TR NEWS

NUMBER 274 MAY–JUNE 2011

PUBLIC–PRIVATE PARTNERSHIPS FOR TRANSPORTATION

3 INTRODUCTION
Public–Private Partnerships for Transportation: Filling Funding Gaps for Infrastructure
Steve DeWitt
The United States is searching—and struggling—for solutions to its critically inadequate transportation funding. Many believe that public–private partnerships could fill some of the gaps. The policy issues and legislative debates, however, have proved substantial and complex; the assembled articles present the legal, policy, and owner perspectives.

4 **Challenges Mount for Traditional Transportation Funding: Are Public–Private Partnerships a U.S. Solution?**
Pamela Bailey-Campbell
Public–private partnerships (PPPs) increasingly have become a way for public agencies around the world to build or upgrade transportation infrastructure; in the United States, PPPs are still developing. The author looks at successful U.S. programs, draws out rules for success, and recommends three actions at the federal level to make the most of PPPs.

10 **International Practices in Public–Private Partnerships: Synthesis and Discussion**
Michael J. Garvin
The experience of international counterparts with public–private partnerships offers lessons and practices that may be applicable to the U.S. market. The author reviews arrangements in Europe and Australia and suggests pointers on project identification and selection; market preparation; revenue transfer, tolls, and direct payments; procurement and contract management; and more.

16 **Value from Public–Private Partnerships: Balancing Prescriptive and Performance Specifications from Design to Handback**
Jonathan Startin
In a long-term concession agreement, the public owners seek to transfer the risks for the asset's condition to the private concessionaire through performance requirements for operation and maintenance and for handback. The author traces out the challenges, which include aligning objectives through a commercial framework, determining measures, and defining benchmarks.

23 **Selecting Public–Private Partnerships for Transportation Projects: From Episodic to Programmatic Public-Sector Decision Making**
Geoffrey S. Yarema
During the 25 years of U.S. experience with public–private partnerships, an evolution has occurred in the way that transportation agencies have selected projects. The author identifies three generations in the evolution, describes the underlying rationales for each, and notes the components of a programmatic approach to integrated project selection.

28 **Protecting the Public Interest in Long-Term Highway Concessions**
Robert W. Poole, Jr.
The author analyzes findings from three U.S. studies of public–private partnerships, as well as initiatives in Florida and Texas, and concludes that long-term concessions for selected large highway projects have merit, and that the public interest can be protected through provisions in the agreement, drawing on the experience of other countries.

4

16

28

COVER: A public–private partnership is responsible for the design and construction of a major Washington, D.C., Metrorail connection to Dulles International Airport. (Photo by Tom Saunders, Virginia Department of Transportation)

TR NEWS

features articles on innovative and timely research and development activities in all modes of transportation. Brief news items of interest to the transportation community are also included, along with profiles of transportation professionals, meeting announcements, summaries of new publications, and news of Transportation Research Board activities.

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ALSO IN THIS ISSUE:

33 Research Pays Off
Warm-Mix Asphalt Heating Up in Virginia
Stacey D. Diefenderfer and Trenton M. Clark

36 Profiles
Transportation landscape architect Scott Bradley and bridge and materials engineer Mohammad S. Khan

38 News Briefs

41 Calendar

42 TRB Highlights
Cooperative Research Programs News, 43

44 Bookshelf

PHOTO COURTESY OF KEVIN MCGHEE

33

COMING NEXT ISSUE

With the 10th anniversary of the terrorist attacks of September 11, 2001, approaching, the July–August 2011 *TR News* assembles feature articles exploring the state of security and critical infrastructure protection, including an assessment of U.S. infrastructure resiliency, North American perimeter security and the movement of trade, the security of bridges and tunnels, measures to protect rail and transit from attacks, the effects of piracy on the global supply chain, and the relative threats from airline passengers and air cargo. Also highlighted are findings and applications for state transportation agencies from Cooperative Research Programs projects, including emergency response planning, physical security basics, communicating with vulnerable populations in emergencies, and an all-hazards guide for costing asset protection.

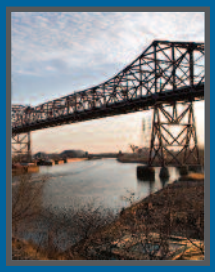
PHOTO: JUSTIN SULLIVAN, GETTY IMAGES

New York City police officers prepare to search trucks entering the Lincoln Tunnel, November 13, 2001. Truck searches at the tunnel are routine since the September 11, 2001, attacks.

INTRODUCTION

Public–Private Partnerships for Transportation

Filling Funding Gaps for Infrastructure


The United States is searching—and struggling—for solutions to its critically inadequate transportation funding. The gas tax has raised well-publicized issues; pricing based on vehicle miles traveled has been slow to gain momentum; tolling is supported here and there—but not everywhere. Other tax strategies fall short of meeting funding needs and public acceptance. Where else can the nation look? One potential resource is the private sector.

The concept is not new. Many of the nation's original roads were developed in the 1800s by private investors to spur economic development, create jobs, and move the nation forward. Those needs and goals sound familiar. The United States struggled then—and struggles now.

Many believe that public–private partnerships (PPPs) could quickly fill some of the ever-widening gaps in funding. Money from the private sector, in exchange for a promised, modest rate of return, could supply a product today that the public could not afford any other way—why not?

The public policy issues, however, have proved substantial. Can a private entity—perhaps even from a foreign nation—be allowed to manage one of America's key transportation facilities over a long term? What about the complexities of the deal or agreement? Do U.S. transportation agencies have staff with the skill sets that these complex transactions require? These arrangements, after all, are not only about the money—they involve long-term performance contracts with intricate provisions that must be administered throughout the concession terms.

At the forefront are the legislative debates. The PPP concept gains traction, and transportation agencies move projects forward, but suddenly legislative support weakens or dissolves, policy moves backwards, elections occur, and the cycle resumes.

The articles in this edition of *TR News* touch on and explore many of these issues. The public policy debates are as complex as the deals themselves, or even more complex. The authors of the assembled features come from a wide cross section of the transportation community, presenting the legal, policy, and owner perspectives.

PHOTO: NEW WOODSTOCK AND VICINITY, PAST AND PRESENT, 1901

Many roads were developed by private investors in the 19th century, such as the Hamilton and Skaneateles Turnpike, constructed in 1811 in New York.

—Steve DeWitt
Chair, TRB Project Delivery Methods Committee
Chief Engineer, North Carolina Department of Transportation Turnpike Authority, Raleigh

EDITOR'S NOTE: Appreciation is expressed to Christopher Hedges for his contributions in developing this issue of *TR News*.

Challenges Mount for Traditional Transportation Funding

Are Public–Private Partnerships a U.S. Solution?

PAMELA BAILEY-CAMPBELL

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Public–private partnerships (PPPs) increasingly have become a way for public agencies around the world to build or upgrade infrastructure, including facilities for transportation, government, health care, schools, and water and wastewater. According to some estimates, PPPs have enabled 10 percent to 20 percent of government infrastructure projects worldwide. The arrangements are much more prevalent outside of the United States, and the merits are debated vigorously.

In the U.S. transportation arena, PPPs are still developing, although some of the earliest implementations started at the end of the 1980s. Considerable misinformation surrounds the use of PPPs, in part because the arrangements are complex, and each is unique. The question persists: Can PPPs offer a solution to the challenges of funding transportation infrastructure needs in the United States?

Infrastructure Needs

The United States has underinvested significantly in transportation and other infrastructure, particularly in the past 15 years. A key source of revenue, the federal fuel tax, stands at 18.4 cents per gallon and has not increased since 1993. With decreasing growth in automobile travel and increasing fuel efficiency, the Highway Trust Fund revenues in the next federal reauthorization may necessitate a significant cut in spending.

Other consequences of insufficient investment include traffic gridlock, which causes 4.2 billion hours of travel delays and wastes 2.9 billion gallons of fuel annually, according to the Texas Transportation Institute. Congestion reduces business productivity and has a negative impact on the environment. At the status quo, Americans can expect to spend the equivalent of four work weeks each year in traffic

PHOTO: TOM SAUNDERS, VIRGINIA DOT

Declining Highway Trust Fund revenues and underinvestment in transportation infrastructure have led to increased traffic congestion, among other consequences.

congestion by 2035, according to the American Road and Transportation Builders Association.

The American Society of Civil Engineers reports that use of transit increased by 21 percent between 1993 and 2002—a rate faster than that of any other mode. Yet the Federal Transit Administration estimates a funding shortfall of $14.8 billion annually to maintain conditions or $20.6 billion to improve to good conditions.

As stated in the final report of the National Surface Transportation Financing Commission:

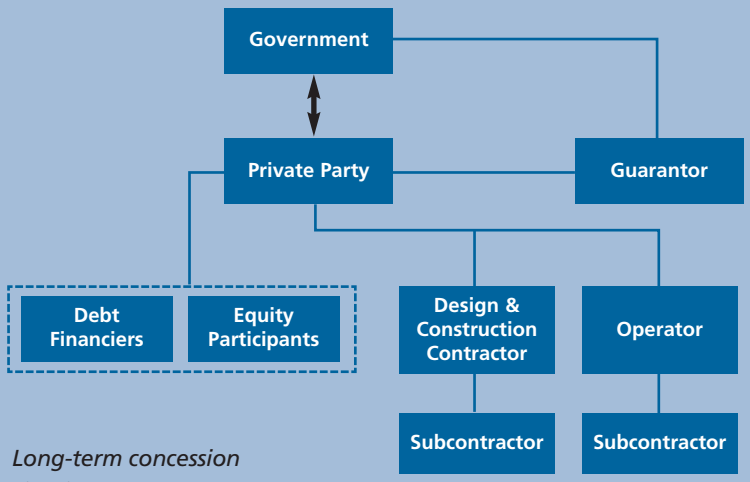
> Over the last few decades, we have grown complacent, expecting to be served by high-quality infrastructure, even as we devoted less and less money in real terms to the maintenance and expansion of that infrastructure. Not only have we failed to make the needed and substantial invest-

What Is a Public–Private Partnership?

Public–private partnerships (PPPs) comprise a variety of project financing and delivery methods that can expedite projects, relieve the public of certain risks, and leverage public funds. In the construction of infrastructure, PPP arrangements have evolved from design–build to design–build–finance–operate–maintain, with many options in between, representing a continuum between public and private funds, along with public and private responsibility (see figure, below).

The United Kingdom has one of the longest-standing comprehensive national PPP programs, extending across all aspects of infrastructure. In 1992, Prime Minister John Major's government established the Private Financing Initiative (PFI), and more than 625 PFI transportation and other projects have been inked, with a total capital value approaching £60 billion. This is a centralized approach, with major transportation projects funded directly by the government; each ministry vets candidates for PPPs as part of the normal procurement process.

Other successful models for PPPs can be found in Canada and Australia; in both nations, the arrangements were initiated at the state or provincial level, and national organizations built on that success. In 2008, Canada created PPP Canada as a government corporation to promote PPPs at the provincial level and committed $1.25 billion for up to 25 percent of the initial construction costs. A typical international concession structure is shown in the figure above.



Long-term concession structure.

The international market of PPPs operates in a financial environment different from that of the United States. In Europe, governmental entities typically deal with banks for project financing, and the corporations that undertake the projects have both public and private owners. With the arrival of the long-term concession model in the United States, the primary participants have been international firms—few domestic firms have had the opportunity as yet to develop the expertise for these projects.

— Pamela Bailey-Campbell

Development	Delivery	Operations	Maintenance	Finance	
Public	D-B-B	Public	Public	Public	Design–Bid–Build (D-B-B)
Public	D-B-B	Private	Public	Public	Private Contract Fee Services
Public	D-B-B	Private	Private	Public	
Public	D-B	Public	Public	Public	Design–Build (D-B)
Public	D-B	Private	Private	Public	Build–Operate–Transfer
Public–Private	D-B	Private	Private	Public–Private	Long-Term Lease Agreement
Private	D-B	Private	Private	Private	Build–Own–Operate

RISK/CONTROL: Public (top) – Private (bottom)

PPPs

Risk–responsibility matrix: options for private-sector involvement—a continuum of risk transfer and control.

Photo: Tom Saunders, Virginia DOT

The Pocahontas Parkway near Richmond, Virginia, opened in 2002 and was leased to a private entity in 2006.

ment; we have failed to pursue the kind of innovation necessary to ensure that our infrastructure meets the demands of future generations. (*1*)

Although innovative finance and delivery cannot substitute for new funding, PPPs can offer an effective and productive solution.

Early U.S. PPPs

In the U.S. transportation arena, PPPs gained attention in the 1990s. Some of the early applications of design–build were introduced in association with PPPs, to address requirements for greater certainty in design and construction costs.

A few of the early PPP transportation projects employed a tax-exempt finance model. The E-470 toll road in Colorado, for example, used a success fee for up-front development, combined with tax-exempt toll revenue bonds; and the Pocahontas Parkway in Virginia, the Greenville Connector in South Carolina, and the Las Vegas Monorail in Nevada used nonprofit corporations.

California's 1989 legislation, AB 680, was one of the earliest U.S. programs for concessions under a design–build–finance–operate–maintain (DBFOM) arrangement. The program produced the SR 91 High-Occupancy Toll (HOT) Lanes, later sold to the Orange County Transportation Authority, and the SR 125 toll road, later renamed Southbay Expressway—although SR 125 recently entered bankruptcy, it remains in full operation.

The latest headlines about concessions have focused on the monetizing of toll road assets by awarding extremely long-term concessions of 75 to 99 years in return for large up-front payments. Examples include the Chicago Skyway and the Indiana Toll Road. The Chicago Skyway arrangement generated controversy when the City of Chicago applied the excess revenues after debt payment to nontransportation programs.

Successful U.S. Programs

Although international programs offer many valuable lessons, a distinct difference prevents any PPP program in the United States from resembling the Private Finance Initiative in the United Kingdom. In the United States, the control of infrastructure funding and the laws affecting its delivery and financing rest at the state, not the federal, level. This increases the variations and frequently frustrates the involvement of global PPP participants comfortable with greater centralized control and standardization.

PPP activity varies substantially across the states. According to the National Conference of State Legislatures, 28 states and Puerto Rico had PPP-enabling statutes as of March 2010, but the parameters for private-sector participation in public projects were not uniform.

One international approach gaining adoption by U.S. PPPs is the use of public-sector comparators (PSCs) and value-for-money (VfM) analysis. A VfM analysis independently validates that a proposed PPP project would provide more value to the public sector than other available financing and delivery options. The PSC is a key to the analysis, establishing the cost and schedule of the public-sector delivery option for comparison. Canada and New Zealand offer several examples of applying the VfM method. A consistent and thorough application of this tool provides a transparent vetting process to assure that the PPP is upholding the public interest.

Recent innovations in PPP configurations have incorporated federal sources of assistance, including loans under the Transportation Infrastructure Finance and Innovation Act (TIFIA)[1] and tax-exempt transportation Private Activity Bonds (PABs)[2]. Also of

[1] TIFIA is a U.S. Department of Transportation (DOT) credit assistance program for large transportation infrastructure projects. The assistance includes secured loans, loan guarantees, and lines of credit. U.S. DOT makes the awards based on a project's merits and fulfillment of statutory requirements. Details are available at http://tifia.fhwa.dot.gov.

[2] PABs allow states to issue and transfer to private companies up to $15 billion in tax-exempt bonds to finance qualified highway, freight, and transit projects. The U.S. Secretary of Transportation allocates the $15 billion.

interest is the availability payment model, which offers long-term financial incentives for private-sector involvement. Availability payments are made annually by the public sector throughout the course of the agreement and form the basis for private-sector financing.

Other opportunities may be generated by the direct investment in infrastructure by pension funds. The Dallas Police and Fire Pension fund, for example, financed the I-635 LBJ project in Texas. States are using all of the financing tools available to validate and perfect PPPs. Virginia and Texas have the longest-standing U.S. programs, which have yielded many successful projects.

Virginia Initiatives

Virginia's Public–Private Transportation Act (PPTA) started in 1995 to promote private-sector innovation and investment in transportation projects. Virginia has completed three PPTA projects, including Route 288 and the Pocahontas Parkway near Richmond and the Jamestown 2007 improvements near Williamsburg. The state has six projects in development, including the Downtown Tunnel–Midtown Tunnel Project in Hampton Roads, the I-495 Capital Beltway HOT Lanes in Northern Virginia, Route 58 near Hillsville, and the Coalfields Expressway in the Bristol District. Two PPTA proposals are under consideration: Route 460 and the I-95–395 HOT Lanes.

The Metrorail extension to Dulles Airport also is being developed as a PPTA project. Construction has begun on the Capital Beltway with $2 billion of project financing leveraged from an initial $409 million public investment. Governor Bob McDonnell has announced plans to establish a separate multimodal PPTA program office at Virginia DOT.

Texas Projects

In Texas, the Comprehensive Development Agreement (CDA) program has allowed the state to invest approximately $3.5 billion since 2002 to leverage and return more than $10.5 billion in long-term transportation improvements. The projects are highlighted in Figure 1 (above). Texas DOT and local-level Regional Mobility Authorities can enter into CDAs.

The program has generated controversy; by statute, Texas DOT lost its general authority to enter into CDAs on August 31, 2009, retaining limited authority on specifically exempt projects and conditions until August 31, 2011. Texas DOT has indicated an interest in continuing the program, which has accelerated project delivery and has closed gaps in funding. In 2009 and 2010, the CDA program attracted more than $6 billion in private investment in state infrastructure.

