$. However, the projects have all been extremely rut resistant. Therefore, the density requirement at $N_{maximum}$ does not appear to be a good indicator of rutting potential and should be eliminated.

Based on the research conducted in this study, the following recommendations are made: The specification for angle of gyration should be revised to allow a DIA of only 1.16 to .02 degrees. The N_{design} levels shown in Table 5.1 should be adopted for the design of Superpave HMA. Consideration should be given to using the 2-year design traffic volume, as opposed to the 20-year design traffic volume or another method of specifying rate of loading, to determine N_{design}. The criteria for $N_{initial}$ and $N_{maximum}$ should be eliminated.

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APRIL 2008

16th Annual Performance of State Highway Systems (1984–2005) by David T. Hartgen and Ravi K. Karanam (Reason Foundation, 3415 S. Sepulveda Blvd., Suite 400, Los Angeles, CA 90034; 310/391-2245; http://www.reason.org/ps360.pdf) (Jun 2007)

Highlights

- The nation's continuing trend of generally improving highway performance from 1998 to 2003 was reestablished in 2005.
- States need to re-think their priorities and focus more on congestion reduction and mobility provision.

The states reversed the 2004 declines in highway condition by spending federal funds approved by Congress in 2005 for improved pavements, bridge repairs, and congestion relief. The nation's continuing trend of generally improving highway performance from 1998 to 2003 was reestablished in 2005.

Federal highway funds increased about 13% between 2004 and 2005, as the states saw the first full year of additional funds from the new federal highway program. Capital and bridge expenditures increased 12% and maintenance expenditures increased 11%. Administrative costs were flat.

The states converted the additional funding into improved performance. The percent of roads in poor condition fell sharply for both the interstate and rural primary roads. Increasingly, the remaining serious pavement condition problems are confined to just a few states. The percentage of bridges rated deficient also improved slightly. The states also held their ground on congestion and narrow lanes. But accident rates crept up slightly.

Substantial as it is, this progress was offset slightly by several troublesome problems. The condition of secondary and local roads continues to worsen. Over one half of urban interstates remain congested, and the states' ability to deal with congestion seems to be slowing. And one quarter of the nation's bridges are still rated 'deficient'; at the current improvement rate it will take 50 years to eliminate bridge deficiencies. Highway fatalities have edged up, increasing the fatality rate slightly. And sharp increases in highway construction costs in 2005–2006 mean that fewer repairs can be made from the same dollars.

This 16th annual study tracks the performance of the state-owned roads from 1984 to 2005. Twelve indicators—covering the states' highway revenues and expenditures, pavement and bridge condition, congestion, accident rates, and narrow lanes—make up each state's overall rating. The study is based on spending and performance data submitted to the federal government by the state highway agencies.

The study also found wide variations among the states in road performance. Just six states (New York, Alabama, California, Utah, Alaska and Michigan) have over 60% of the poor rural interstate mileage in the country. And four states (California, Minnesota, New Jersey and North Carolina) have more than 70% of their urban interstates congested. The states also vary widely by fatality rates. Massachusetts reported the lowest rate, Montana the highest.

Congress passed new highway legislation in August 2005. The federal bill increased highway funding by about 40% over 1998 levels. Congress did not address fundamental reforms in how road projects are financed, so the action averted a looming drop in highway performance. But there is still cause for concern about the lack of progress in reducing congestion. It is simply unacceptable for half of urban interstates to be congested. We need to spend our dollars on real problems, not frills. States need to re-think their priorities and focus more on congestion reduction and mobility provision.