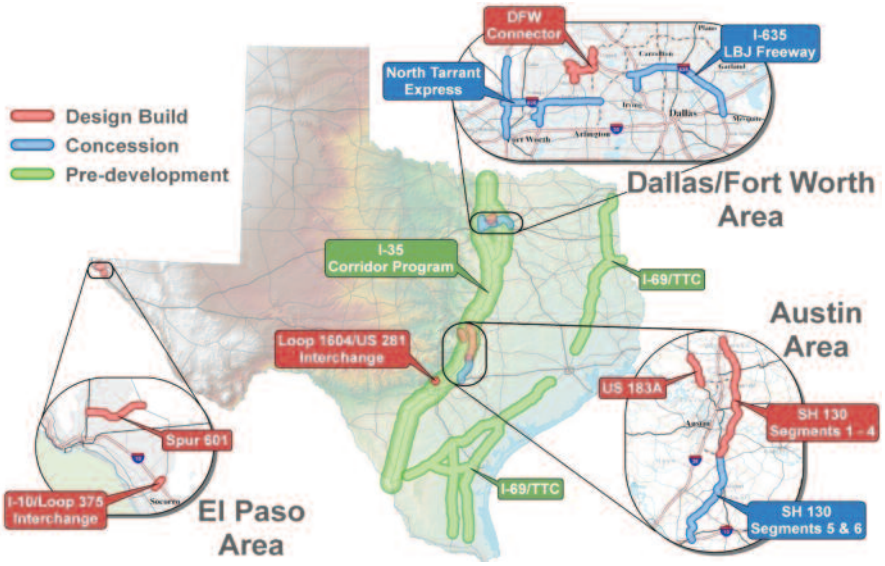


FIGURE 1 CDA projects in Texas.

Two recent Texas projects—the I-635 and North Tarrant Expressway managed lane PPP—used tax-exempt PABs and low interest TIFIA loans as sources of debt capital, amounting to more than $1 billion of PABs and $1.5 billion of TIFIA loans.

Other Active Programs

Florida is among the states most active in transportation PPP programs, with two successful projects, the Port of Miami Tunnel and the I-595 Managed Lanes, both financed under the availability payment model. Georgia recently reactivated its program, issuing three separate RFPs in 2010. In 2009, Arizona adopted PPP legislation, and the state DOT is drafting program guidelines and beginning to screen projects.

California adopted the PPP legislation SBX2 4 in 2009, despite long-standing opposition from public employee unions. The state has moved rapidly and reached commercial close on a PPP contract for the Presidio Parkway project in San Francisco. The Los Angeles Metropolitan Transit Authority is conducting an in-depth analysis of potential PPP projects in the transit and highway modes and expects to initiate its first procurement in 2011.

The Denver Regional Transportation District Eagle PPP project, one of the most successful transit PPP projects, completed financial close in August 2010 with FTA funds, PABs, and private equity. The arrangement will deliver three separate commuter rail projects under the DBFOM model. PPPs also are a cornerstone of the delivery and funding strategies for the high-speed rail programs in Florida and California.

Rules for Success

The delivery of transportation infrastructure can benefit from PPPs in many ways, by accelerating projects, transferring risk to the private sector, and bringing innovative and creative solutions to the public sector. Effective use of PPPs for transportation projects adheres to the following rules:

1. PPPs are only part of the solution and cannot overcome systematic underinvestment in infrastructure. Attempting to avoid difficult decisions by shifting responsibility to PPPs or to any other financing mechanism is "ostrich politics."
2. Not all projects are good candidates for a PPP. Carefully assess and screen potential projects and then determine that the PPP approach will add value. Develop PSCs and complete a VfM analysis to evaluate a PPP arrangement against the more traditional options.
3. Focus the PPP on delivering new or enhanced infrastructure, not on monetizing an asset to pay down a deficit in the operating budget of the general fund.
4. Establish clear, realistic goals, whether for a single project or an entire PPP program. If the PPP approach cannot meet the goals, postpone or halt the process. A PPP is a tool, not a goal in and of itself.
5. Make sure that the public-sector participants have the knowledge and expertise to develop the procurement effectively and to evaluate and negotiate the agreements.
6. Create procurement processes that maximize opportunities for the private sector to exercise innovation and creativity.
7. Conduct fair, open procurements that are transparent, that focus on achieving the best value for the public, and that ensure fairness for the private participants.

Three Actions

With those seven rules for PPP success in place, three actions can assist in making PPPs a more valuable tool in delivering transportation infrastructure in the United States:

1. Create PPP Information Resources.

Create PPP clearinghouses and organizations that can offer support through information on best practices, key legislative elements, and templates. The Federal Highway Administration's Office of Innovative Program Delivery and Infrastructure Australia offer models. These resources can be housed at the federal level, within state DOTs, or at separate entities such as the Public Infrastructure Advisory Commission in California. The goal is to provide clear, unbiased information for public officials and government employees.

These resources could provide valuable information to public entities—particularly to smaller transit agencies or municipalities—that are starting to

PHOTO: PRESIDIO PARKWAY PROJECT

Currently under construction, the Presidio Parkway project was developed soon after California adopted PPP legislation in 2009. Successful projects have made use of information resources and available financial tools.

IMAGE COURTESY OF DENVER RTD

The Denver Regional Transportation District Eagle PPP financed the development of three commuter rail lines in Denver, Colorado. The East Rail Line, pictured here in a rendering, is scheduled to open in 2016.

explore PPPs. For example, some state DOTs have called on Partnerships BC in Canada for help in assessing PPP approaches and programs.

2. Supply Financial Tools.
At the federal level, programs such as TIFIA and tax-exempt PABs have proved important for PPP projects. These tools not only lower the cost of financing PPP projects but can make the difference on proceeding.

- The flexible, subordinated financing of TIFIA allows for greater leveraging of project-related revenue. The addition of a revolving fund—making funds that are repaid available for future projects—could greatly increase TIFIA's value. The TIFIA loan program, however, is oversubscribed—more than 39 applications were received in 2010—and more capacity is needed. TIFIA originally focused on encouraging private investment; the evaluation criteria for TIFIA applications should continue to encourage private-sector involvement.
- Similar structures could be created at the state or metropolitan levels, following the revolving loan model of the Infrastructure Bank.
- PABs would benefit from an increase in the current $15 billion cap and from an expanded ability to issue a variation of Build America bonds.

3. Provide Seed Money.
A source of seed money or matching funds for PPPs is needed at the federal and state levels, similar to that offered through PPP Canada. These funds would provide incentives for public entities that need financial assistance to pursue innovative PPP solutions.

The Bottom Line

Can PPPs offer a solution to the mounting challenges to fund transportation in the United States? Yes, but PPPs are only a solution, not the solution. Pushing the approach too far will harm the ability of PPPs to fill their intended niche.

Nonetheless, failing to consider the use of PPPs is like a mechanic throwing out the 3/4-inch wrench from the toolbox, declaring it unnecessary without considering future needs. The seven PPP rules and three actions presented here can ensure appropriate and beneficial use of PPPs to aid in solving U.S. infrastructure challenges.

Reference

1. *Paying Our Way: A New Framework for Transportation Finance*. National Surface Transportation Infrastructure Financing Commission, Washington, D.C., February 2009. http://financecommission.dot.gov/Documents/NSTIF_Commission_Final_Report_Advance%20Copy_Feb09.pdf.

International Practices in Public–Private Partnerships

Synthesis and Discussion

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In the United States, the private sector provided public infrastructure and management before the 20th century, but since the end of World War II, design–bid–build—a tax-based funding model with a segmented delivery—has prevailed. In the past 20 years, however, some states and municipalities have started to apply alternative delivery systems for infrastructure, and others have experimented with these approaches.

The arrangements often are grouped as public–private partnerships (PPPs), characterized by any two or all of the following:

- Long-term contractual agreements between public and private parties;
- The creation and enhancement of assets, bundled together with the provision of services; or
- Capital financing through a private entity.

The resurgence of PPP activity in the United States has slowed recently as a result of heightened civic and political scrutiny, a sluggish economy, and apparent federal indifference. These circumstances, however, can play to the nation's advantage. The slowdown allows a more thoughtful assessment of PPPs at the program and the project levels. The experience of international counterparts offers an opportunity to consider practices that are applicable and that may improve the domestic market models.

Procurement Procedures

Several international regions share procurement regulations across boundaries. For instance, the legal framework of the European Union (EU) sets standards and procedures for the procurement of public works and services that apply to all member

PHOTO: WIKIMEDIA COMMONS

Cars enter the Cross City Tunnel at Darling Harbour in Sydney, Australia. Built in 2003 and opened to traffic in 2005, the toll road is scheduled to revert to public ownership in 2035.

countries. In general, the basic principles of the applicable laws and regulations are similar to those of the United States—for example, an advertisement must be placed in EU's official journal, technical specifications may not be discriminatory, and permitted criteria may be used to reject or select participants.

The procedures for procurement may be open, restricted, or negotiated, or may involve a competitive dialogue; participants must be treated equally, and awards must be made under reasonable criteria, which typically translate into the lowest price or the most economically advantageous offer. The open procedure requires a public notice followed by bids from interested parties; in contrast, the restricted procedure requires a public notice followed by bids from invited parties. PPPs may use either of these procedures.

The applicability of the negotiated and competitive dialogue procedures is limited. The negotiated procedure is allowed as an exception, when the nature or risks of the intended work make preliminary pricing unfeasible. Typically, parties iteratively negotiate a project's conditions and terms with a public authority until a binding offer is made and evaluated against specified criteria.

A competitive dialogue is permitted when a public authority cannot define a project for procurement because of the technical, financial, or legal complexity. Selected participants then engage in a dialogue with the public authority to develop one or more acceptable solutions. Participants are iteratively eliminated until a winner is identified.

Project Selection

Identification

Throughout the EU and Australia, candidate projects for PPPs typically are identified according to the requirements listed in each country's long-range transportation plan. Projects of significant scale and complexity often are viewed as possible PPP arrangements.

For instance, in the United Kingdom, a private finance strategy must be the first option considered for any major highway scheme or plan, defined as having a capital cost of more than £7.5 million. Schemes valued at less than £100 million are expected to offer better value, however, if delivered conventionally.

Although scale can offset the substantial transaction costs involved, scale coupled with complexity is more likely to introduce meaningful risks throughout a project's life cycle. The assumption of long-term risk by the private partner stimulates innovative project concepts and solutions.

Assessment

After a candidate project is identified and conceptually defined, the United Kingdom and Australia and other countries employ a methodical approach for evaluation, developing a public-sector comparator (PSC) and conducting a value-for-money (VfM) analysis. Generally, a PPP approach is taken only if VfM is expected. The thinking is that VfM is achievable only if private-sector expertise, innovation, competitive efficiency, and risk assumption can overcome the increased transaction, contracting, and negotiation costs, and yield economic profit (*1*).

Other countries do not apply VfM methods. Portugal and Spain, for example, conduct a feasibility analysis of a candidate project during the programming process. If the majority of a project's market risks can be transferred to the private sector in an economically viable manner, then the project is likely to proceed as a PPP.

Often, the government will evaluate the expected rate of return and adjust the project. If the expected rate of return for a PPP project is too high, then the government will look to reduce the rate, for example by increasing the project's scope of work to include feeder or connector roadway segments. If the expected rate is too low, then the government will consider measures to increase the rate, for example by including public subsidies.

Market Preparation

After concluding that a PPP strategy is appropriate for a project, many countries undertake extensive preparation for markets. Conducting market soundings is a nearly standard practice as a project takes shape. Early dialogue with potential bidders before the procurement can improve the public sector's understanding of what may be feasible, what the bidders' commercial considerations may be, and whether market interest is serious.

To avoid potential or perceived impropriety, these soundings are conducted on a fair and equitable basis. The time and effort spent in engaging end-users and other interested stakeholders early in the process can reduce the number of changes to a project's conditions or outputs in the later stages.

In the United Kingdom, the project preparation process also includes

- Creating an "illustrative design" to demonstrate a feasible solution for the project;
- Making progress on statutory requirements, such as environmental permitting;
- Completing surveys of site and subsurface conditions and assets;
- Preparing for right-of-way acquisition;

Image: Taylor Made Digital Images

The Northern Busway PPP will connect Brisbane, Queensland, Australia, to the city's northern suburbs. Investors in Queensland's highway PPPs are responsible for possible market losses, but also share in a project's potential gains.

- Starting on agreements with other stakeholders, such as utilities; and
- Maintaining a risk register to indicate the planned allocation of key risks.

The level of development of each element will vary from project to project. Although this represents a significant investment for the public sector, the clear articulation of a project's fundamental requirements and a comprehensive understanding of a project's conditions are invaluable.

Revenue Transfer Mechanisms

Real Tolls

PPPs often employ real tolls or user fees. As a result, the issue of revenue risk tends to dominate the risk transfer and the commercial or financial considerations. The magnitude of the revenue risk is difficult to predict and can vary from project to project, involving such factors as expected economic growth, user behavior, price elasticity, and substitute or parallel facilities. Countries have adopted a variety of practices when real tolls are the principal source of revenue for a project.

Demand Risk-Sharing

In Spain, the law allows the bidding terms to establish a risk-sharing scheme based on user demand. The government establishes a threshold for a specific demand-risk variable, and the bidders propose an upper and a lower boundary in relation to the threshold. The government often sets a limit for the lower boundary, to ensure that the contractor assumes a significant portion of the risk. A traffic- or revenue-based variable may serve as the basis for the forecasts.

If the actual economic conditions differ from the expected conditions, the contract must be rebalanced by adjusting preestablished parameters, such as the toll rate. For example, the government may choose gross revenue as the basis for the threshold and select the toll rate and the contract's duration as the parameters to be adjusted in rebalancing. The government then forecasts the annual gross revenue for the contract's duration and establishes the lower boundary at 80 percent of the annual forecast.

Bidders then propose their boundaries, which will be evaluated as part of the award criteria. If the winning bidder proposes upper and lower boundaries of 130 percent and 70 percent of the threshold value, no change is made to the contract as long as the actual annual gross revenue falls within this range. If actual gross revenue falls below the lower boundary, then a rebalancing must take place.

One option may be to raise the maximum toll rate until the gross revenue comes back within the established boundaries. Similarly, a rebalancing is triggered if the actual gross revenue exceeds the upper boundary (*2*).

Variable-Length Concessions

In Chile and other South American nations, public agencies have adopted a variable-length concession model to alleviate the revenue risk. In a variable-duration concession, the contract ends when certain financial targets are met. Under the terms of the least present value of revenue, the concessionaire has the right to collect tolls until the present value of the total revenue reaches an agreed level (*3*).

This mechanism can adapt to changing circumstances, such as toll schedule adjustments or the addition of a competing facility, without lengthy and costly renegotiation—this is difficult to accomplish in standard fixed-duration contracts. Alternatively, the least present value of net revenue takes into account the duration-dependent costs of operation and maintenance and uses the net revenue as the threshold parameter (*4*).

Upside Sharing Provisions

Australia takes a different approach to demand risk. All highway PPPs in New South Wales, Victoria, and Queensland are real toll projects. These states maintain that private investors, whether equity- or debt-holders, must bear the downside market risks, or potential losses. In other words, if the expected revenues or rates of return do not materialize, the private investors must bear the consequences.

The maturity of the PPP market in Australia supports this approach—investors and lenders are comfortable with the conditions, and the marketplace can provide remedies to financial hardships, for example by restructuring the financing arrangements. Recent contracts, however, have included sharing provisions for the government and the contractor if the upside should exceed predefined thresholds. This precludes windfall gains by the contractor; such provisions are the direct result of social and political pressures.

Direct Payments

Although direct payments from the government have taken many forms internationally—such as shadow tolls and congestion payments—the availability payment model developed principally in the United Kingdom has received substantial attention in the United States. In this approach, the government pays the PPP contractor periodically during the contract period, and payments are based on meeting project milestones and performance requirements. Often the payment is subject to parameters such as lane availability, route performance, condition criteria, and safety performance. Lane availability, however, is often the principal element.

The approach has several advantages. First, the public sector amortizes its budgetary commitments to a project. In a way, the public entity is opting to pay a contractor for a specified level of service in lieu of paying debt service. In addition, the public sector can avoid the sociopolitical issues associated with instituting a toll or transferring the toll-setting and collection rights to a private entity. Finally, payments can be structured to create incentives for performance or to penalize lack of performance.

Contracts

Modifications

Because PPP contracts typically are long-term, a robust modification protocol is needed to deal with potential changes in laws, modifications initiated by the private partner, changes to accommodate project enhancements, or revisions to the service requirements. In the international arena, many early contracts did not provide for updates.

The Highways Agency in the United Kingdom, for example, is currently negotiating major changes to contracts signed in 1996. The process has proved arduous, leading the agency to adopt a two-tiered strategy in recent contracts to facilitate modifications. Any major change prompts a contract review and may necessitate negotiation of a new contract. The M25 project, encircling Greater London, is the first to include the condition for contract review. Otherwise, a step-change process allows the handling of more standard modifications within the agreement.

Management

With PPP contracts ranging from 25 to 50 years, managing the partnership between the public and private sectors is key. The partnership arrangement manifests itself most tangibly in contract management practices, which become critical during the operations phase.