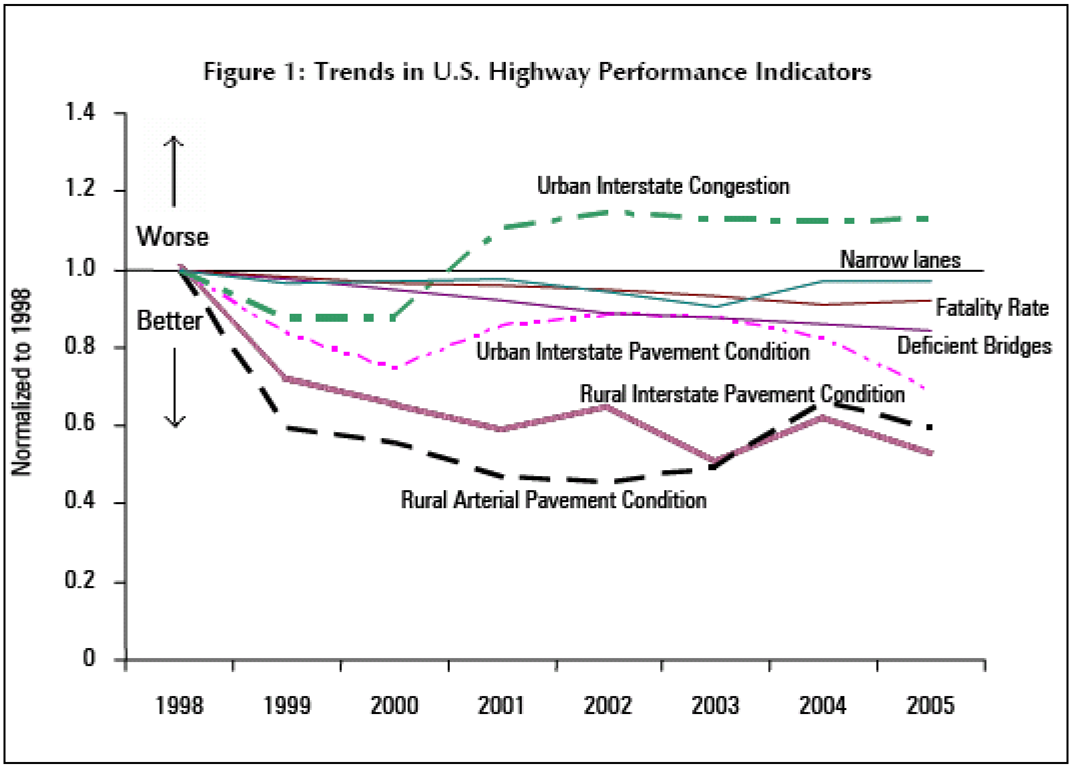

Table 1A: Expenditures and Performance of State-Owned Highways, 1998-2005				
Statistic	1998	2004	2005	Percent Change, 04-05
Total Revenues, All Sources, $B	$67.80	$90.68	$102.71	13.27
Total Expenditures, $B	$66.40	$87.69	$98.91	12.80
Expenditures, Capital/Bridges, $B	$36.30	$47.74	$50.31	5.38
Expenditures, Maintenance, $B	$11.40	$14.29	$15.94	11.55
Expenditures, Administration, $B	$4.70	$6.32	$6.36	0.63
Highway Construction Price Index	126.9	154.4	175.4	13.6
Rural Interstate, Percent Poor Condition	3.25	2.02	1.73	-15.84
Urban Interstate, Percent Poor Condition	8.69	7.13	5.97	-16.27
Rural Primary, Percent Poor Condition	1.42	0.94	0.85	-9.57
Urban Interstate, Percent Congested	45.90	51.60	51.85	**0.48**
Bridges, Percent Deficient	29	25.03	24.53	-2.12
Fatality Rate per 100 Million Miles Driven	1.58	1.440	1.453	**0.69**
Rural Primary, Percent Narrow Lanes	11.04	10.72	10.72	-0.19

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Restructured Federal Approach Needed for More Focused, Performance-Based, and Sustainable Programs (United States Government Accountability Office (GAO), 441 G Street NW, Room LM, Washington, D.C. 20548; JayEtta Z. Hecker at (202) 512-2834 or heckerj@gao.gov; http://www.gao.gov/new.items/d08400.pdf) (Mar 2008)

Highlights

- Federal goals and roles are unclear, many programs lack links to needs or performance, and the programs often do not employ the best tools and approaches.
- Rigorous economic analysis is not a driving factor in most project selection decisions.

Surface transportation programs need to be reexamined in the context of the nation's current unsustainable fiscal path. Surface transportation programs are particularly ready for review as the Highway Trust Fund faces a fiscal imbalance at a time when both congestion and travel demand are growing. This report (1) provides an overview of the federal role in surface transportation and the goals and structures of federal programs, (2) summarizes GAO's conclusions about the structure and performance of these programs, and (3) provides principles to assess options for focusing future surface transportation programs. GAO's study is based on prior GAO reports, stakeholder reports and interviews, Department of Transportation documents, and the views of transportation experts.

Since federal financing for the interstate system was established in 1956, the federal role in surface transportation has expanded to include broader goals, more programs, and a variety of program structures. To incorporate additional transportation, environmental and societal goals, federal surface transportation programs have grown in number and complexity. While some of these goals have been incorporated as new grant programs in areas such as transit, highway safety, and motor carrier safety, others have been incorporated as additional procedural requirements for receiving federal aid. Broad program goals, eligibility requirements, and transfer provisions give states and local governments substantial discretion for allocating most highway infrastructure funds. For transit and safety programs, broad basic grant programs are augmented by programs that either require a competitive selection process or use financial incentives to directly target federal funds toward specific goals or safety activities.

Many current programs are not effective at addressing key transportation challenges such as increasing congestion and freight demand. They generally do not meet these challenges because federal goals and roles are unclear, many programs lack links to needs or performance, and the programs often do not employ the best tools and approaches. The goals of current programs are numerous and sometimes conflicting. Furthermore, states' ability to transfer highway infrastructure funds among different programs is so flexible that some program distinctions have little meaning. Moreover, programs often do not employ the best tools and approaches; rigorous economic analysis is not a driving factor in most project selection decisions and tools to make better use of existing infrastructure have not been deployed to their full potential. Modally-stove-piped funding can impede efficient planning and project selection and, according to state officials, congressionally directed spending may limit the states' ability to implement projects and efficiently use transportation funds.

A number of principles can help guide the assessment of options for transforming federal surface transportation programs. These principles include: (1) ensuring goals are well defined and focused on the federal interest, (2) ensuring the federal role in achieving each goal is clearly defined, (3) ensuring accountability for results by entities receiving federal funds, (4) employing the best tools and approaches to emphasize return on targeted federal investment, and (5) ensuring fiscal sustainability. With the sustainability and performance issues of current programs, it is an opportune time for Congress to more clearly define the federal role in transportation and improve progress toward specific, nationally-defined outcomes. Given the scope of needed transformation, it may be necessary to shift policies and programs incrementally or on a pilot basis to gain practical lessons for a coherent, sustainable, and effective national program and financing structure to best serve the nation for the 21st century.

What GAO Recommends

Congress should consider reexamining and refocusing surface transportation programs so that they: (1) have goals with direct links to an identified federal interest and role, (2) make grantees more accountable through more performance-based links between funding and program outcomes, (3) use tools and approaches that emphasize the return on the federal investment, and (4) address the current imbalance between federal surface transportation revenues and spending. DOT generally agreed with the information in this report, and provided technical clarifications, which were incorporated as appropriate.

TRANSPORTATION RESEARCH DIGEST

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APRIL 2008

Tribal Transportation Programs *NCHRP Synthesis 366* by Stuart Meck, Rebecca Retzlaff and Jim Schwab, American Planning Association, Chicago, Illinois (Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001; (202) 334-3213; http://gulliver.trb.org/bookstore) (2007)

Highlights

- The study identifies innovations and model practices among tribal transportation programs.

Indian tribal transportation is undergoing significant change; however, relatively little significant research has examined where such programs currently are and where they are headed. This report attempted to establish a baseline for future research by examining numerous essential details of 30 programs from across the nation, from New England to Alaska, from Texas to North Dakota. The programs surveyed were large, small, and in between. The study also examined the extant literature of the field and summarizes the history and legal and administrative evolution of tribal transportation programs within the larger context of issues of tribal sovereignty and relationships with the federal government, states, and local and regional planning. In addition, the study includes extensive interviews with directors of the Transportation Technical Assistance Program (TTAP) centers, with Tim Penney of FHWA, and several Bureau of Indian Affairs (BIA) officials.

The primary vehicle for federal aid to tribal transportation remains the Indian Reservation Roads (IRR) program. Today, the program consists of more than 25,700 miles of BIA and tribally owned public roads and 800 bridges, plus 25,600 miles of state, county, and local government public roads. Authorizations for the IRR program and the BIA maintenance funds cover only a small fraction of the ongoing needs of tribes, although those authorizations are steadily increasing, and a new Tribal Transportation Allocation Methodology (TTAM) is in place to determine direct allocations to individual tribes. The profiles generated from this study, however, reveal that numerous tribes are seeking, experimenting with, or implementing additional sources of revenue to fund their transportation needs, including creative grant writing, flexible financing to borrow against future IRR allocations, tribal tax and casino revenues, and profit-making tribal enterprises that identify and fill market niches in the larger regional economy.

Much of what was learned through the synthesis survey was highly contextual. Tribal transportation managers and their staffs, along with their tribal governments, often make very specific initiatives and programs work in unique circumstances. For instance, the development of tribal transit programs often depends on the proximity of the reservation to neighboring jurisdictions that either already operate transit systems, can cooperate with the tribe in serving common needs, or can benefit from expansion of the tribal system, at the same time that tribes lacking such proximity find ways to develop an appropriate level of transit service in relative isolation.

As a result of these adaptations to circumstance, tribes have incorporated a full range of responses to opportunities for self-determination and the use of outside assistance such as contractors. However, there is a marked tendency among the tribes surveyed to have taken full control of the preparation of long-range transportation plans, with two-thirds of the tribes surveyed having done this work in-house, and almost none relying on the BIA for a function that is in effect the central element of decision making for their own transportation futures. Likewise, two-thirds of these tribes reported that they had taken charge of developing and maintaining their own inventory of transportation facilities, the central element of the BIA formula for determining tribal shares through TT AM. Moreover, there is clearly a growing determination among tribes to assume greater responsibilities for program operation through self-governance compacts and U.S. Public Law (P.L.) 93-638 (the Indian Self-Determination and Education Assistance Act of 1975) contracts with the BIA. It is possible that in the near future these tribes will also exercise the emerging option of contracting with FHW A instead.

The survey also found that the plans developed most commonly established linkages with four other types of plans, with other possibilities being relatively uncommon. These were community and economic development, land-use planning, historic preservation, and public utilities. There were few surprises in this arena, or in the use of citizen participation techniques, where tribes largely relied on public hearings and public meetings as their primary mechanisms for involvement.

Tribal use of the TTAP centers was found to be almost pervasive, with only a small minority failing to report the use of TTAP resources, suggesting that this is likely to remain a highly successful means of distribution of technical assistance. In tribal coordination with outside agencies, aside from universal involvement with BIA, the most frequent area of coordination reported was with state transportation departments. Given new mandates for consultation with tribes, this is both not surprising and likely to increase. However, many tribes also reported extensive involvement with other federal agencies besides the U.S.DOT. The study included other department of transportation entities such as FHWA, FTA, and FAA in that category .

The study identifies innovations and model practices among tribal transportation programs. In seeking to classify these for ease of discussion, the study identified 10 areas of innovation among the findings in the profiles:

- Relationship building with outside entities,
- Financing and fundraising skills,
- Highway design and environmental management,
- Transit,
- Transportation enhancements,
- Marketing technical skills,
- Solving problems related to special hazards,
- Use of planning tools,
- Cultural preservation techniques, and
- Solving social problems through transportation programs.

Finally, the study identified four areas of potential future research based on the information gathered from all sources:

- Operation and development of tribal transit services,
- Staffing of tribal transportation programs,
- Creative financing, and
- Building relationships to further tribal transportation goals.

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Vehicle Occupancy Trends in Florida: Evidence from Traffic Accident Records by Kaiyu Liu & Albert Gan *in Transportation Research Board, 87th Annual Meeting, January 13-17, 2008, Washington, DC.* (Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001; (202) 334-3213; http://gulliver.trb.org/bookstore).

Highlights
- The use of crash records as a potential source of vehicle occupancy data offers benefits over the traditional field data collection methods.
- AVO in Florida has continued to decline over the years, from a high 1.58 passengers per vehicle in the 1991 down to 1.42 passengers per vehicle in 2005.