In the United Kingdom, the Department's Representative (DR) has three main roles: performance monitoring, financial monitoring, and contract administration. These may appear similar to the roles of an owner's representative on a typical construction project, yet the DR must balance the relationship with the PPP contractor to fulfill the intended contract requirements, risk allocation, and service standards for a substantial period.

The DR must recognize who holds what risks and act accordingly, without inadvertently making the public sector liable for a risk allocated to the PPP contractor. Moreover, the DR must do this with a modest number of in-house support staff. Other countries have created similar positions; in Spain, for example, the role is filled by the government delegate.

PHOTO: ADRIAN PINGSTONE

Cars travel England's M25 near Heathrow Airport. This motorway project was the first in the United Kingdom to include a condition for contract review in case of a major change.

Adapting International Practice

Normalizing Procurement

In practice, Spain uses an open procurement procedure for PPPs, but the United Kingdom typically employs a negotiated procedure. Each procedure offers merits; nonetheless, private entities know that the EU's framework governs public procurement. Nuances in the process arise from country to country, but the ground rules remain the same.

In the United States, 23 states and one territory currently have legislation authorizing the use of some type of PPP for transportation infrastructure. The legislation varies from state to state. But creating unique state markets for PPPs could deter private participation and drive up transaction costs. Some level of standardization, therefore, is essential. States will want to exercise jurisdiction over infrastructure projects—they foot most of the bill—but some consistency is advisable in procurement processes and contract provisions.

In 2000, the American Bar Association's Section of Public Contract Law promulgated a Model Procurement Code for states and local jurisdictions, but only a few states have enacted legislation based on the code. In states that have adopted the code, sometimes the department of transportation is exempt from the requirements. FHWA recently has worked on producing a model for enabling legislation, as well as PPP program guidelines, but more work is needed in this area.

The predevelopment agreement (PDA) for PPPs is unique to the United States. PDAs provide advantages for public agencies unable to define or scope a project—even with consultant support—without engaging a private partner.

EU's competitive dialogue process was designed to offer similar benefits. Recent evidence from the Netherlands, however, indicates that the procedure is time-consuming and costly—but that may be inherent in the procurement for any complex infrastructure project. A comparable or derivative procurement standard is needed, so that PDAs maintain a level playing field and foster accountability and transparency during implementation.

Selecting Projects

The public sector can identify candidate projects for PPPs through long-range transportation plans but also should adopt a policy for handling unsolicited proposals, if these are permitted under the state's legislation. The trend in practice worldwide is that unsolicited proposals should align or conform with projects in a long- or short-term plan, unless a compelling rationale is presented. This lowers transaction costs and makes any subsequent competing proposals—known as "Swiss challenges"—more likely and more viable.

After a candidate project is identified, further evaluation is necessary. States have shown interest in the VfM techniques practiced in Australia and the United Kingdom. These warrant caution, however—the techniques are complex, subject to abuse, and have faced criticism; in the United Kingdom, some of the most vocal opponents have been members of Parliament. Nevertheless, the methodology promotes a systematic and auditable process for making a project delivery decision, avoiding expediency and political motivations.

Managing Revenue

Forecasting traffic demand is problematic, and for real toll projects, the question is whether the public sector should transfer the revenue risk fully to a private entity. Several nations have adopted techniques to reduce the risk burden, but these approaches may not be viable in the U.S. financial market—the nations employing these techniques have markets that are tailored to support public–private transactions.

The U.S. market historically has responded to the needs or demands of investors. Ruling out provisions for rebalancing or variable-length concessions, therefore, seems premature. In addition, the current push by the public sector to share in the revenue upside will be met by a push back from private entities for downside protection. This may spawn interesting agreements coupling revenue guarantees with revenue sharing.

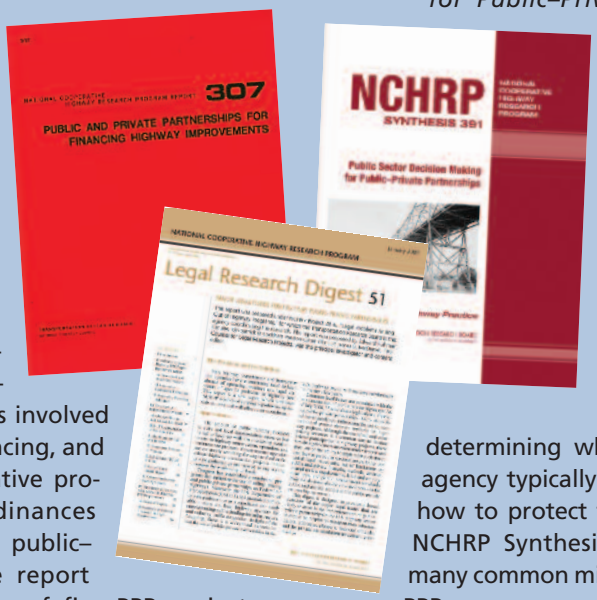
Although worthy of consideration, the availability payment model does not solve the fundamental problem of marshaling budgetary funds for projects. Even the United Kingdom, which has led the way in the use of government payment mechanisms, has started to consider limited tolling of its motorways as governmental budgetary pressures mount. In addition, the availability approach introduces an auditing burden that likely exceeds that of a real toll project, because the amount of each payment hinges on the performance parameters.

Managing Contracts

Once a deal is struck, the significance of the partnership dimension of a PPP becomes unmistakable. International public agencies recognize that the arrangement creates a long-term relationship with the private sector according to the terms of a contract. The public sector's contract management team and the private partner's operator are responsible for sustaining this relationship, which may require understanding the spirit, as well as the let-

Research Publications Explore Legal Issues, Current Practice

The National Cooperative Highway Research Program (NCHRP) has conducted research on public–private partnerships for more than 20 years. In 1988, the Transportation Research Board published NCHRP Report 307, *Public and Private Partnerships for Financing Highway Improvements*. The report included a summary of potential funding mechanisms, presented the legal issues involved in public–private financing, and reviewed state legislative proposals and local ordinances intended to facilitate public–private funding. The report presented case studies of five PPP projects already implemented.



In 2009, NCHRP Legal Research Digest 51 presented an in-depth treatment of the *Major Legal Issues for Highway Public–Private Partnerships* likely to arise in the U.S. highway sector.

Also released the same year, NCHRP Synthesis 391 examined *Public-Sector Decision Making for Public–Private Partnerships*, examining the information available to evaluate the benefits and risks associated with the private sector's taking on a greater role in financing and developing highway infrastructure. The synthesis describes recent practice in determining when a government agency typically pursues a PPP and how to protect the public interest. NCHRP Synthesis 391 also dispels many common misperceptions about PPPs.

These titles are available on the TRB publications series website, www.trb.org/Publications/PubsTRBPublicationsbySeries.aspx, and from the TRB Online Bookstore at http://books.trbbookstore.org/.

ter, of the contract.

The lengthy time frame of PPPs increases the importance of the rapport. This does not mean that the parties should deemphasize or work around the contract, but they ought to work within its bounds to resolve issues proactively.

The robustness of a contract is also critical. No contract can cover every possible contingency—such a contract would be complex and unmanageable. The long-term agreements must be malleable as circumstances and expectations evolve. For instance, performance criteria can follow positive or negative trends or can track moving benchmarks; similarly, a contract can specify periods for the review and adjustment of performance criteria to reflect changes in expectations or technology.

Applying Lessons Learned

Will the United States become a major market for PPPs and will the transition be beneficial? PPPs are neither a panacea nor a fad. The most mature PPP market in the world has invested nearly 85 percent of its funds in infrastructure through conventional delivery strategies; the balance has come through PPPs. Other nations are using these arrangements effectively to deliver needed infrastructure. By applying the lessons learned by others, the United States can do the same.

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Value from Public–Private Partnerships

Balancing Prescriptive and Performance Specifications from Design to Handback

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In a typical public–private partnership (PPP) concession agreement for an infrastructure asset, the public owners transfer the performance risk to the concessionaire for 30 years or more and stipulate that the asset will be handed back in as-new condition. The concessionaire must fix all defects at cost, and when parts are renewed or replaced, the public owner expects that these will meet the latest specifications.

For a concessionaire, taking on the risk for the asset's condition means taking on the risk of the wear and tear during service, including damage from overweight trucks, vehicle fires, impacts and spills, flooding, and deicing. The concessionaire must correct the effects of design errors long after the design is finished, as well as the construction errors that eventually show up as defects. The concessionaire also must replace obsolete components—for example, state-of-the-art fiber networks may be out of date in 30 years—to achieve the as-new service standards at handback.

PHOTO: PORTLAND CEMENT ASSOCIATION

Public–private partnership agreements may stipulate that particular technical specifications must be followed or construction procedures used—for example, requesting a certain number of rollers for compaction.

Owners must make the right technical specifications for the best value in exchange for the risk premium included in the concessionaire's price. The right technical specifications and requirements for performance and handback will avoid inadvertently taking back the risk for the asset condition and will provide value for the money invested.

Framework Approach

Technical requirements are a vital component of a well-constructed concession agreement. The framework of a PPP must find the correct balance between prescribing what is built and how it performs.

Different types of specifications are available for different methods of procurement. In concession agreements, operation and maintenance performance requirements and handback requirements typically supplement—instead of supplant—the traditional and evolving specifications familiar to public owners.

A long-term PPP concession agreement transfers the design, construction, and the operation and maintenance responsibilities to the concessionaire. The intent is to shift to the concessionaire the risk for the asset's condition. Paying for the transfer of the risk but without receiving the benefit—or paying more than is necessary—may result if the public owner

- Continues to dictate all design and construction details, so that the originally intended allocation of risk turns out to be unachievable;
- Steps in and performs repairs and maintenance, so that enforcement becomes more challenging; or
- Specifies operation and maintenance performance requirements that far exceed the standards generally applicable to similar roads under public operation and control.

TABLE 1 Summary of Specification Types and Examples of Use

Specification Type	Explanation
Method and material specification (also known as prescriptive specification)	The final product is described in terms of component materials, dimensions, tolerances, weights, and required construction methodology, such as equipment type, size, and speed; currently prevalent in traditionally procured infrastructure construction. *Example: Compact using 6 passes of specified roller.*
Performance-related construction specification (also known as quality assurance–quality control specification)	The future performance of a product is projected using construction tests and measurements linked to design via modeling; becoming more common across all forms of procurement. *Example: Achieve specified permeability of concrete.*
Operation and maintenance performance requirement (also known as a warranty specification in design–build procurement)	Actual performance of the product is measured after a predetermined time in service; common under a concession agreement and also used in design–build as a warranty specification, but difficult to enforce. *Example: Achieve specified roughness index on roadway throughout maintenance period.*
Handback requirement	Specifies the condition of the asset at handback; applicable only to a long-term concession agreement. *Example: Achieve residual life of 50 years for steel girder.*

Increasingly applicable to PPP concession agreements ↓

The main challenges in establishing performance requirements for operation and maintenance include aligning objectives, determining measures, and defining benchmarks and obsolescence. Handback requirements do not have a long history; published information on best practices and lessons learned is sparse. (See sidebar, below, for definitions of key terms.)

Technical Requirements

Technical requirements have evolved under different circumstances (*1–4*); Table 1 (above) summarizes types of specifications and some typical examples. In addition to specifications for construction and for operation and maintenance, technical requirements include

Glossary of Key Terms in Public–Private Partnerships

Handback requirements—The requirements to be met by the concessionaire as conditions for the acceptance of the facility by the public owner at the end of the concession term, including the achievement of a certain residual life for individual components.

Handback reserve—A reserve account established during the 5 to 6 years before the end of the concession period, to provide a fund for major renewal work by the public owner after the handback and to provide a reserve for any necessary, unplanned repair or renewal work undertaken by the concessionaire before the public owner accepts the asset at handback. The handback reserve is funded out of payments that normally would accrue to the concessionaire but are withheld by the public owner according to measurements of asset condition.

Operation and maintenance performance requirements—The portion of the technical requirements that sets forth the minimum performance standards that each component of the asset must meet in service. Operation and maintenance performance requirements, for example, could specify the ride quality of the finished surface of a roadway in terms of the International Roughness Index.

Residual life—The estimated period remaining until a component will next require reconstruction, rehabilitation, restoration, renewal, or replacement. The residual life can be estimated at any point in the concession agreement, but typically at handback. Residual life can only be estimated using histories, inspections, testing, and deterioration modeling; it generally cannot be determined with precision.

Specified service life—A period specified by the public owner during which a component of a newly constructed asset is expected to remain in service under ordinary maintenance, until it next requires reconstruction, rehabilitation, restoration, renewal, or replacement. Although the specified service life is not the same as the design life, the goal is to make the specified service life of a component equal to its design life.

Technical requirements—Provisions in the concession agreement that specify the design, construction, and operation and maintenance requirements.

Useful Life—The period estimated by the public owner during which a component of the asset that is renewed or replaced by the concessionaire is expected to remain in service, under ordinary maintenance, until it next requires reconstruction, rehabilitation, restoration, renewal, or replacement. The useful life of a component may not be the same as its original specified service life.

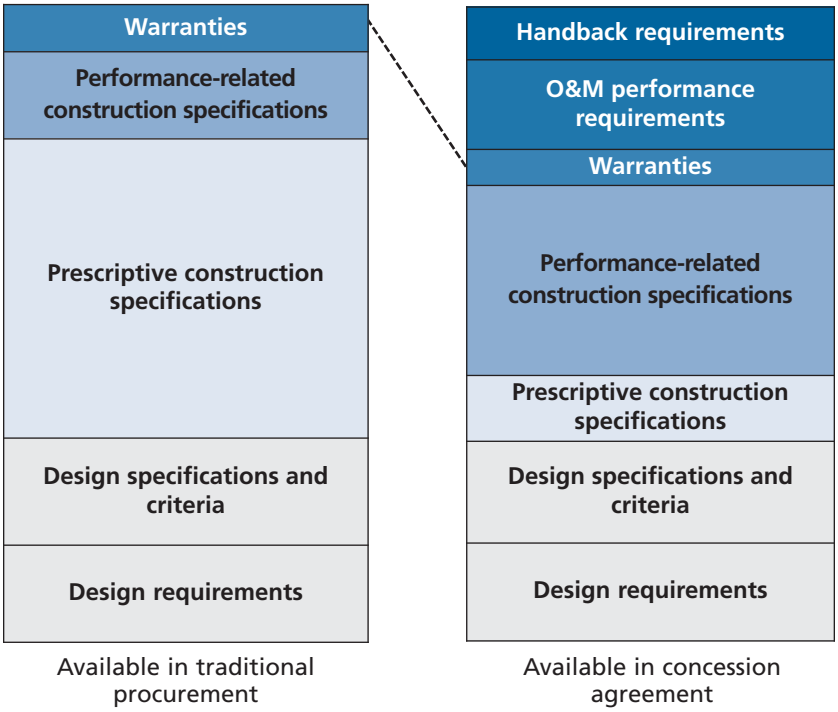


FIGURE 1 Comparison of specification types available. (Traditional procurement = design–bid–build or design–build; O&M = operation and maintenance.)

- Design requirements—for example, directives to follow a certain design manual or methodology; and
- Design criteria—for example, achieving a minimum factor of safety.

For a long-term concession agreement, public owners may effectively transfer asset condition risks through two powerful tools: operation and maintenance performance requirements and handback requirements, as illustrated in Figure 1 (above).

Concession Agreement

The concession agreement provides the commercial and contractual framework and risk transfer for public owners to integrate performance and handback requirements with the technical requirements. Because the concessionaire has an equity interest in the project throughout the concession term (see Figure 2, below), the public owner is protected against the possibility of the concessionaire abandoning the contract instead of complying with the obligation to repair defects. This feature is essential to a concession agreement; without it, operation and maintenance performance requirements and handback requirements would be ineffective.

Aligning Incentives

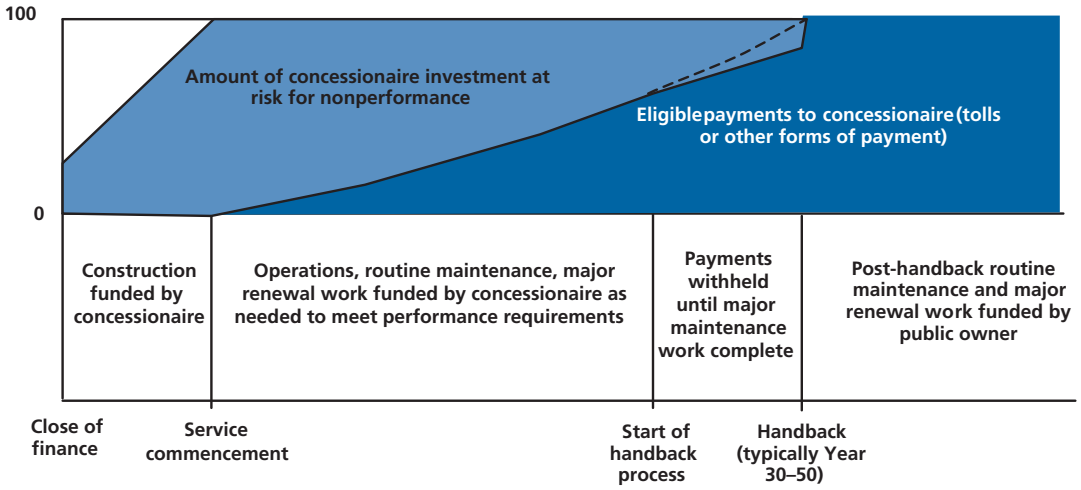
The interests of the public owner and concessionaire are aligned in the concession agreement through a combination of the commercial framework, the payment mechanism, the abatement regime—that is, the deductions for failure to perform—the operation and maintenance performance requirements, and the handback requirements. The contributions of these different contractual components are illustrated in Figure 3 (page 19).