Average vehicle occupancy (AVO), or the average number of persons in a vehicle, has a direct impact on the amount of traffic using our roadway systems and is, thus, a major measure used in the assessment of transportation demand management (TDM) techniques. The number of persons in a vehicle involved in an accident is routinely recorded in many states by police officers at the site of the accident. Because accident records are both comprehensive and readily available, several states have attempted to extract vehicle occupancy data from these data. Traditionally, vehicle occupancy data are collected using the roadside windshield and the carousel method. The roadside windshield method involves stationing observer(s) along the roadside to perform physical counts of vehicles and occupants. The carousel method positions observers in vehicles traveling on multi-lane highways to count passengers in neighboring vehicles.

While field collection methods have the benefit of being more up to date and can be tailored to specific application needs in terms of location, sample size, and accuracy, they are also much more costly to conduct, especially for purposes of continuous monitoring, for which a time series of data must be collected. The use of crash records as a potential source of vehicle occupancy data offers the following benefits over the traditional field data collection methods:

- It is both cost effective and safe as it involves no field observation.
- It covers all time periods, including night hours when field data collection cannot be performed.
- It counts all passengers, including small children, who are difficult for observers to see in the field.
- It is not subject to visibility problems due to tinted vehicle windows.
- It is not subject to data quality problems as a result of field crews experiencing fatigue, providing poor job performance, over- or under-counting, etc.

While this method has many benefits compared to the traditional methods, it is also known to be subject to potential biases resulting from under- and over-involvement of certain population sectors in traffic accidents. For example, vehicles driven by younger drivers tend to carry more passengers and are known to be more prone to traffic accidents, which inflate the AVOs estimated from accident records. While it is important to obtain adjusted AVOs to correct for potential biases for such applications as converting person trips to vehicle trips in the traditional demand forecasting process, it may not be necessary for such adjustments to be made for the purpose of monitoring AVO trends in a study area. This is because, for the latter, it is the relative values of AVOs, rather than absolute AVOs, that are important.

This paper describes an effort to examine the vehicle occupancy trends in Florida using the unadjusted passenger information extracted from traffic accidents that occurred on the Florida state roadway system. The trends are examined in the context of the following three groups of factors:

- Temporal factors: accident year, accident month, accident day, and accident time.
- Socioeconomic factors: driver's age, driver's gender, and driver's race.
- Miscellaneous other factors: level of urbanization, roadway functional class, and weather conditions.

A better understanding of how these factors affect average vehicle occupancies can help to improve the planning and design of TDM strategies.

Average vehicle occupancy (AVO) has a direct impact on transportation demand. Traditionally, vehicle occupancy data are collected using the field data collection methods such as the roadside windshield method and the carousel method. While these field collection methods have the benefit of being more up to date and can be tailored to specific application needs, they are also much more costly to conduct. This paper describes a study that applies the passenger information in accident records to analyze the average vehicle occupancy trends in Florida as they relate to different years, months, days of week, hours, driver's age group, driver's gender, driver's race, urbanization, roadway functional class, and weather conditions. Both parametric and nonparametric analyses of variance (ANOVA) were applied and it was found that AVOs were affected by all of the factors considered to various degrees.

Despite continued effort over the past decades to encourage people to carpool, the data show that the overall AVO in Florida has continued to decline over the years, from a high 1.58 passengers per vehicle in the 1991 down to 1.42 passengers per vehicle in 2005, or a 10% decrease. This study also found that AM peaks tend to have the lowest AVO in a day and weekend AVOs were significantly higher than weekday AVOs. In addition, younger drivers were found to have higher AVOs than older drivers, female drivers tend to have more passengers in their vehicles than male drivers, and Blacks and Hispanic Americans tend to have higher AVOs than White Americans, and rural AVOs are significantly higher than urban AVOs.

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Annual Privatization Report 2007 by Leonard C. Gilroy (Reason Foundation, 3415 S. Sepulveda Blvd., Suite 400, Los Angeles, CA 90034; 310/391-2245; http://www.reason.org/apr2007/) (2007)

Highlights

- A growing number of states are either enacting first-time public-private partnership (PPP) legislation or amending existing laws.
- Shifting risks from taxpayers to investors can be a major benefit of the long-term concession approach.

From the perspective of U.S. transportation history, 2006 will be noted as the year in which long-term toll highway concessions emerged as a major new alternative. The lease of the Indiana Toll Road for $3.86 billion in June 2006 garnered much of the attention, but the longer-term story is the potential for using the concession mechanism to meet a significant share of the need for new highway capacity, both on urban freeways and on long-distance Interstates. That's why a growing number of states are either enacting first-time public-private partnership (PPP) legislation or amending existing laws to ensure that they are conducive to concession-type PPP agreements.

The basic concession model works as follows. For a given large-scale roadway project, the state selects a winning bidder that will design, finance, build, operate, and maintain the project over a sufficiently long term to have a reasonable likelihood of achieving a competitive (double-digit) return on its investment. The state's commitment, by signing a legally binding long-term concession agreement, provides the means by which the company can raise the needed funds to build the project (assuming the underlying economics are sound). Typically, such deals transfer at least three risks from the state to the private partner:

- The risk of construction cost over-runs;
- The risk of delays in project completion;
- The risk of inadequate traffic and revenue.