Concession agreements require input from legal, financial, and technical advisers. These inputs must be integrated and aligned through a collaborative effort. Full alignment of interests is unlikely under any contractual arrangement, but the operation and maintenance performance requirements and the handback requirements make alignment of interests more likely under a concession agreement.

Performance Requirements

Operation and maintenance performance requirements provide the following benefits in a concession agreement:

FIGURE 2 Amount of concessionaire investment at risk.



◆ The scope for technical innovation increases,
◆ The concessionaire must consider life-cycle costs, and
◆ Single-point responsibility is established for long-term asset performance.

To achieve these benefits, operation and maintenance performance requirements should

◆ Relate directly to the public owner's objectives and to user needs,
◆ Adjust flexibly to changing circumstances, and
◆ Be auditable and measurable.

Operation and maintenance performance requirements should align with the public owner's objectives. Figure 4 (below) identifies how the United Kingdom Highways Agency developed contract terms to accomplish its aims and objectives, to ensure that each operation and maintenance performance requirement linked directly to a published goal or objective (5).

Obsolescence and Benchmarking

Some assets become obsolete, and despite provisions in the concession agreement, making appropriate upgrades may prove difficult for the concessionaire. For example, the expectations that information will be provided to drivers or that incidents will be cleared rapidly are more commonplace today than they were 25 years ago.

Writing technical requirements based on current norms and expectations could lead to unacceptable performance in later years. Therefore relying on a payment mechanism to achieve goals in certain performance areas is preferable to drafting detailed requirements. For example, a concessionaire paid in part for quickness and efficiency in cleaning up incidents will be likely to introduce the latest incident-detection systems as needed.

Many concession agreements require that operation and maintenance performance requirements undergo annual review, update, and approval to reflect good industry practice. To administer updates effectively, public owners need an agreed-on benchmark to compare the assets in the concession agreement with other assets in the same class that are managed by the public owner or by private entities.

Additional research is needed to establish the role of benchmarking to keep operation and maintenance performance requirements and targets fresh and relevant in a long-term concession agreement. Established examples of best practices are needed for incorporating benchmarking into PPPs, including records of how the requirements were updated to reflect general improvements, as well as the lessons learned.

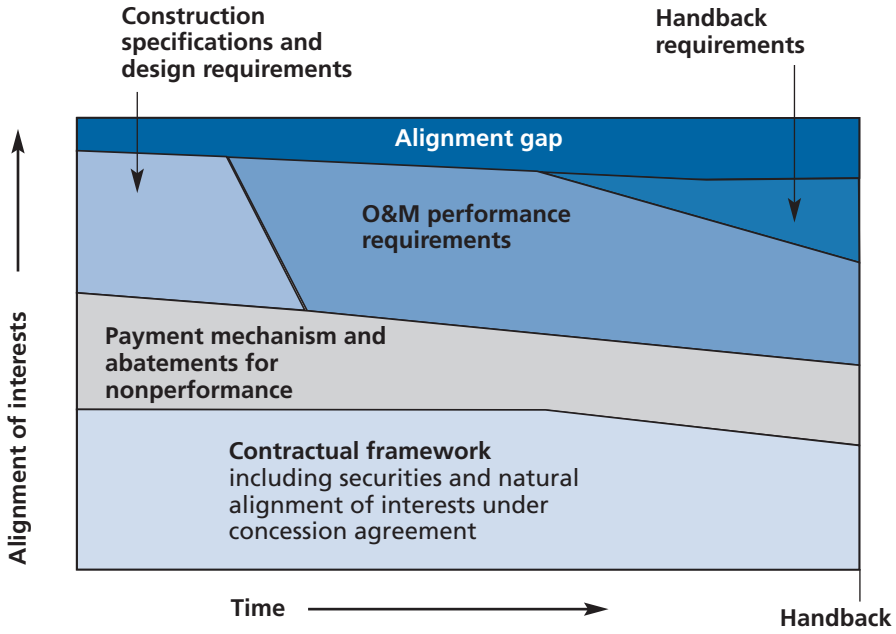


FIGURE 3 Alignment of interests under concession agreements.

Life-Cycle Issues

The public owner justifiably may want the technical requirements to include design features that will facilitate and enable inspection and condition assessment. Active monitoring systems can be installed to measure the deterioration of key components that are not replaced frequently or that may not be replaced at all during the concession period. For example, devices can be installed to detect corrosion rates in embedded steel or deterioration within concrete or to identify and monitor fatigue locations in a structure.

Good measurement practice is essential for ensuring performance. Including operation and maintenance performance requirements in a concession agreement in addition to construction specifications

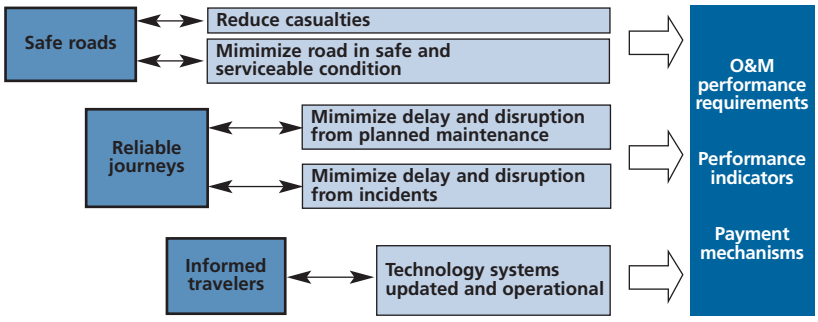


FIGURE 4 Alignment of owner aims with operation and maintenance performance requirements, as developed by the U.K. Highways Agency.

Photo: Washington State DOT

Wheelpath ruts indicate pavement wear; the public owner must monitor the key components of a PPP project during the concession period to ensure performance.

allows the owner to defer, to some extent, the problem of oversight and enforcement to a later period. The public owner needs to ensure that

- Systems and people are in place to audit and monitor requirements sufficiently and accurately and to enforce them;
- Automated processes and systems are implemented wherever possible; and
- Requirements can adjust flexibly to changes in customer needs and in technology and can include processes for adaptation and change, as well as incentives for the concessionaire.

Handback Requirements

During the final years of a concession agreement, the concessionaire has fewer incentives for investing in asset stewardship and may underinvest. Handback requirements therefore form an important part of any concession agreement and are designed to ensure that at handback the asset is functional and

- Meets a predetermined, measurable condition, with each component having a defined residual life; and
- Satisfies all of the operation and maintenance performance requirements.

In U.S. practice, handback requirements generally follow the guidance in documents such as the World Bank PPP toolkit (*6*), which indicates the importance of a comprehensive testing regime. The report from the scan tour jointly conducted by the Federal Highway Administration, the American Association of State Highway and Transportation Officials, and the National Cooperative Highway Research Program (*7*) and a report from the Southwest Region University Transportation Center (*8*) provide a review of practice. Although the provisions adopted in current U.S. concessions follow the generally accepted practices, further research is needed on this topic.

Current practice distinguishes elements that have a long expected service life—more than 100 years—from replaceable elements, with a medium expected service life of 5 to 25 years and a more regular asset renewal cycle. Examples of long service-life elements are reinforced concrete and steel structures, which are required to have a specified minimum residual life at handback; examples of medium service-life elements are deck surfacing, structural bearings, signs, and lighting. These elements are required to have a specified minimum expected useful life when last replaced before handback.

Long Service-Life Elements

The concession agreement should include provisions for determining the residual life of the elements that have long service lives. The concessionaire typically prepares and submits a methodology for the inspection and assessment of these elements and for the reporting of their residual lives as the time for handback approaches.

A study of the materials performance in key elements of the asset can inform the estimate of residual life. Additional or more focused investigation—such as a petrographic analysis of concrete or a sensor monitoring of elements—can be undertaken in areas considered most vulnerable. A contractor also may rely on embedded technology installed at construction.

The measurement techniques for residual life are developing and because of the uncertainties involved, the results are likely to be ambiguous. Public owners typically do not expect to enforce handback requirements through a one-time measurement. The public owner also should obtain information about the asset condition by reviewing the history of maintenance and repair issues throughout the concession agreement, including information from regular inspections and annual reporting. Public owners should audit and verify the materials and workmanship of critical long-life elements during the concession term, to minimize the risk of problems arising.

Medium Service-Life Elements

Condition requirements at handback can specify two scenarios:

1. The asset is practically new, with all replaceable elements renewed immediately before handback; or
2. All major replaceable components of the asset have a residual life in line with the normal expected and planned replacement cycle, with no component requiring immediate replacement or major renewal.

Scenario 1 may be attractive to an owner but would be wasteful and difficult to enforce. Scenario 2 represents a practical compromise that generally is adopted in concession agreements. The scenario is achieved in part by specifying that when a component is replaced, it should have a minimum useful life; this prevents the concessionaire from using a temporary, patch-up approach to renewals during the concluding years of the concession agreement.

Handback Reserve

In addition, during the last few years of the concession term, the public owner typically builds up a handback reserve—a fund for the capital maintenance of elements that will need to be replaced in the period after the handback. Building up the fund requires a sufficient period to address the significant needs that will arise. Additional research on the successful application of funds of this type would be helpful; some features are illustrated in Figure 5 (page 22).

Examples of privately financed assets that were handed back at the end of a concession term include Hong Kong's Cross-Harbor Tunnel, which opened in 1972 and was handed back in 1999; and the United Kingdom's Queen Elizabeth II cable-stayed crossing at Dartford, which opened in 1991 and was handed back in 2003. Further research is needed into the experiences of these and other PPP concession agreements approaching the end of their concession terms.

Alignment and Balance

Operation and maintenance performance requirements and handback requirements in long-term PPP concession agreements can help public owners supplement well-understood and tested design requirements and construction specifications. The commercial framework of a concession agreement, together with the payment mechanism and an abatement-and-deduction regime for nonperformance, play a major role in aligning the interests of the private and public sectors.

The public owner's objectives should be to achieve the best balance of different specification types, noting that prescriptive construction specifications are not well suited to concession agreements—if overused, prescriptive specifications can undermine the intended transfer of asset risk.

Operation and maintenance performance requirements should be aligned with the public owner's objectives and should be measurable and flexible, to account for changing circumstances over the course

PHOTO: ERIC TSUI SING YAN, WIKIMEDIA COMMONS

The Cross-Harbor Tunnel in Hong Kong was administered by a private company until the end of its 30-year franchise in 1999.

PHOTO: KENNETH YARHAM

The Queen Elizabeth II Bridge over the Thames River in Dartford, England, was authorized by Parliament in 1988 and owned by Dartford River Crossing Limited until 2003. More experience with handing back PPPs at the ends of their concession periods will help guide the process in the future.

of a long concession. The benchmarking of operation and maintenance performance requirements has received little attention but will become increasingly important as more concession agreements reach the operational stage.

Research is needed to establish an annual process of updating performance requirements for operation and maintenance so that the measures remain fresh. Owners need to gain experience in measuring and reporting conditions in terms of equivalents at privately run and state-controlled assets.

Handback requirements must be appropriate and enforceable. Concession agreements in the United States typically follow best international practice for handback, although further research is needed into how the requirements are applied and into the lessons learned from privately financed assets that have been handed back.

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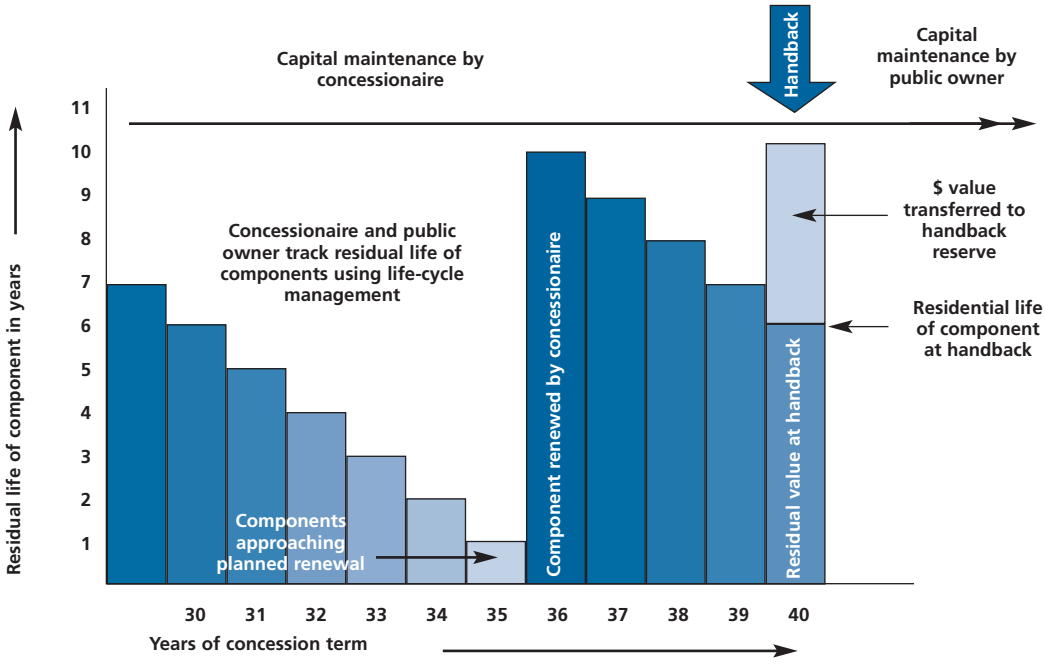

FIGURE 5 Operation of handback reserve for medium service-life elements.

Selecting Public–Private Partnerships for Transportation Projects

From Episodic to Programmatic Public-Sector Decision Making

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Much of the world sees the United States as a nascent market for public–private partnerships (PPPs) for transportation projects. This country offers a largely untapped opportunity for alternative delivery and financing that can

- Fix capital costs and completion dates early in a project's design life,
- Achieve life-cycle cost-efficiencies, and
- Deliver greater financial advantages to public sponsors than conventional municipal bonds would.

Few outside observers appreciate that the United States has been experimenting with PPP delivery for more than 25 years, predating initiatives in more established PPP jurisdictions around the world. PPPs in the United Kingdom and Europe began with the goal of achieving off-balance-sheet financing, but in the United States the original motivations among the pioneering transportation authorities were to

- Improve the way that projects were defined and delimited;
- Attract private capital and innovation to otherwise infeasible projects;
- Shift to the private sector the significant and ever-present risks of project overruns and delays,

PHOTO: NORTH TARRANT EXPRESS

Construction on the North Tarrant Express lanes in Texas is scheduled to be completed in 2015. The project is one of many PPPs in the United States begun in the past 25 years.

which often embarrass policy makers; and

◆ Demonstrate to the public the value of enhanced infrastructure services.

During the 25 years of U.S. experience with PPPs, an evolution has occurred in the way that transportation agencies have selected projects. This evolution has undergone three generations, each with its own underlying rationales.

Plans and Policy Goals

Transportation policy makers establish plans in accordance with governing law and good stewardship practices. At the state and regional levels, public officials develop short-, mid-, and long-term plans to reflect their decisions on

◆ Tax funding allocations for preliminary engineering, environmental resources, final design, construction, and operation and maintenance;

◆ Allocations of responsibilities among in-house staff and management; and

◆ Priorities for processing and delivering planned projects.

Historically, agencies at the state and local levels are charged with delivering almost all transportation projects in the United States. State and often federal law requires the agencies to use a single project-delivery mechanism—design–bid–build, frequently combined with pay-as-you-go funding. This reflects three policy goals:

◆ Avoiding favoritism or graft in public works contracting by stamping out subjective selections;

◆ Maximizing the number of bidders on a project by breaking the work down into minimum-size biddable scopes, to reach small and medium contractor pools; and

◆ Maximizing efficiency through the division of labor.

Risks Retained

Although this approach has minimized opportunities for favoritism and has maximized competition among the greatest of number of contractors, it retains a great deal of risk for public agencies. These risks include the following:

◆ The possibility that the design process did not define the project in a way that achieves optimum mobility for the investment;

◆ The lack of certainty about how the work will perform;

◆ The challenges of integrating many construction contracts for a single job;

◆ The obligation to pay claims and change orders under contracts standardized to appeal to the lowest common denominator; and

◆ The complexity of managing interfaces among designers and multiple contractors.

Pursuing the three policy goals, therefore, may result in projects with closeout costs and completion dates that exceed the design estimates.

Certain project categories under design–bid–build delivery fall short in on-time and on-budget performance. Nevertheless, life-cycle cost efficiencies are captured, and innovative finance is successfully deployed.

Alternatives to Design–Bid–Build

Several project delivery models offer alternatives to design–bid–build. Collectively these are known as PPPs, for example,

◆ Design–build contracts, which achieve through competitive bids a fixed price and a guaranteed completion date early in a project's design life;

◆ Availability payment contracts, which achieve for a competitive price the benefits of a design–build contract, combined with long-term responsibility for infrastructure performance, as well as financial leverage beyond that of municipal financing;

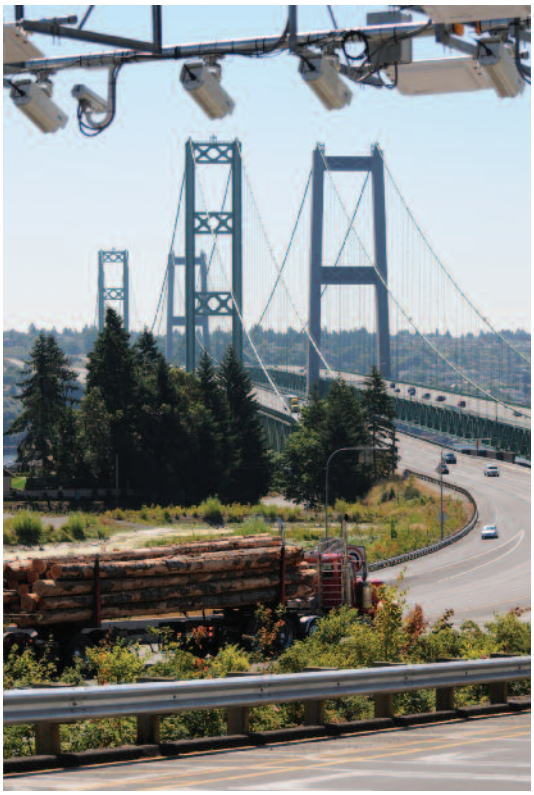

PHOTO: WASHINGTON STATE DOT

The Tacoma Narrows Bridge was constructed under a design–build contract for Washington State Department of Transportation (DOT) and opened in 2007.

◆ Toll concessions, which offer the competitive benefits of availability contracts, combined with financing from the project's future revenue stream, reducing the possible tax revenues needed for construction; and

◆ Predevelopment agreements, which capture innovation and cost sharing from the private sector during the feasibility stage and which can lead to any of the other three types of contracts during implementation.

The assumption that design–bid–build offers maximum value for money clearly is no more valid than the assumption that PPP delivery does. In examining a large and complicated transportation project, however, policy makers sometimes find that that a PPP option will deliver a project when design–bid–build will not until years later. In terms of the programming and planning process, deferring the project indefinitely is a no-cost decision; however, this ignores the real but seldom quantified consequences of project delays, including

◆ The escalation of construction costs,
◆ Traffic accidents that are the result of the deferred safety improvements,
◆ Lost productivity from deferred mobility,
◆ Lost quality-of-life advantages in competing with other regions,
◆ Deferred environmental improvements,
◆ Deferred job creation, and
◆ Lost opportunities for economic growth.

How can the right PPP projects be identified to avoid project delay or to capture other private-sector capability not available under design–bid–build?

First-Generation PPPs

States originally approached the identification of projects for PPPs as a task appropriate to the private sector. Agencies relied on unsolicited proposals and calls for project nominations to encourage private firms to choose projects suitable for PPP delivery. Key examples include the following:

◆ In the mid-to-late 1980s, the Virginia Department of Transportation (DOT) used an unsolicited proposal and a project-specific state law to authorize the Dulles Greenway—a 14-mile toll road connecting Washington Dulles International Airport with Leesburg—as a regulated utility.

◆ In 1989, California DOT implemented AB 680, issuing a call for project nominations that resulted in the SR 91 and SR 125 toll concessions in Orange County and San Diego, respectively.

PHOTO: WIKIMEDIA COMMONS

The Dulles Greenway toll road in metropolitan Washington, D.C., was initiated through an unsolicited proposal from a private firm.

◆ Under generic state PPP legislation, Washington State DOT issued a call in 1993 for project nominations, which led to a design–build contract for the Tacoma Narrows Bridge.

◆ Minnesota DOT, under generic PPP legislation, issued a call in 1995 for project nominations, but a proposal for a negotiated toll concession on Trunk Highway 212 was vetoed by a city council that had partial jurisdiction.

◆ Virginia DOT, starting in 1994 and continuing under a generic authority known as the Public–Private Transportation Act, proceeded on a list of unsolicited proposals processed according to published guidelines and completed several projects, including the Pocahontas Parkway near Richmond. Additional projects are under construction, including the Capital Beltway (I-495) High-Occupancy Toll Lanes and an extension of the Washington Metrorail to Dulles Airport.

Pluses and Minuses

Relying mostly on the private sector to identify the projects most suitable for PPP delivery has pluses and minuses. On the one hand, the private sector brings innovative ideas to the project definition and to mobility solutions that public agencies were not developing. On the other hand, this first-generation approach sometimes creates friction in the programmatic planning process; private-sector goals do not always align with public-sector goals; the selection process is not necessarily subjective and may not be price-based, raising the transparency concerns that originally drove most public works agencies to favor design–bid–build; and frequently, a private proposer may seek to advance its project's priority on the state's list or to receive favored treatment among potential competitors.

The biggest cause of friction, however, arises from the National Environmental Policy Act (NEPA). NEPA regulates the definition and scope of a project by requiring the identification of alternatives, the analysis of the environmental impact of each alter-

Photo: Tom Saunders, Virginia DOT

In the 1990s, Virginia's Public–Private Transportation Act cleared the way for a major Metrorail project connecting Washington, D.C., with Dulles Airport. The project is managed by the Metropolitan Washington Airports Authority, which contracted with Dulles Transit Partners, LLC, for the design and construction.

native, and a selection of the preferred alternative.

In practice, active stakeholders can drive the process to ever-greater levels of detail. For example, private-sector innovations that arrive late in the NEPA process create for a public agency a classic Hobson's choice: either incorporate the value-added ideas and suffer the delays required in filing the environmental impact statements; or ignore the private-sector proposals and their benefits, proceeding without delay to the already identified alternatives.

In the first generation of agreements, the art of the PPP deal involved integrating private-sector innovation into the identification and scoping of projects without creating delays in the environmental process. Unsolicited proposals remain a viable option for identifying PPP projects in the right circumstances, but the trend now is away from this approach.

Second-Generation PPPs

Some transportation agencies have proceeded to define and identify PPP projects, often with the assistance of specialized advisers. These agencies are defining the key parameters for a project through the NEPA process, including the scope of work and the specifications the project must meet.

The agencies then analyze the individual projects for suitability to a PPP arrangement and determine the most suitable options. After this, they complete a sufficient amount of the preliminary engineering to secure bids and guaranteed completion dates. They then solicit proposals, requiring technical conformity and hard bids.

The main examples of this second-generation approach were successfully delivered between 2007 and 2010 by Texas DOT with the North Tarrant Express and IH-635 (LBJ) Managed Lanes toll concessions; and by Florida DOT with the Port of Miami Tunnel and the I-595 Managed Lanes availability payment contracts.

Moving toward a hard bid proposal approach to capture competitive pricing from multiple bidders moves away from the qualifications-based selections and sole-source negotiations of the first-generation approach. To achieve optimal results, the public sector must develop expertise and secure advisory services for analyses of PPP suitability, must establish goals for each project, and should determine which delivery model achieves the most value for money.

Capturing Innovation

Although the work needed to prepare for a bid pro-

curement may limit the impact that the private sector can have on defining and scoping a project, the model nevertheless offers opportunities to capture private-sector innovation through a variety of specialized procurement tools—for example,

- Industry workshops with prospective bidders, to solicit suggestions and characteristics to incorporate into the procurement documents;
- One-on-one, competitive dialogue with shortlisted bidders, to solicit suggestions for refining technical specifications, creating life-cycle flexibility and cost–benefit trade-offs for specific contract provisions;
- Solicitations of alternative technical and financial concepts as permitted deviations from the contract and technical terms;
- Negotiations with preferred bidders to incorporate ideas from competing proposals; and
- Contract provisions establishing incentives for value engineering after completion of the project.

Despite the movement toward greater public-sector control over PPP project selection, the decision often is made after significant investments that assumed conventional delivery.

Third-Generation PPPs

Thinking less in terms of projects and more in terms of programs, public sponsors increasingly are recognizing the range of project delivery options available for larger and more complicated projects. Public sponsors are realizing that these decisions are not only determinations to be made when the NEPA processes are almost complete but are early, key drivers of the planning and programming process.

Examples of this third generation in PPP project identification are Texas DOT's project delivery screening of its statewide capital program; Georgia DOT's biannual report to the state legislature—required by statute—on projects suitable for PPP delivery; the PPP analysis by Los Angeles Metro of its Measure R long-range capital program; and the screening of the Express Lanes Network Master Plan by the San Francisco Bay Area's Metropolitan Transportation Commission for optimal project delivery.

These agencies are finding that preliminary project-delivery determinations made early in the development process can have the following results:

- Optimizing the use of conventional and alternative project delivery and finance options;
- Performing an objective value-for-money analysis, not only for PPP projects, but for any major project delivery decision;
- Planning availability payments and other PPP tax funding obligations to conform to the debt management policies for bond and Grant Anticipation Revenue Vehicle, or GARVEE, programs;
- Scoping the preliminary engineering, prioritizing limited NEPA resources, and scheduling prefeasibility expenditures to meet the different demands of each delivery option;
- Avoiding the overengineering of projects that involve alternative delivery, for which private developers will be assuming the final design responsibilities; and
- Reprogramming the engineering and construction funds away from projects while accelerating them at the same time.

Programmatic Approach

Components of a programmatic approach to integrated PPP project selection, common to the examples cited, include the following:

- Establishing project delivery screening criteria that reflect the public sponsor's key goals;
- Identifying projects that are suitable for alternative delivery, that would benefit from innovative financing tools, and that would have market acceptance;
- Screening identified projects initially and regularly for optimal delivery methods from among the available options;
- Loading selected projects into a master schedule, to reflect short-, mid-, and long-term milestones, enabling a pipeline approach;
- Creating a PPP steering committee to guide and direct the process; and
- Developing documents, contracts, and technical specifications for best-practice procurement.

Evolutions Ahead

Many states have legal authority to employ not only the historical default option of design–bid–build, but also a range of PPPs. Transportation agencies seeking to deliver large and complicated projects may have less tax funding but more project delivery methods to apply.

The 25 years of U.S. experience with PPPs demonstrates that lessons learned and best practices are essential to decision making. Each jurisdiction must make its own decisions in the contexts of its own goals for its own program, according to the characteristics of each project and the defined role of the private sector. As each agency seeks the best way to maximize value for money, the U.S. approach to selecting and procuring PPP projects will continue to evolve.

Protecting the Public Interest in Long-Term Highway Concessions

ROBERT W. POOLE, JR.

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Long-term concessions, under which the private sector finances, designs, builds, operates, and maintains a highway for several decades, have been standard practice in much of Europe since the 1960s and 1970s, and in Australia since the 1990s. The recent arrival of long-term concessions in the United States, however, has provoked controversy, particularly with the 99-year lease of the Chicago Skyway in 2004 for $1.8 billion and the subsequent lease of the Indiana Toll Road for $3.8 billion.

Critics have raised many concerns about toll concessions. In two reports, the Public Interest Research Group (PIRG) has noted the following drawbacks to private concessions:

- The public loses control;
- The public does not receive full value from the deals;
- The financing is risky;
- The concession terms are excessively long;
- Transparency is lacking; and
- The oversight to protect the public interest is inadequate.

Other critics maintain that anything the private sector can do, a public-sector toll authority can do equally well, or better, and may be more attuned to protecting the public interest. Others oppose the leasing of existing—or brownfield—toll roads but admit the value of using toll concessions to create needed new capacity—or greenfield toll roads.

Concession Rationales

Why have long-term concessions become attractive to public officials in recent years? The primary reason is the large and increasing shortfall in highway funding, especially in fast-growing states. The toll concession model provides a way of generating large new investments in the highway system, despite the unwillingness of legislators to increase the fuel tax rates.

This obviously is true for greenfield toll roads but also applies to leases of brownfield toll roads if the proceeds are dedicated to highway or transportation funding. Indiana paid off the existing toll road bonds and then dedicated 100 percent of the net lease proceeds to highway capital investments; in contrast, Chicago did not use any of its proceeds for transportation investment.

The Government Accountability Office and academic researchers have presented a second reason—

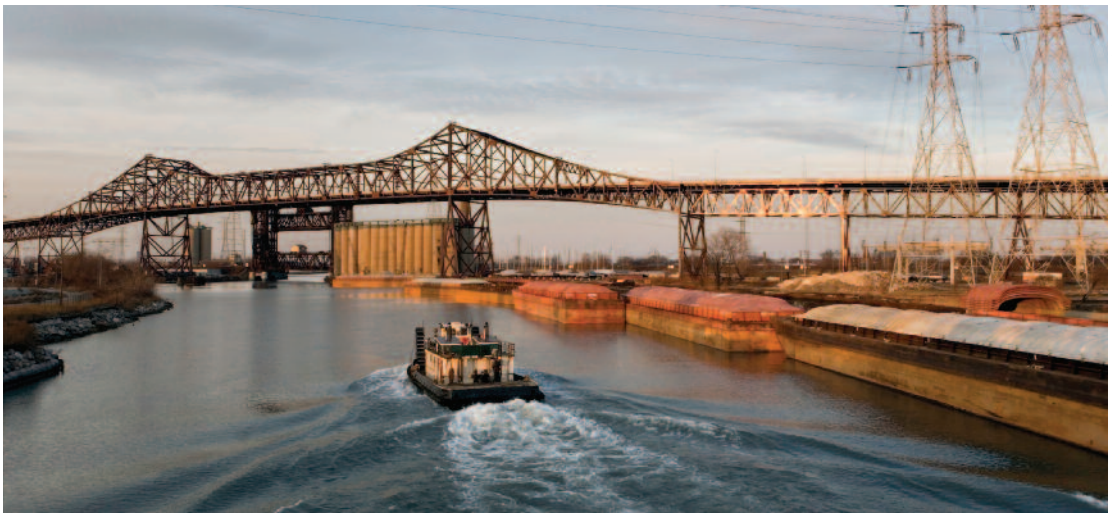


PHOTO: SKYWAY CONCESSION COMPANY

The 99-year, $1.8-billion lease for the Chicago Skyway—which includes the landmark bridge over the Calumet River—was signed in 2004. Long-term private concessions are relatively new in the United States.

the current federal and state highway funding allocation process often fails to direct resources to the highest and best uses. In contrast, investors will support a toll concession project only if it is expected to produce a return on the investment. This resource-allocation benefit is often ignored in the controversies over concessions.

Life-Cycle Costing

A third rationale is to ensure life-cycle costing. Traditional U.S. highway design and maintenance decisions are affected by two disincentives. First, a state department of transportation (DOT) deciding on specifications for new construction is always under pressure to make the capital investment support as many projects around the state as possible. The state DOT is generally required to select the low-bid contractor.

As a result, state DOTs often specify pavement designs that cost less initially but have higher life-cycle costs, so that the highways will need maintenance sooner than if they had been more durably designed. When the state DOT operating budgets are under pressure or cut by legislators, the necessary maintenance may be deferred.

In contrast, concession companies that have a de facto long-term ownership interest have strong incentives to minimize the facility's life-cycle costs. Deferring maintenance is not likely, because the bondholders typically require that the toll revenues be used first for maintenance, to protect their investment. Concession companies are not selected for a low bid on construction; they make design and investment decisions with a longer-term perspective, trading a higher up-front cost for a lower life-cycle cost.

Risk Transfer

Risk transfer is a fourth rationale for concessions. Large projects—typically one-half billion dollars or more—are best suited for concession arrangements. Transportation megaprojects are high-risk endeavors, often involving construction cost overruns and late completion. Another major risk is added when the project must generate toll revenues. In well-designed concession agreements, these and other risks are largely or entirely transferred to the concession company.

The investors who put equity into such projects accept the risk in exchange for the hope of a double-digit return on investment. These returns lead naïve critics to deem the projects unacceptable because of the "higher cost of capital." But this criticism ignores the value to the public of the large risk transfers that the concession companies have taken.

PHOTO: SMITH AERIAL PHOTOS

Greenfield toll roads that add new capacity—like the express toll lanes along I-595 in Fort Lauderdale, Florida—also help state highway agencies contend with decreased highway funding.

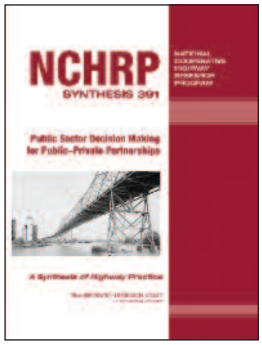
Road Pricing

Last but not least is road pricing. To help start the transition from fuel taxes to per mile charges for highway funding, the Transportation Research Board's Committee for the Study of the Long-Term Viability of Fuel Taxes for Transportation Finance, appointed by the National Research Council, recommended that states move expeditiously to implement more toll and pricing projects (*1*).

In general, the public sector historically has failed to adjust toll rates to inflation. The toll concession companies, in contrast, take inflation-adjusted tolls as a given and are proceeding with congestion-pricing projects in the form of high-occupancy toll and express-toll lanes.

Protecting Public Interest

Toll concessions offer large potential benefits; how can the public interest be protected under this model? The recent National Cooperative Highway Research Program (NCHRP) Synthesis 391, *Public-Sector Decision Making for Public–Private Partnerships*, provides comprehensive guidance (*2*). The publication serves as a primer on long-term concession arrangements, describing government decision making about when and how to use this approach,



NCHRP Synthesis 391 addresses the public interest in long-term concession agreements.

with an extensive discussion about how to address the public-interest issues.