For mega-projects, in particular, shifting those risks from taxpayers to investors can be a major benefit of the long-term concession approach. The other major benefit of long-term toll concessions is the mobilization of large new sums to be invested in much-needed highway improvements. There are other forms of "innovative finance," including issuing bonds backed by future fuel-tax revenues. But while such mechanisms shift the timing of funds to permit some projects to be built sooner, they do not add to the total amount of highway investment. Only the introduction of tolls adds new capital investment, making possible large-scale new projects.

The Federal Highway Administration's 2006 report on highway conditions and performance, released early in 2007, finds that capital investment by all levels of government averaged $70 billion in the most recent year for which data were available (2004). To maintain pavement conditions and current congestion levels (i.e., prevent things getting even worse) would require an additional $9 billion per year. To improve conditions, including actually reducing congestion below today's levels by removing bottlenecks and otherwise adding capacity, would require a total annual investment of $132 billion, i.e., $61 billion per year more than current levels. (This calculation was based on doing all proposed highway projects whose benefits exceed their costs.)

There are several other national investment needs studies, by groups like the American Association of State Highway & Transportation Officials and the U.S. Chamber of Commerce. While their numbers differ, all agree that the United States faces a major shortfall in highway capital investment over the next several decades, with serious consequences for both goods movement and personal mobility. This is the context in which the introduction of the long-term toll concession model to the United States must be assessed.

As of the end of 2006, three existing toll roads had been leased to the private sector under long-term concession agreements. The Chicago Skyway deal closed in January 2005, and the Indiana Toll Road deal closed in June 2006, shortly after Gov. Mitch Daniels signed the enabling legislation. And that same month, Transurban closed a deal for a 99-year lease with the Virginia DOT to rescue the ailing Pocahontas Parkway, one of two new toll roads developed under a kind of non-profit public-private partnership during the 1990s. The Parkway, located in Virginia, had attracted only about 60 percent of the projected traffic and revenue during its early years, and was at serious risk of defaulting on its toll revenue bonds. Under the deal, Transurban will defease the existing bonds, refinancing the Parkway. It will also build a planned extension to the Richmond airport, which will likely increase traffic and revenue. Although there was no up-front payment (given the parlous state of the Parkway's finances), if the road does well enough over the long term, the concession deal provides for revenue sharing with VDOT.

Several other ailing start-up toll roads would be logical candidates for such rescues. Another nonprofit PPP toll road is the Southern Connector in Greenville, SC. Like the Pocahontas Parkway, its traffic and revenue are far below projections, but thus far no offers from the private sector have materialized (or if they have, they have not been disclosed). Yet another ailing toll road is the Northwest Parkway, opened in 2003 as the northwestern portion of greater Denver's beltway (of which the E-470 toll road forms the eastern half). In this case, the toll agency that was created to do the toll road has gone out to bid for a concession-based rescue. In April 2007, the Northwest Parkway Public Highway Authority selected from among 11 bidders the proposal of Brisa/CCR to negotiate a long-term concession agreement.

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Solving the Freight Rail Transportation Bottleneck by Wendell Cox (Heartland Institute, 19 South LaSalle Street #903, Chicago, Illinois 60603; phone 312/377-4000; http://www.heartland.org/pdf/22296.pdf) (Nov 2007)

Highlights

- Rail in the U.S. carries more ton miles than any other freight mode.
- Rail typically costs 1/3 as much as trucks to move the same commodities.

Railroads are often thought of as a transport of the past, yet freight rail systems in the U.S. carry more volume (measured in ton miles) than any other freight mode, and more than ever before. Freight rail has several advantages over trucks and other competing modes of moving freight:

- Rail typically costs 1/3 as much as trucks to move the same commodities.
- Rail is three times as energy efficient as trucks per ton mile and emits 1/3 as much nitrogen oxide.
- Increasing rail's share of the freight market would reduce congestion on highways, which improves productivity and shortens commuting time.

Freight rail ton miles are expected to increase 47% from 2000 to 2020. However, it will be challenging for the railroad industry to finance the expansion necessary to accommodate this growth. The capacity situation is even more dire for the trucking industry.

- Freight train average operating speeds dropped from 24 miles per hour in 1990 to 21 miles per hour in 2000, suggesting the system is nearing capacity.
- Trucks already are impeded by serious traffic congestion problems in many urban areas on the roadway system.
- From 1983 to 2005, average peak-hour delays in the largest urban areas increased 285% while freeway lane miles increased only 50%.
- Texas Transportation Institute data indicate annual congestion costs rose from $6 billion in 1982 to $60 billion in 2003 (in 2003 dollars).

With sufficient funding, the railroad industry could add the capacity it needs to handle much larger freight volumes. This would reduce congestion and bottlenecks on highways by reducing the need to use trucks on longer routes. Commuters would benefit from shorter drive times, and there could even be environmental and other benefits.

- According to the American Association of State Highway and Transportation Officials, $30 billion in additional investment would save $839 billion in costs to highway users and shippers and in highway investment costs, a benefit-to-cost ratio of more than 25 to 1. Another $30 billion in investment would yield a further $653 billion in benefits, for a benefit/cost ratio of 22/1.
- The Texas Governor's Business Council estimated the economic benefits from reducing congestion over the next 25 years in Texas urban areas would be eight times the cost of roadway expansion.