Common Misperceptions

The synthesis also reviews the misperceptions about PPPs—including three of the most common:

- Rigid noncompete provisions are always involved;
- PPP deals always mean tolling and the likelihood of windfall profits from excessively high toll rates; and
- The public sector loses control of the facility.

NCHRP Synthesis 391 notes that selling long-term toll revenue bonds is seldom possible without protection from unlimited nontoll competition; nonetheless, prohibitions on all parallel capacity are rare. Agreements typically accept all projects in the state's or region's long-term transportation plan.

Although agreements may define a competition zone within a few miles on either side of the toll road, they do not prohibit other new capacity within that zone. Instead, if the state builds currently unplanned, competing roadways during the life of the agreement, some degree of compensation will be offered if the concession company can demonstrate that traffic has been diverted and toll revenues have been lost.

The synthesis points out that some long-term concession projects rely on either shadow tolls or availability payments,[1] which do not involve payments by the vehicles using the roadway. These nontolled concessions benefit from life-cycle costing and from the transfer of risk for construction and completion but do not provide the full set of benefits outlined earlier.

On toll projects, the private sector is more businesslike about keeping toll rates with or ahead of inflation—but control of rate-setting nearly always rests with the public sector. Windfall profits increasingly are being addressed through revenue-sharing provisions in concession agreements.

Contract Strategies

Concession agreements are inherently about control; the agreements often incorporate state DOT performance standards and typically run several hundred pages. Because the agreements will last for decades, they must cover many what-if questions, including lane additions and new interchanges, as well as what to do if either party changes its mind *N* years into the arrangement. The entire concession agreement should be posted on the Internet as a public document.

NCHRP Synthesis 391 goes into detail on ways of protecting the public interest, concluding that "most of the concerns about PPPs can be managed through the contract terms" and with careful monitoring of the company's performance throughout the life of the agreement. Because unforeseen circumstances can arise over such a long period, the synthesis notes, "clauses that allow for contract termination or buyout are important."

Leasing Toll Roads: Lessons

A second useful report, produced by the Pew Center on the States, *Driven by Dollars: What States Should Know When Considering Public–Private Partnerships to Fund Transportation,* was stimulated by the controversy over the proposed lease of the Pennsylvania Turnpike (3). The report offers a balanced examination of Pennsylvania's pursuit of the transaction. The report focuses on the lease of existing toll roads—a fraction of the likely public–private partnership transactions for highways in the next several decades—but the guidelines and lessons learned have more extensive applications.

First, what information do states need in considering toll concessions? States need a decision process that examines all of the options for raising funds, including toll concessions. The process should be transparent. The states need an objective financial analysis and a plan for making wise use of any net revenues. A structure for long-term management and oversight of the agreement should be in place.

The Pew report suggests six lessons for other states:

- Enact broad, enabling legislation before considering any specific deals.
- Keep the process transparent and encourage stakeholder participation.
- Reach agreement on the goals of the conces-

[1] A shadow toll is an amount per vehicle paid by the state to the company. An availability payment, made monthly or annually, is adjusted when all lanes are not open 100 percent of the time.

The first major highway PPP in the Nordic countries, Finland's Järvenpää-Lahti Motorway opened in 1997 with a 15-year concession period. Long-term concessions have been a feature of European infrastructure for many years.

PHOTO: SKANSKA

sion mechanism before using it.

- Base each deal on realistic financial assumptions.
- Specify how any net revenues will be used and how the company's performance will be monitored.
- Consider long-term as well as short-term effects.

Terms and Proposals

The Pew and NCHRP reports provide helpful guidance and cite lessons learned. Although the PIRG report also supports transparency and oversight, two of its primary recommendations are problematic. One is that "no deal should last longer than 30 years." This stipulation ignores the range of costs and risks among potential projects, especially large greenfield projects such as bridges and tunnels. Several recent bridge and tunnel concessions in France, for example, have terms of more than 70 years, necessary to make them self-supporting from the toll revenues.

The other problematic PIRG recommendation is that "the legislature must approve the terms of a final deal." Several states have passed enabling legislation with this provision, and not a single project has been proposed, because the provision creates excessive risk for the private sector.

Preparing and researching a proposal may cost several million dollars; a company on a prequalified short list of three or four contenders would have only a one-in-three or one-in-four chance of winning. The winner must then spend months negotiating the specifics of the several-hundred-page agreement, tapping legal, financial, and engineering experts. To have the agreement vetoed or rewritten by a legislative vote after a year of costly effort is too high a risk for most companies—especially when they can do the same kinds of projects in jurisdictions that are more deal-friendly.

The PIRG report also put forward a proposition that "any private deal must demonstrate that it saves money compared to what public authorities could generate by borrowing against the same toll rates." This comparative cost-of-capital approach, however, ignores the availability of tax-exempt, private activity–exempt, public-sector debt, as well as the value of the large risk transfers likely to be involved in toll concession projects.

Florida: Division of Labor

In states such as Texas and Florida, several public-sector toll authorities operate long-established toll road systems, and the role that private-sector toll concessions should play is still being worked out. The Florida Turnpike Enterprise and the local toll authorities in Miami, Orlando, and Tampa have had no conflicts with the private sector. These agencies follow conservative financial practices, including specified bond coverage ratios and break-even periods, as well as limits on their bonding capacity.

PHOTO: VÉRONIQUE PAUL

The A41 Motorway connects Annecy, France, with Geneva, Switzerland. Like many new PPPs in France, the project has a concession period of more than 50 years.

The result seems to be leading to a division of labor, with the private sector taking on larger and higher-risk projects than the public-sector agencies would. Two large Florida concession projects—the rebuilding of I-595, with the addition of express toll lanes, and the Port of Miami Tunnel—have been financed with availability payments. Florida DOT plans to request toll concession proposals for a third major project, an outer beltway for Jacksonville.

Texas: Local Primacy Issues

In Texas, however, the established toll agencies in Dallas and Houston took the position in 2007 that they should receive the first offers of any new toll projects in their regions and that a public–private partnership should be considered only if the toll agencies opted out. This local primacy position became law, along with a two-year moratorium on any new toll concession projects. The bill also authorized the creation of a special Legislative Study Committee to examine the issue and recommend revisions to legislation enabling the toll concessions.[2]

The committee's final report stated that because of a large highway funding shortfall, expanded tolling and continued use of toll concessions made sense. The report presented evidence of the high-risk nature of stand-alone, greenfield toll roads, suggesting that the risk-transfer benefits were important to the state's newest, start-up toll agencies, such as those in Austin and San Antonio, because of their lack of experience and the inherent risks in undertaking the greenfield toll projects.

The study committee's recommendations on protecting the public interest were similar to the issues identified in the NCHRP synthesis and the Pew

[2] The author served on the Texas Legislative Study Committee.

PHOTO: PARTNERSHIPS BC

The Port Mann–Highway 1 Improvement Project in Canada was developed by Partnerships BC, which works to facilitate PPPs in the public interest. The company has served as a model for similar entities in the United States.

report. On the critical issue of local primacy, the committee argued that Texas should make use of the public-sector comparator methodology to decide which approach to take for each toll project (see sidebar, below). Because of the high degree of politicization of the issue, the committee proposed the creation of an independent entity, Partnerships Texas, modeled after Partnerships BC in Canada and Partnerships Victoria in Australia.

Generating a Public–Sector Comparator

Many other countries that have used toll concessions have developed detailed procedures for assessing the value for money (VfM) in public–private partnership transactions. Australia, Canada, and the United Kingdom often employ a VfM procedure called the public-sector comparator (PSC), which also has been recommended by the U.S. Government Accountability Office. Here is how the PSC is generated:

1. The public agency creates the raw PSC—the base cost under public-sector provision, including all capital and operating costs.
2. To provide for competitive neutrality, cost adjustments are made to remove any inherent advantages or disadvantages that the public sector may have vis à vis the private sector—for example, the private sector must pay a variety of taxes. This net cost is added to the PSC.
3. The transferable risk is quantified, representing the risks that will be shifted to the private partner.
4. The retained risks are quantified, representing risks that the public sector will retain—such as land acquisition or natural disasters during construction.

In this way, the decision on whether to use the public sector or the private sector can reflect more than each one's weighted average cost of capital. In Australia, Canada, and the United Kingdom, the methodology routinely includes the cost of capital as one of several quantified factors; the value of the risk transferred is critically important.

—Robert W. Poole, Jr.

When the legislature reconvened in 2009, the debate over toll concessions continued, but the committee's recommendations were largely ignored. The session adjourned without passing any transportation legislation, and a subsequent special session reauthorized Texas DOT and approved a transportation bond issue. As of 2010, therefore, Texas had a half-dozen previously authorized toll concession projects moving forward but no authority to initiate any more, until a subsequent legislature revisits the issue.

Crafting Public Policies

Making use of long-term concessions for selected large highway projects presents a good case on the merits. The public interest can and should be protected through provisions in the long-term agreement, drawn from the experience of other countries that have a long history with concessions.

Transparency and ongoing oversight of the concession company by the state DOT are both essential. Deciding when and why to use the concession approach is as important as how to oversee the projects; rigorous and transparent methodologies exist for both and should be utilized, as a growing number of reports recommend.

Finally, the argument that concessions are fine for greenfield toll roads but not for existing ones misunderstands the concession model. All the same principles of governance apply in both cases, with only some differences because of the lack of initial construction requirements in a brownfields case. With the huge transportation funding shortfalls in most states, the proceeds from a brownfields lease should be dedicated solely to transportation investment.

Long-term concessions will not solve the U.S. highway funding problems—but they can play an important role in the solution, if supportive public policies are crafted.

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Warm-Mix Asphalt Heating Up in Virginia

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Warm-mix asphalt (WMA) technologies produce asphalt at temperatures that are 25°F to 100°F (14°C to 38°C) lower than the production temperatures for conventional asphalt concrete, which range from 280°F to 350°F (138°C to 177°C). In general, three WMA technologies are in use. Some WMA technologies use wax-based additives to reduce the viscosity of the binder at lower temperatures; this allows for mixing, aggregate coating, and mixture workability at reduced temperatures. Chemical additives in other WMA mixtures promote coating, adhesion, and workability. Yet other technologies introduce water; the resulting steam causes the asphalt binder to foam, which improves workability.

WMA was introduced in the United States in 2004, and the potential cost savings from reduced fuel at the plant, improved field compaction, and improved air quality have attracted interest. Several states, the Federal Highway Administration, the National Center for Asphalt Technology, and the National Cooperative Highway Research Program have conducted research on WMA (see list of online resources, page 35).

Problem

Implementing WMA raises the following challenges:

- Verifying that the pavement performance will match that of conventionally produced asphalt concrete; and
- Addressing the susceptibility to moisture—although field studies on Virginia and other states have found no definitive evidence of this problem.

WMA promises constructability and environmental benefits. Without proof that the technology provides an equivalent level of performance, however, some transportation agencies in the United States have questioned implementation.

Research Approach

In 2006, the Virginia Department of Transportation (DOT) and the Virginia Center for Transportation Innovation and Research (formerly the Virginia Transportation Research Council) constructed maintenance overlays on trial sections to evaluate the laboratory and field performance of WMA materials. The objective was to determine the potential use of the materials on Virginia's roadways.

Three research projects were initiated (*a*) to document and evaluate the construction of three pairs of hot-mix asphalt (HMA) control sections and WMA trial sections using two technologies; (*b*) to evaluate the laboratory performance of WMA materials; and (*c*) to evaluate the field performance of the trial sections.

PHOTOGRAPHS COURTESY OF KEVIN MCGHEE

The reduction in visible fumes can be seen in a comparison of conventional HMA paving (*left*) and paving with WMA (*right*).

TABLE 1 Core Air Voids

Age	Average Air Voids, % (standard deviation)					
	Trial A		Trial B		Trial C	
	HMA	WMA	HMA	WMA	HMA	WMA
Initial	7.7 (1.1)	6.7 (1.8)	9.2 (1.3)	8.1 (2.5)	7.6 (1.6)	9.4 (3.5)
3-month	6.0 (0.9)	6.8 (1.9)	8.0 (2.5)	8.3 (2.7)	9.6 (1.8)	9.2 (3.0)
6-month	6.2 (0.7)	7.8 (1.4)	8.4 (2.1)	7.9 (1.5)	7.1 (2.4)	7.4 (2.1)
1-year	5.5 (0.7)	7.4 (1.9)	6.6 (0.9)	7.3 (0.8)	7.0 (2.7)	7.6 (1.9)
2-year	7.1 (1.2)	7.5 (1.1)	9.6 (1.0)	7.4 (1.5)	6.3 (0.8)	8.6 (2.7)

Construction and Field Performance

Construction of the HMA and WMA sections for each trial followed standard HMA paving practices; the only exception was the WMA's lower production temperature. In Trial A and Trial B, the WMA used an organic wax additive; in Trial C, the WMA used an emulsion technology.

Density was measured with a nuclear gauge and cores during construction. Field cores and loose material from the plant were collected for laboratory testing. Coring and visual inspections were performed during construction and at intervals of 3 months, 6 months, 1 year, and 2 years.

Cores were tested to determine the air void contents before the extraction and recovery of the asphalt binder for performance grading. Table 1 (above) shows the differences in the air void contents of the HMA and WMA in each trial; these were not statistically significant at a level of $\alpha = .05$.

Nuclear density measurements generally supported these observations for the WMA in Trials A and B. The difference in the nuclear density measurements of the compacted WMA and HMA sections from Trial C was significant at $\alpha = .05$. Performance grading of the recovered binders indicated that the WMA from Trials A and B aged during the first 2 years in service at a slightly reduced rate from that of the HMA, indicated by a reduced rate of stiffening. No difference was measured in the performance grade between the HMA and WMA in Trial C.

Laboratory Evaluation

All mixtures for the field trials underwent laboratory testing. The volumetric properties for all HMA and WMA mixes compared reasonably well (see Table 2, below).

Specimens for the tensile strength ratio (TSR) test were evaluated for moisture susceptibility. In addition, rutting susceptibility was assessed with an asphalt pavement analyzer.

The TSR values of the HMA in all three trials and of the WMA from Trial B passed the 0.80 ratio requirement, but the WMA from the other two trials did not pass, suggesting that the mixes were susceptible to moisture (see Table 3, next page); nonetheless, the susceptibility was not evident in the field. With these results, the initial specification developed for WMA required a minimum TSR value of 0.60, compared with 0.80 for HMA; however, after one construction season, the specification for the minimum TSR value was raised to 0.80.

The rutting susceptibility results indicated that the HMA and WMA from Trials A and B would be expected to perform similarly. In Trial C, the WMA exceeded the maximum allowable rutting depth of 5.5 mm for a PG 70-22 mixture, but the HMA was acceptable (see Table 3, next page).

Study Implications

The field trials indicated that WMA can be placed at lower temperatures, using conventional HMA paving practices and procedures. After 2 years, cracking was

TABLE 2 Volumetric Properties

Property	Trial A		Trial B		Trial C	
	HMA	WMA	HMA	WMA	HMA	WMA
% AC	5.86	5.80	5.39	5.81	5.83	6.06
Rice SG (G_{mm})	2.501	2.502	2.604	2.597	2.487	2.464
% VTM	3.1	4.5	3.3	2.9	3.1	1.7
% VMA	15.7	16.8	9.5	16.5	16.4	15.5
% VFA	80.4	73.3	65.2	82.5	80.9	89.3
Dust/AC ratio	1.17	1.14	2.57	1.14	0.94	0.90

AC = asphalt content; SG = specific gravity; VTM = voids in total mix; VMA = voids in mineral aggregate; VFA = voids filled with asphalt.

TABLE 3 Rutting and Moisture Susceptibility Test Results

Technology	APA Rutting				TSR Values	
	HMA		WMA			
	Avg. Rutting, mm (std. dev.)	Avg. Voids, % (std. dev.)	Avg. Rutting, mm (std. dev.)	Avg. Voids, % (std. dev.)	HMA	WMA
Trial A	4.39 (0.43)	6.97 (0.15)	3.81 (0.48)	7.03 (0.06)	0.82	0.75
Trial B	2.74 (0.11)	8.53 (0.06)	2.72 (0.25)	8.53 (0.25)	0.85	0.90
Trial C	4.61 (0.36)	8.57 (0.12)	7.69 (0.67)	7.60 (0.00)	0.85	0.76

TSR = tensile strength ratio

observed along the center line of the HMA and WMA sections in Trial A, although the cracking in the WMA section was much less extensive.

The cause of the cracking was related to the paving equipment, not to the materials. No cracking was seen in any of the sections of Trials B and C. The performance of the HMA and WMA sections, therefore, was the same; long-term monitoring is planned.

Application

In 2008, Virginia DOT developed special provisions allowing contractors to use WMA technologies for maintenance overlay projects. The special provisions removed the minimum mixture and placement temperatures for WMA but required a minimum temperature of 40ºF for the base on which the WMA is placed. The density requirements for WMA were identical to those for HMA. After one construction season, the minimum TSR value for WMA, initially 0.60, was raised to 0.80, the value for HMA.