According to the Association of American Railroads, railroads are investing $2 billion a year less in capital than is required to maintain their current market share. This is due in part to public policies:

- Federal laws require freight railroads to grant Amtrak passenger trains priority over freight trains throughout their systems. As a result, along most of the mileage used by Amtrak, freight trains must routinely be stopped on sidings to allow passenger trains to pass, making freight rail service less reliable, and therefore less competitive with trucking.
- Federal law also prevents railroads from charging Amtrak the fully allocated costs for its use of the rail infrastructure. Thus, freight rail is forced to subsidize passenger trains.
- The way transportation infrastructure is financed gives a major advantage to trucks over trains. Railroads bear the entire cost of building and maintaining tracks, whereas the cost of building and maintaining the roads used by trucks is shared with the owners and drivers of cars and buses via motor fuel taxes.

To avoid a freight rail reform plan becoming just another failed attempt at central planning or unearned subsidies for special interest groups, reform efforts ought to adhere to four principles:

1. *Rely on market forces*. The most fundamental principle is that railroads must be allowed to operate as private businesses.
2. *Reduce existing barriers to new investment*. Before approving any new laws or taxes, policymakers should first remove existing government policies and programs that interfere with market processes.
3. *Limit political interference*. Freight railroads are unlikely to contribute substantially more to freight reliability if public strategies are subject to interference by politics in Washington.
4. Acceptable reforms should be consistent with the twin objectives of ensuring that the railroad industry can make sufficient infrastructure investments to maintain its present market share, and then to go beyond that level to make infrastructure investments that produce social benefits associated with reduced congestion on roads.

Recommended reforms

- Remove the requirement that Amtrak trains be given priority over freight trains;
- Allow railroads to charge Amtrak the fully allocated costs for its use of rail infrastructure;
- Allow any expansion of rail passenger service on freight rail infrastructure only upon an administrative law finding that the additional passenger trains will have no detrimental impact on the competitiveness of the freight railroad system or the corridor involved; and
- Grant railroads investment tax credits and accelerated depreciation allowances for their choice of infrastructure improvements.
- Create an independent Strategic Rail Enhancement Plan (SREP) Design Commission to identify cost-effective opportunities for increasing railroad capacity and removing intermodal bottlenecks;
- Federally charter a Strategic Rail Enhancement Corporation (SREC) to seek competitive bids on the highest-priority projects from potential project sponsors; and
- Use tax incentives, tax-exempt bonds, more robust public-private partnerships, and government loans to the winning bidders.

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Crashes vs. Congestion –What's the Cost to Society? by Cambridge Systematics, Inc., 4800 Hampden Lane, Suite 800, Bethesda, Maryland 20814 (American Automobile Association, 607 14th Street NW, Suite 201, Washington, DC 20005; Tel: 202-638-5944; http://www.aaanewsroom.net/Assets/Files/20083591910.CrashesVsCongestionFullReport2.28.08.pdf) (March 5, 2008)

Highlights

- In the urban areas studied, the cost of traffic crashes is nearly two and a half times the cost of congestion – $164.2 billion for traffic crashes and $67.6 billion for congestion.
- 40% to 50% of all nonrecurring congestion is associated with traffic incidents.

When American motorists talk about transportation problems, they generally key in on traffic. Snarled highways, epic commutes, and gridlocked business and commercial districts mar our suburban existence, weighing heavily upon our elected leaders, our policymakers, and our families. Yet there's a more costly problem to be addressed on America's roads: motor vehicle crashes. In 2006, traffic crashes killed 42,642 people in the United States – about 117 deaths per day, and nearly 5 every hour. Most Americans would be surprised to learn the societal costs associated with motor vehicle crashes significantly exceed the costs of congestion.

AAA commissioned this study to examine the costs of crashes to society. The study, along with recommendations for improvements, is designed to raise awareness of the importance of transportation investments, and provide policy-makers, departments of transportation, and the public with information on the magnitude of the safety problem.

The AAA study compares the costs of crashes to the costs of congestion by calculating a per person cost for crashes and multiplying by the population figures in the same 85 urban areas used by the Texas Transportation Institute (TTI) in the annual Urban Mobility Report. The costs of crashes are based on the Federal Highway Administration's (FHWA) comprehensive costs for traffic fatalities and injuries which place a dollar value on 11 components.

The 11 comprehensive cost components include property damage; lost earnings; lost household production (non-market activities occurring in the home); medical costs; emergency services; travel delay; vocational rehabilitation; workplace costs; administrative; legal; and pain and lost quality of life. According to FHWA, in 2005 dollars, the per person cost of a fatality is $3,246,192 and the cost for an injury is $68,170. Congestion costs, as reported in the Urban Mobility Report, are based on delay estimates combined with value of time and fuel costs.

Figure ES.1 shows data from 2005. The yellow bar graph shows, in 2005 dollars, the total cost of fatal and injury crashes for very large metropolitan areas (population over 3 million); large urban areas (population of 1 million but less than 3 million); medium areas (over 500,000 and less than 1 million); and small areas (less than 500,000). The blue bar shows the costs of congestion as reported by TTI in their 2007 Urban Mobility Report.