In 2009, Virginia DOT adopted a supplemental specification incorporating WMA into standard practice. The specification allows contractors to use Virginia DOT–approved WMA products and processes in lieu of HMA and requires the following:

- Superpave® mixture properties must be determined on the reheated materials;
- The minimum TSR must be 0.80 in the design and production tests;
- The initial production of new mix designs and processes must be limited to 500 tons; and
- WMA may be placed when the base temperature is 40ºF or greater.

Benefits

The research supported Virginia DOT's use of WMA as an alternative to HMA. The construction and environmental improvements benefit the agency, the industry, and the public. Contractors can increase the hauling distances from the plant to the project, can reduce energy consumption during production, and can reduce plant emissions, improving air quality. Crews benefit from the cooler mat temperatures and reduced fumes during paving. The improved compaction can increase the durability and the performance of WMA.

For more information, contact Stacey Diefenderfer, Research Scientist, Virginia Center for Transportation Innovation and Research, 530 Edgemont Road, Charlottesville, VA, 22903; phone 434-293-1933; fax 434-293-1990; e-mail: Stacey.Diefenderfer@VDOT.Virginia.gov.

Resources

Installation of Warm-Mix Asphalt Projects in Virginia. VTRC 07-R25. www.virginiadot.org/vtrc/main/online_reports/pdf/07-R25.pdf.

Laboratory Evaluation of a Warm Asphalt Technology for Use in Virginia. VTRC 09-R11. www.virginiadot.org/vtrc/main/online_reports/pdf/09-R11.pdf.

NCHRP Report 691: Mix Design Practices for Warm-Mix Asphalt. Transportation Research Board of the National Academies, Washington, D.C., 2011. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_691.pdf.

Performance of Virginia's Warm-Mix Asphalt Trial Sections. VTRC 10-R17. www.virginiadot.org/vtrc/main/online_reports/pdf/10-R17.pdf.

www.virginiadot.org/business/resources/const/07RevDiv_II.pdf.

www.virginiadot.org/business/resources/Materials/Approved_Lists.pdf.

NCHRP Projects

Go to www.trb.org/NCHRP/FindaProject.aspx and type in the project number:

- NCHRP Project 09-47: Engineering Properties, Emissions, and Field Performance of Warm-Mix Asphalt Technologies;
- NCHRP Project 09-47A: Properties and Performance of Warm-Mix Asphalt Technologies;
- NCHRP Project 09-49: Performance of Warm-Mix Asphalt Technologies: Stage I—Moisture Susceptibility;
- NCHRP Project 09-49A: Performance of Warm-Mix Asphalt Technologies: Stage II—Long-Term Field Performance;
- NCHRP Project 09-52: Short-Term Laboratory Conditioning of Warm-Mix Asphalt Mixtures for Mix Design and Performance Testing; and
- NCHRP Project 09-53: Asphalt Foaming Characteristics for Warm-Mix Asphalt Applications.

EDITOR'S NOTE: Appreciation is expressed to G. P. Jayaprakash, Transportation Research Board, for his efforts in developing this article.

Suggestions for "Research Pays Off" topics are welcome. Contact G. P. Jayaprakash, Transportation Research Board, Keck 488, 500 Fifth Street, NW, Washington, DC 20001 (202-334-2952; gjayaprakash@nas.edu).

Scott Bradley

Minnesota Department of Transportation

Not long after Scott Bradley undertook a major career shift—from principal landscape architect and manager at a private firm to a middle-management position at the Minnesota Department of Transportation (DOT)—he attended a meeting of the TRB Landscape and Environmental Design Committee. The introduction to expert research and to professionals from a variety of disciplines sparked Bradley's enthusiasm for transportation landscape architecture and research—and more than 20 years of TRB involvement and leadership.

"Exposure to active TRB members opened my eyes to challenges, needs, and opportunities in transportation," Bradley recalls. "Engagement with these folks and with TRB instilled a passion and a greatly increased capacity for making a positive difference." Bradley's 2004 induction as a Fellow in the American Society of Landscape Architects cited the far-reaching influence he achieved through innovation, leadership, teamwork, and advocacy for context-sensitive solutions (CSS) and sustainable transportation project and program development.

"Research helps to inform knowledge, skills, and attitudes that can lead to new habits—making us more relevant and successful in addressing current and future problems."

In 1995, Bradley joined TRB's oldest continuing committee, Landscape and Environmental Design, becoming secretary in 2000 and chair in 2009. He also has been a member of the Design Section Executive Board and was appointed to populate and chair the crosscutting Task Force on Context-Sensitive Design and Solutions in 2003. With Bradley's leadership and participation in pushing interdisciplinary collaboration and teamwork, these groups sponsored many workshops and research paper presentation sessions as well as nine project proposals funded by the National Cooperative Highway Research Program. He currently is comanaging a Minnesota DOT project to pilot-test a collaborative decision-making framework for the second Strategic Highway Research Program.

An alumnus of the University of Minnesota, Bradley spent 10 years in private-sector landscape architecture before arriving at Minnesota DOT in 1988. He has managed many statewide programs and interdisciplinary teams applying CSS in multimodal transportation planning, project development, design, construction, operations, and maintenance activities. He began as a middle manager supervising highway landscape programs and was appointed Chief Landscape Architect in 2001, when he also began leading Minnesota DOT's efforts as one of FHWA's designated CSS pilot states. In 2009, he became director of CSS, guiding a new flagship initiative to implement CSS philosophy, strategies, and principles as a business model throughout Minnesota DOT.

A spirit of collaboration guides Bradley in his work at Minnesota DOT. Early in his tenure as Landscape Unit chief, he built a consensus among internal and external stakeholders and directed a revamping of many of the department's highway landscaping and vegetation management programs, guidelines, specifications, best practices, resource tools, and training. At times the moves were controversial, but Bradley overcame obstacles through cooperation, building rapport and trust with stakeholders, and a clearly articulated vision; his efforts garnered considerable state and national recognition for Minnesota DOT as an industry leader.

"Involvement with research and TRB taught me always to examine and challenge the conventional assumptions, habits, and wisdom that lie at the root of resistance to change," Bradley notes. "Research helps to inform knowledge, skills, and attitudes that can lead to new habits—making us more relevant and successful in addressing current and future problems."

In 1991, Bradley employed a collaborative approach in developing the nationally acclaimed Community Roadside Landscape Partnership Program, which has been recognized with many state and national awards—including one of the first National Environmental Excellence Awards for Exemplary Public Involvement from the Federal Highway Administration (FHWA). He also led a collaborative effort to develop an expert system for improving plant selection and establishment in roadside environments. Originally a CD-ROM and now an online resource tool, the Minnesota DOT plant selection expert system received the FHWA 2001 Environmental Excellence Award for Research.

In addition to program and project awards, Bradley has received many tributes from Minnesota DOT for management, performance, teamwork, and leadership, as well as commendations from several governors. In the 1990s Bradley was a founding member, secretary, and cochair of the Minnesota Earth Day Network and in 1995 received the National Arbor Day Foundation's Joyce Kilmer Award.

Mohammad S. Khan

Professional Service Industries, Inc.

Mohammad S. Khan recalls his journey from a bridge engineer in India in the 1980s to senior vice president at Professional Service Industries, Inc. (PSI), as "filled with well wishers, family members, mentors, colleagues, and organizations such as TRB." Khan started at PSI as a department manager in 1995, and since then has held positions as district manager and vice president before becoming senior vice president in 2005.

In 1980, Khan received a bachelor's degree from Aligarh Muslim University in India, a master's degree from the University of Petroleum and Minerals in Saudi Arabia in 1985, and a Ph.D. from Oklahoma State University in 1992, all in civil engineering. During his dissertation process, mentors Robert Hughes and Michael Ayers encouraged him to define and pursue his own research topic. This piqued a continuing interest in research, along with the research and writings of the late Bryant Mather, U.S. Army Corps of Engineers. "The clarity and expression of Mather's thoughts were unparalleled," he notes.

"In this dynamic and competitive global environment, we need to leave our comfort zones and take calculated risks to succeed."

Khan leads PSI's government sector, directing business with federal and state government agencies nationwide. To ensure successful management and leadership of more than 30 senior managers in the large, complex program, Khan stresses the importance of careful planning, discipline, and "an absolute determination to succeed." Although the government sector encompasses many branches, from military and government buildings to land and water management, his occupational association with transportation—research, consulting, design, construction, testing, and management—has continued the longest.

Khan has initiated, conducted, and managed many projects focusing on the safety, economics, and preservation of the nation's transportation infrastructure—some of which have resulted in updates to the American Association of State Highway and Transportation Officials' *Bridge Design and Construction Specifications*—and has validated and implemented several technologies as part of the first and second Strategic Highway Research Programs. Current research subjects include bridge engineering and alkali–silica reaction.

An enthusiastic proponent of innovation, Khan devotes much effort to participating in and encouraging new research activities and to identifying new technology and related technology transfer activities. "In this dynamic and competitive global environment, we need to leave our comfort zones and take calculated risks to succeed," Khan comments. "This is an area in which I feel very optimistic about the upcoming generation of researchers, engineers, and scientists."

Khan is a longtime member of TRB's Basic Research and Emerging Technologies Related to Concrete Committee, which he chaired from 2003 to 2009. He currently is a member of the Design and Construction Group Executive Board and the Task Force on Nanotechnology-Based Concrete Materials; he organized the First International Conference in North America on Nanotechnology in Cement and Concrete, May 2010, in Irvine, California. In 2009, Khan coauthored *High-Performance Concrete Bridge Deck Investigation*, a guide for designing and constructing concrete bridge decks with low crack density. From 2008 to 2010, Khan also chaired the Research and Current Developments Committee of the American Concrete Institute (ACI).

Khan's particular research interest is sustainable development in transportation infrastructure—he regularly organizes forums for industry leaders, innovators, and entrepreneurs from federal, state, and regulatory agencies; academia; research; and business. "By working collectively and collaboratively, we can lay the foundations of a sustainable transportation infrastructure today on which our future generations can build tomorrow," Khan affirms.

Khan has authored more than 25 papers on technical and management issues, and has written for *TR News*, ACI's *Concrete International* and *Materials Journal*, and the American Society of Civil Engineers' (ASCE) *Journal of Materials in Civil Engineering*. In 1993, he wrote an article for the ASCE *Journal of Management in Engineering* on leadership methods for increased productivity. "The principles and concepts presented in this paper still form the basis of my management philosophy and practice," Khan observes.

He is active with ACI and NACE International (formerly the National Association of Corrosion Engineers)—he currently chairs NACE's Baltimore–Washington section. Khan also is a member of ASTM (formerly the American Society for Testing and Materials), the American Society of Nondestructive Testing, and ASCE. Honors include the NACE Mars Fontana Award, the Research Excellence Award from Oklahoma State University, and the ACI National Capital Chapter Outstanding Accomplishment Award.

Calculating the Impact of Biofuel-Based Economy on Rural Roads

BY KONSTANTINA (NADIA) GKRITZA AND INYA NLENANYA

Gkritza is Assistant Professor, Department of Civil, Construction, and Environmental Engineering, and Nlenanya is Transportation Research Specialist, Institute for Transportation, Iowa State University, Ames.

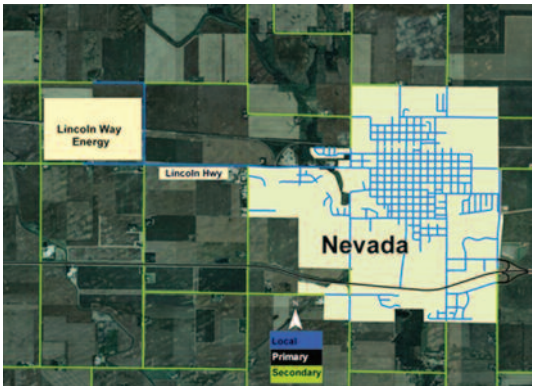
A new, multibillion-dollar economy is emerging in Iowa, rooted in the production of sustainable energy and of biofuels such as grain-based ethanol and soy biodiesel. According to the Iowa Department of Economic Development, Iowa leads the United States in ethanol and biomass production, is second in biodiesel production, and recently superseded California in wind energy production.

Nearly 80 percent of Iowa's state, county, and municipal roads are under the jurisdiction of a county and most—if not all—biofuel plants or wind farms are located on a county or secondary road. This pushes the burden of maintenance onto counties that already have more roads under their jurisdiction than they can maintain. Because a biofuel-based economy depends on the quality of service provided by transportation infrastructure, Iowa State University researchers have designed a simple spreadsheet model to determine the roadway service life and the fiscal impacts of biofuel plant operations on Iowa's secondary road system.

The impact calculator is a small area model that estimates the additional truck trips to and from a biofuel plant. The calculator estimates truck traffic on the major road connecting to the proposed or existing plant and calculates the incremental cost of the new traffic limited to paved surfaces.

To model maintenance costs, the research team consulted with county and city public works engineers, as well as with representatives of the Asphalt Paving Association of Iowa and the Iowa Concrete Pavement Association. The bidding system of the Iowa Department of Transportation (DOT) yielded an average cost per mile for the maintenance practices used in the state.

The model requires two categories of critical information: plant inputs and traffic inputs. For plant inputs, the key is plant capacity; from that, the calculator estimates the bushels of corn and the truckloads needed to move the raw materials and finished products. Users may apply a default value or enter the percentage of raw materials and finished products moved by trucks.



The Lincolnway Energy Cooperative biofuel plant was tested by an impact calculator developed by researchers at Iowa State University.

Traffic inputs include roadway design, the annual traffic growth rate, the number of trucks, the pavement thickness, and equivalent single axle loads (ESALs). The module also captures non-plant-generated traffic and assumes that passenger cars have a negligible effect on the incremental cost.

The calculator output summarizes the incremental costs, by pavement type, of a new or proposed biofuels plant. The roadway design ESALs are determined from the pavement thickness in accordance with the American Association of State Highway and Transportation Officials' *Pavement Design Guide for New and Rehabilitated Pavements*.

The design ESALs of the roadway are compared against the total ESALs from the biofuels plant, and that information is used to estimate costs—if the total ESAL value resulting from the plant is greater than that for which the road was designed, the pavement will deteriorate more quickly and will generate higher maintenance costs.

Also estimated are annual maintenance and present worth costs. The calculator assumes that crack sealing and seal coating are performed alternately; because maintenance practices vary between counties, the user can override the default values.

Researchers applied the model to an evaluation of the Lincolnway Energy Cooperative, a coal-fired dry mill ethanol plant that began production in 2006. Located between Ames and Nevada, Iowa, the plant produces 50 million gallons of ethanol a year and uses 20 million bushels of corn annually. Traffic figures were obtained from Iowa DOT Geographic Information Management Systems 2004 snapshot, and pavement thickness measurements came from the Story County engineering office and the City of Nevada.

When plant and traffic inputs were applied, the model showed that plant activities would not affect roadway maintenance costs—the road was designed to handle the anticipated amount of plant traffic. If the plant increased production capacity to 100 million gallons, however, maintenance costs would increase by 26 percent, unless the pavement thickness was increased.

For more information, contact Gkritza at 515-294-2343 or nadia@iastate.edu.

PHOTO: UNIVERSITY OF CALIFORNIA, RIVERSIDE

The Eco-Way device, deployed by researchers at the University of California, Riverside, allows drivers to monitor fuel usage as they drive.

Increasing Fuel Economy: Strategies and Tools

Improving fuel economy—using tools both technological and educational—is the subject of two recent studies. In a report for the Global Fuel Economy Initiative (GFEI), researcher George C. Eads finds that a GFEI target of 50 percent improvement in fuel economy for light-duty vehicles across the globe by 2050 can be achieved with existing technologies. A study from the College of Engineering Center for Environmental Research and Technology at the University of California, Riverside (UCR), examines the benefits of ecodriving, or ways of driving that minimize fuel consumption.

Although the GFEI fuel economy target is global, its significance differs between regions, according to the report. Much of the vehicle fleet in Asia consists of smaller vehicles, notes Eads; therefore, the average new car in these countries currently has better fuel economy than one in Western Europe. Although consumer trends in countries such as China and India are favoring larger, more expensive vehicles with high performance standards, appropriate regulatory incentives for technological improvements can offset the reduction in fleet average fuel economy over time.

Eads recommends national fuel economy initiatives and a manufacturer focus on improved fuel economy rather than on enhanced vehicle performance. According to the report, fuel economy regulation will aid in limiting vehicle size and performance; in some countries, this regulation would require changes to current vehicle sizes and performance standards. According to the report, the 2005 average new vehicle fuel economy level of 8 L per 100 km can be reduced to approximately 4 L per 100 km by 2050.

The UCR study employed an on-board ecodriving device, Eco-Way, which allows drivers to monitor fuel consumption. The availability of instant feedback on a vehicle's fuel economy and its effect on driving behavior under real-world driving conditions was studied using 20 drivers in the Riverside area. Subjects used the Eco-Way device for their daily commutes for 2 weeks and were surveyed on their experience. Researchers Matthew Barth, Kanok Boriboonsomsin, and Alexander Vu found that drivers who were educated on efficient driving techniques experienced a 6 percent increase in fuel economy on city streets and a 1 percent fuel economy increase on highways.

According to the UCR report, ecodriving already is practiced in much of Europe, where the technique is taught in some driving courses. Efficient driving programs overseas have yielded fuel economy improvements of 5 percent to 15 percent. Techniques include shifting to higher gears as soon as possible, maintaining steady speeds, anticipating traffic flow, accelerating and decelerating smoothly, and keeping the vehicle well-maintained, including frequent checks of the tire pressure.