Key Findings

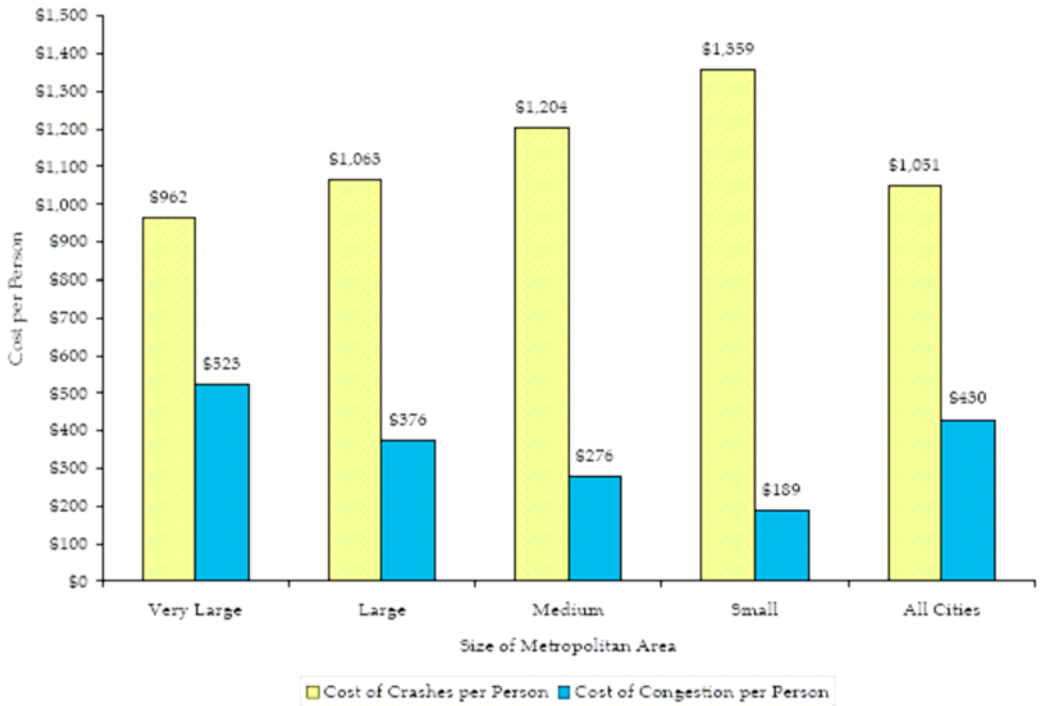
In the urban areas studied, the cost of traffic crashes is nearly two and a half times the cost of congestion – $164.2 billion for traffic crashes and $67.6 billion for congestion.

The crash costs include property damage; lost earnings; lost household production (non-market activities occurring in the home); medical costs; emergency services; travel delay; vocational rehabilitation; workplace costs; administrative; legal; and pain and lost quality of life. The economy and the environment also are impacted but those costs are not quantified in the study. According to FHWA, in 2005 dollars, the average cost of a fatality is $3,246,192 and the average cost of an injury is $68,170.

Improving safety may improve congestion. Forty to 50% of all nonrecurring congestion is associated with traffic incidents.

The cost of crashes on a per person basis decreases as the size of the metropolitan area increases. This is the inverse of the cost of congestion, which increases with an increase in the size of the metropolitan area.

Figure ES.1 Per Person Cost of Crashes and Congestion
Cost of Crashes includes Fatality and Injury Costs and excludes Property Damage Only (PDO) Crashes



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Cruising for Parking by Donald Shoup in *Access* (University of California , Transportation Center, Berkeley, CA 94720; http://www.uctc.net/access/30/Access%2030%20-%2004%20-%20Crusing%20for%20Parking.pdf) (Spring 2007)

Highlights

- About 30% of the cars in the traffic flow are cruising for parking.
- The price of curb parking is usually too low.

A surprising amount of traffic isn't caused by people who are on their way somewhere. Rather it is caused by people who have already arrived. Our streets are congested, in part, by people who have gotten where they want to be but are cruising around looking for a place to park.

Perhaps because cruising is a disguised source of congestion, most transportation planners and engineers have ignored it. Cruising creates a mobile queue of cars waiting for curb vacancies, but cruisers are mixed with traffic that is going somewhere, so no one can see how many cars are in the cruising queue. Nevertheless, a few researchers have analyzed cruising by videotaping traffic flows, interviewing drivers who park at the curb, or driving test cars to search for a curb space. Sixteen studies of cruising behavior were conducted between 1927 and 2001 in the central business districts of eleven cities on four continents. The average time it took to find a curb space was eight minutes, and about 30% of the cars in the traffic flow were cruising for parking. The data varied widely around these averages, however; on some uncrowded streets no cars were cruising, while on some congested streets most of the cars were cruising.

Cities have changed since these observations were made, and the data are selective because researchers study cruising only where they expect to find it. Nevertheless, cruising itself has not changed, and the studies show that cruising for parking has wasted time and fuel for many decades.

Even a small search time per car can create a surprising amount of traffic. Consider a congested downtown where it takes three minutes to find a curb space and the parking turnover is ten cars per space per day. For each curb space, cruising thus results in thirty extra minutes of vehicle travel per day (3 minutes x 10 cars). When the average cruising speed is ten miles an hour, cruising creates five vehicle miles traveled per space per day (10 mph x 0.5 hour). Over a year, this driving in circles amounts to 1,825 VMT for each curb space (5 miles x 365 days), greater than half the distance across the United States.)

Over a year, cruising in Westwood Village creates 950,000 excess VMT. This is equivalent to 38 trips around the earth, or four trips to the moon. The obvious waste of time and fuel is even more appalling when we consider the low speed and poor fuel efficiency of cruising cars. Because drivers average about ten miles an hour in the Village, cruising 950,000 miles a year wastes about 95,000 hours (eleven years) of drivers' time every year. And here's another inconvenient truth about underpriced curb parking: cruising 950,000 miles wastes 47,000 gallons of gasoline and produces 730 tons of CO_2 emissions in a small business district.

When drivers compare the prices of parking at the curb or in a garage, they usually decide the price of garage parking is too high, but instead the reverse is true. The price of curb parking is too low. Underpriced curb spaces are like rent-controlled apartments: they are hard to find, and once you find a space you'd be crazy to give it up. This makes curb spaces even harder to find, and increases the time cost (and therefore the congestion and pollution costs) of searching for them. Like rent-controlled apartments, curb spaces go to the lucky more than to the deserving. One person might find a curb space and park there for days, while others are left to circle the block.

Only trial and error will reveal the right price for curb parking. Initially, if all the curb spaces are always occupied, a city might periodically raise the meter rate by 25-cent increments until occupancy at some hours is about 85%. If spaces are still full during other hours, the city could continue to nudge meter rates upward during those times until the occupancy is about 85% all day. We can call this balance between the varying demand for parking and the fixed supply of curb spaces the Goldilocks

Principle of parking prices: the price is too high if too many spaces are vacant, and too low if no spaces are vacant. When only a few spaces are vacant, the price is just right, and everyone will see that curb parking is both well used and readily available.

Pricing curb parking to ensure a few vacancies does not mean that travel will become unaffordable. Drivers can use several strategies to economize on curb parking without reducing their travel. They can (1) drive at off-peak hours when curb parking is cheaper, (2) park where prices are lower and walk farther to their destinations, (3) park for a shorter time, (4) park off-street, (5) carpool and split the cost of parking, or (6) take public transit, ride a bike, or walk all the way to their destinations. Diverting some trips to carpools, public transit, cycling, and walking will reduce vehicle travel without reducing human travel, and all real travel is by people, not cars.

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Defining the Range of Urban Congestion Impacts on Freight and their Consequences for Business Activity by Glen Weisbrod and Stephen Fitzroy *in Transportation Research Board, 87th Annual Meeting, January 13-17, 2008, Washington, DC.* (Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001; (202) 334-3213; http://gulliver.trb.org/bookstore).

Highlights

- Current impact studies may be under-estimating the full costs of congestion.
- Congestion is most likely to be minimized by roadway capacity investments, investment in modal alternatives and pricing schemes.

Current impact studies may be under-estimating the full costs of congestion and the full benefits of investing to reduce future congestion growth, as they fail to capture the full range of business and economic implications generated by congestion growth.

While the implications of congestion growth can be severe, it is most likely impossible to solve those impacts merely by building more roadway capacity. That is because the interactions of traffic congestion, business location decisions and land use patterns lead to complex interactions that make single dimension policies (such as capacity building) self defeating. Rather, congestion growth and its adverse economic impacts are most likely to be minimized by policies that combine roadway capacity investments with investment in modal alternatives (for both passenger and freight travel) and pricing schemes that can facilitate the movement of high value and priority freight shipments without undue delay.

To design and implement such policies, transportation planning and economic impact analysis models must become more sensitive to the different facets of traffic impact and economic consequences. They are:

Mode and Trip Purpose. There are major differences in the severity of scheduling constraints and reliability concerns for commuting, business worker travel, truck freight deliveries and operation of intermodal facilities. They can differ among various combinations of mode, trip purpose and affected industry/commodity.

Time Periods. For classes of business-related travel that are most affected by congestion delays and schedule unreliability, there are important differences in the extent of options to modify work shifts and delivery schedules. These options vary by industry depending on abilities to operate and ship during morning, afternoon and/or evening periods.

Business Location and Operations Patterns. For industries that are most dependent on closely integrated supply chains, congestion can affect deployment and use of truck fleets, and that can lead to subsequent changes in the number, location and dispersion of locations for manufacturing and distribution facilities.

Intermodal Linkages. Ultimately, every change in congestion along a segment of the road network is likely to affect access from some areas to airport, marine port or rail intermodal facilities. Conversely, every change affecting the activity at an airport, marine port or railroad facilities is likely to also affect traffic levels to and from it. Thus, congestion impact analysis calls for an intermodal perspective for measuring effects.

In an attempt to address these key dimensions of impact, all three of the impact studies identified in this paper relied on enhanced travel and economic models. They all started out by using regional travel demand forecasting systems to identify the nature of current and potential future congestion. In each case, additional effort was made to separate commuting, business travel and personal trips. These studies also involved additional efforts to separate truck movements from car traffic, and to estimate peak vs. off-peak traffic for key affected areas.

Among the three studies cited, it is notable that all three required a multi-modal analysis framework because they fundamentally involved issues of road connections to other modes – which could include rail, air and/or port facilities. Yet there was a different combination of local modal issues in each case. For Chicago, a particularly critical issue was capacity and access for truck movements to rail yards and industrial corridors. For Vancouver, a particularly critical issue was capacity of access routes to seaport and airport facilities. For Portland, a particularly critical issue was region-wide truck delivery for warehousing and distribution facilities.

A remaining problem that has not yet been well covered in the studies to date is the extent to which businesses can adjust to mitigate congestion through schedule, location and operational changes. It is important for impact studies to recognize that even when businesses shift truck delivery and worker shift schedules to avoid peak congestion, those activity shifts come do have an incremental cost for the business. As noted in the Portland report,

"As congestion becomes a day-long condition, businesses can adjust by further changing their deployment of staff, inventory management and delivery areas. However, such changes affect costs and revenues for both local-serving and trade-oriented businesses. Local-serving businesses either absorb added costs and reduce their profits or pass these costs on to people in the region. Trade-oriented businesses though, can and do move their operations to locations outside the region."