For information on the GFEI report, visit www.globalfueleconomy.org. For information on the UCR study, visit http://newsroom.ucr.edu/news_item.html?action=page&id=2541.

PHOTO: BLOG.UDOT.UTAH.GOV

Workers prepare to move the Sam White Bridge near Salt Lake City, using SPMTs.

Bridge Move Breaks Record

On March 26, a pair of hydraulic self-propelled modular transporters (SPMTs) lifted a 354-foot-long bridge more than 20 feet into the air and moved it 500 feet across a major freeway—the longest two-span bridge ever transported in the Western hemisphere. Part of the Utah County I-15 Corridor Expansion (I-15 CORE), a $1.7-billion Utah DOT project reconstructing 24 miles of freeway from Lehi to Spanish Fork, the Sam White Bridge move was performed by Provo River Contractors and showcased by the Federal Highway Administration.

From July 2010 to March 2011, the 27,500-square foot bridge was constructed on a site to the east of I-15. The weight of the superstructure was more than 3.8 million pounds—2.27 million pounds of concrete, 1.47 million pounds of steel, and more than 275,000 pounds of rebar. SPMTs moved the two 177-foot spans simultaneously, dropping them into place across eight lanes of I-15 freeway.

The move was completed in one evening, finishing three hours earlier than expected. The use of SPMTs—an accelerated bridge construction technique—is a key feature of the I-15 CORE project. The Sam White Bridge was the third of six bridges moved via SPMTs as part of the project. Utah DOT has been a leader in the use of this technology—of the 36 SPMT bridge moves in the United States, 23 have been in Utah.

According to Utah DOT, construction of the bridge by traditional methods would have required six additional nighttime freeway closures.

For more information, contact Heather Barnum at 801-214-4782 or hbarnum@utah.gov.

Technology, Collaboration Attracting Students

In 2010, the Institute for Transportation at Iowa State University produced a new version of the online magazine *Go!* incorporating an interactive approach to reach its target audience. Developed for and with young people, *Go!* provides entertaining content and a dynamic visual interface to attract teenagers to pursue transportation studies and careers. The magazine has more than 800 subscribers and 8,000 monthly visitors from more than 100 countries. Features include a Spanish-language version, *¡Vamos!;* links to social network sites; and *Curriculum Connections*, a series for teachers.

A dynamic interface helps the online magazine *Go!* promote transportation education and careers to teens.

Drawing on a professional background in technology and student learning, coordinator Rema Nilakanta—assisted by graduate students Britta Mennecke and Bennett Stone—is implementing a plan to enhance *Go!*'s impact. Hands-on games, puzzles, audio and video clips, and contests supplement texts and aim to energize visitors' online experience with *Go!* Students from middle and high schools are encouraged to participate actively in content development and functionality; the site allows students to publish original transportation-related content such as text, games, video clips, and photos.

Go! receives support from the Midwest Transportation Consortium, a U.S. DOT University Transportation Center at Iowa State University, and from the Federal Highway Administration's Eisenhower Fellowship program.

For more information about Go!, *visit www.go-explore-trans.org or contact Rema Nilakanta at 515-294-1945 or rema@iastate.edu.*

TRB Meetings

June

27–30 6th International Driving Symposium on Human Factors in Driver Assignment, Training, and Vehicle Design*
Lake Tahoe, California

28–July 1 6th International Symposium on Highway Capacity and Quality of Service
Stockholm, Sweden

July

10–13 TRB Joint Summer Meeting
Boston, Massachusetts

11–13 National Summit for Rural Traffic Safety Culture*
Big Sky, Montana

11–14 Southern African Transport Conference*
Pretoria, South Africa

14–15 6th SHRP 2 Safety Research Symposium
Washington, D.C.

17–20 50th Annual Workshop on Transportation Law
Seattle, Washington

21–22 FAA–TRB Business and General Aviation Forecasting Workshop
(invitation only)
Washington, D.C.

24–27 10th International Conference on Low-Volume Roads
Orlando, Florida

25 Geophysical Exploration, Nondestructive Evaluation, and Monitoring Techniques for Landslides, Rockfalls, and Other Geohazards
Lexington, Kentucky

25–26 6th New York City Bridge Conference*
New York, New York

25–27 Waste Management and Resource Efficiency Workshop
Portland, Oregon

25–28 TRB–AASHTO Joint Geometric Design Meeting
Irvine, California

August

1–2 20th Biennial Visibility Symposium
Minneapolis, Minnesota

20–23 International Visualization in Transportation Symposium
Chicago, Illinois

22–25 Transportation Hazards and Security Summit
Irvine, California

29–Sept. 1 Rethinking Energy and Climate Strategies for Transportation
(invitation only)
Pacific Grove, California

30–Sept. 1 Emerging Issues in Safe and Sustainable Mobility for Older People
Washington, D.C., area

September

13–16 Smart Rivers 2011: Systems Thinking*
New Orleans, Louisiana

14–16 3rd International Conference on Road Safety and Simulation
Indianapolis, Indiana

TBD Conference on Performance Measures for Transportation and Livability*
Austin, Texas
Thomas Palmerlee

October

2–6 7th World Congress on Joints, Bearings, and Seismic Systems for Concrete Structures*
Las Vegas, Nevada

10–12 European Transport Conference*
Glasgow, Scotland

16–20 World Congress on Intelligent Transport Systems
Orlando, Florida
Richard Pain

25–27 Using Census Data for Transportation Applications Conference
Irvine, California

November

2–3 Improving Transportation Safety Programs Through University–Agency Partnerships Conference
Washington, D.C.

Additional information on TRB meetings, including calls for abstracts, meeting registration, and hotel reservations, is available at www.TRB.org/calendar. To reach the TRB staff contacts, telephone 202-334-2934, fax 202-334-2003, or e-mail TRBMeetings@nas.edu. Meetings listed without a TRB staff contact have direct links from the TRB calendar web page.

*TRB is cosponsor of the meeting.

Photo: Cable Risdon Photography

Communications competition finalists watch a video presentation by Kevin Green of the Clean Air Campaign. (*From left:*) Wendy Feuer, New York City Department of Transportation; Randall Blankenhorn, Chicago Metropolitan Agency for Planning; Anne Lucey, University of Delaware; Katherine Turnbull, Texas Transportation Institute and Chair, TRB Technical Activities Council; Valerie Knepper, Metropolitan Transportation Commission; and Matthew Trowbridge, University of Virginia.

Winning Communications Inform the General Public

Since 2007, the TRB Planning and Environment Group has sponsored the Communicating with John and Jane Public competition to stimulate fresh and creative methods for communicating technical transportation issues to general audiences—from students to retirees, elected officials to business owners, and vacationers to commuters.

The 2010 competition examined best practices in communicating sustainability and livability, buzzwords that can be difficult to define and that create a challenging dynamic for transportation professionals and the public. Contestants addressed practices to promote sustainable and livable conditions; the relationship of existing development to sustainability and livability; planned development and the creation of a sustainable and livable city; and measuring sustainability and quality of life. Entries ranged from books to multimedia presentations to interactive online games.

The winner of the 2010 contest was Randall Blankenhorn of the Chicago Metropolitan Agency for Planning (CMAP), for the agency's Go to 2040: Invent the Future, a large-scale effort that encouraged residents to express their priorities for the future of the region. During the summer of 2009, CMAP conducted an extensive campaign to solicit feedback from residents and stakeholders on several alternative development scenarios for the Chicago metropolitan region. Besides gaining public input, the goal was to educate residents on the impacts of multiple planning strategies. An interactive software program, MetroQuest, allowed users to experiment with different development patterns and transportation investments and to view the outcomes of each decision.

Joe Curley and Valerie Knepper of San Francisco's Metropolitan Transportation Commission (MTC) were runners-up for the publication, *New Places, New Choices: Transit-Oriented Development in the San Francisco Bay Area*, which showcased 10 examples of transit-oriented districts and corridors. The text and full-page photos encouraged replication of best practices around the region. MTC and the Association of Bay Area Governments also released podcasts on transit-oriented development (TOD). These TODcasts include narrated audio tours of local transit corridors and TODs featuring interviews with planners, developers, and stakeholders.

Honorable mentions included a survey of Delaware-area residents that used a video to convey the benefits of sustainable roadside vegetation management strategies, by Anne Lucey, University of Delaware; a series of illustrations and photos from real-world communities that explained the 5-minute walk and its importance to livable and sustainable urban design, by Will Grimm, Groundworks Urban Design + Planning, and Nisha Botchwey and Matthew John Trowbridge, University of Virginia; a rap video on the benefits of carpooling by Kevin Green, Clean Air Campaign; and the New York City Department of Transportation's *Street Design Manual*, which provides policy and design guidelines for the improvement of New York's streets and sidewalks, by Commissioner Janette Sadik-Khan,Wendy Feuer, Michael Flynn, Ed Janoff, Margaret Newman, Andy Wiley-Schwartz, and Bruce Schaller.

For more information on the contest, including the 2011 contest rules and procedures, focused on the theme, "Transportation During Emergency Situations," contact Stephanie Camay at Stephanie_Camay@URSCorp. com or visit the TRB Public Involvement in Transportation Committee's website at https://sites.google.com/site/trbcommitteeada60.

Bringing Bridge Technology into Mainstream Practice

With the Federal Highway Administration and the American Association of State Highway and Transportation Officials (AASHTO), the second Strategic Highway Research Program (SHRP 2) is working to integrate new technologies into mainstream practice. Initiatives address designing and constructing new bridges and repairing existing ones; stabilizing bridge foundations; and nondestructive testing.

Innovative geotechnical solutions to be used in rapid renewal projects include column-supported embankments, reinforced soil slopes and platforms, lightweight fills for bridges over unstable soils, intelligent compaction, geosynthetic-reinforced platforms, high-energy compact rollers, and chemical and mechanical subgrade stabilization for bridge

working platforms.

In bridge construction, SHRP 2 is working to standardize design concepts such as precast abutments and piers, hybrid-drilled shafts, and space frame superstructures; the use of ultra-high-performance concrete in joints; and construction equipment including above-deck driven carrier systems, launched temporary truss bridges, wheel carriers, and self-propelled modular transporters.

SHRP 2 also is developing bridge design procedures and proposed specification changes, as well as the tools required for implementation of service limit states. Impact echo techniques and other nondestructive technologies are being explored to detect deck delamination, investigate crack depth, and evaluate grouting condition in ducts.

For more information about SHRP 2 activities, contact Patrick Zelinski, TRB, 202-334-1916, pzelinski@nas.edu.

STUDENTS TAKE FLIGHT—Using a flight simulator, Cardozo Senior High School students David Hayes (*seated, left*) and Anthony Martin (*seated, right*) demonstrate their studies of proper airport runway traffic pattern procedures. Hayes and Martin—a TRB intern—were part of a presentation by Cardozo's TransTech Academy March 30, 2011, at the Keck Center. TransTech students shared their research on engineering design, bridge analysis, and electromechanical technology. A program for transportation studies, TransTech is celebrating its 20th anniversary and has graduated more than 500 students since its founding in 1991.

COOPERATIVE RESEARCH PROGRAMS NEWS

Guidelines for Nighttime Visibility of Overhead Guide Signs

Highway agencies often must decide how to light overhead guide signs effectively at night. Although the *Manual on Uniform Traffic Control Devices* provides minimum retroreflectivity standards for overhead guide signs, it is difficult to find site-specific guidelines for nighttime performance of overhead guide signs. Minimum sign retroreflectivity requirements ensure conspicuity and legibility for all signs—including overhead guide signs—but in complex visual environments such as urban areas, the signs may require more retroreflectivity or illumination. Other challenges to nighttime sign performance include roadway geometry, the amount of roadway lighting, traffic volume, traffic speed, and sign position and orientation.

Texas A&M University has received a $600,000, 30-month contract [National Cooperative Highway Research Program (NCHRP) Project 05-20, FY 2011] to develop guidelines for effective nighttime performance of overhead guide signs in site-specific contexts. The research also will develop spreadsheet tools to support application of the guidelines, along with new tests to measure performance.

For more information, contact Ed Harrigan, TRB, 202-334-3232, eharriga@nas.edu.

Bidding Alternative Drainage Pipe Systems

When selecting products such as drainage pipe systems, transportation agencies traditionally have used a means-and-methods approach—owner agencies specify a system during the design process, and the cost is included in contractors' project bids. Federal regulations, however, require competition when specifying alternative types of drainage pipes of similar quality; agencies can satisfy this requirement and lower costs by providing contractors a choice of systems during the bidding process.

Golder Associates Inc. has received a $484,010, 36-month contract (NCHRP Project 10-86, FY 2011) to develop a recommended practice, suitable for adoption by AASHTO, to guide the implementation of a performance-based contractor selection and delivery process for drainage pipe systems on highway construction projects. Performance-based criteria include durability, hydraulic capacity, structural capacity, service life, and environmental compatibility, as well as requirements for inspection, preventive maintenance, and rehabilitation.

For more information, contact Ed Harrigan, TRB, 202-334-3232, eharriga@nas.edu.

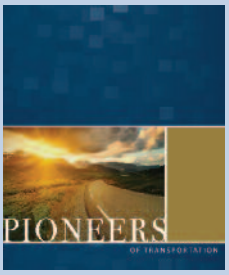
Fracture-Critical System Analysis for Steel Bridges

Advances in materials have raised the need for a redefinition of a fracture-critical steel bridge. Modern steel bridges often are made of high-performance steel and are built using high-quality welding procedures; they inherently are better suited to carry redistributed loads through alternate paths.

Although AASHTO code allows the building of new fracture-critical bridges, current fabrication and maintenance inspection requirements discourage it. Increased maintenance costs and structural concerns could be eliminated or minimized by reexamining the fracture-critical designation and reclassifying bridges, but opinions diverge widely on what defines a fracture-critical bridge. Guidance is needed for appropriate fracture analysis methods.

Virginia Polytechnic Institute has received a $350,000, 33-month contract (NCHRP Project 12-87, FY 2011) to develop a methodology—based on loads, existing conditions, material properties, and bridge configurations—for measuring the parameters of what defines a fracture-critical steel bridge system.

For more information, contact Waseem Dekelbab, TRB, 202-334-1409, wdekelbab@nas.edu.



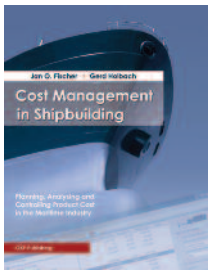
Honoring the Giants of Transportation

Pioneers of Transportation is a collection of biographical sketches, assembled by Carlton C. Robinson and published by the Institute of Transportation Engineers, honoring notable achievers in the field of transportation. The 64-page book focuses on U.S. transportation leaders in the early years of the profession—a profession that began in the first quarter of the 20th century, loosely defined as "traffic engineering," and gradually grew to encompass the safe and efficient use of roadways and other modes for passenger and goods movement. Grouped into various eras of mobility—good roads, highway, and suburban—the accounts trace a history of the transportation profession from the early 19th century to the 1960s.

Among the innovators and leaders featured in the book are William Phelps Eno, 1858–1945; Roy Winchester Crum, 1885–1951; Bruce D. Greenshields, 1893–1979; Walter P. (Pyke) Johnson, 1889–1969; Wilbur S. Smith, 1911–1990; D. Grant Mickle, 1908–1995; Francis C. Turner, 1909–1999; William S. Vickrey, 1914–1996; and Alan M. Voorhees, 1922–2005.

For more information, visit www.ite.org.

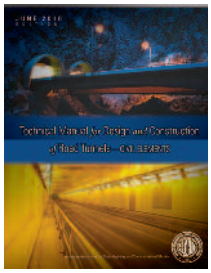
Cost Management in Shipbuilding: Planning, Analyzing, and Controlling Product Cost in the Maritime Industry



Jan O. Fischer and Gerd Holbach. GKP Publishing, 2011; 196 pp.; €54.95; 978-3-000-33225-8.

Shipbuilding costs have risen substantially in recent years. Since nearly all of these costs are fixed at the start of production, cost optimization should occur in the design and engineering phases of a project. This book examines methods, processes, and systems to plan for, analyze, and control costs efficiently in all phases of shipbuilding. Focusing on the Costfact software system and drawing on years of experience at the Flensburger Schiffbau shipyard in Germany, the authors describe the role of effective cost management in ensuring manufacturer competitiveness and assess the current state of the industry and areas for improvement.

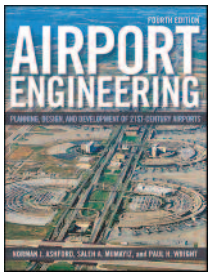
Technical Manual for Design and Construction of Road Tunnels: Civil Elements



American Association of State Highway and Transportation Officials (AASHTO), 2010; 662 pp.; AASHTO members, $250; nonmembers, $300; 978-1-560-51457-2.

Increased use of underground space for transportation systems—along with the growing complexity of constructing and maintaining aboveground transportation infrastructure—has underscored a need for a technical manual that addresses the many aspects of road tunnel development. Jointly published by AASHTO and the Federal Highway Administration, this manual provides guidelines for the planning, design, construction, and structural rehabilitation and repair of the civil elements of road tunnels—including cut-and-cover tunnels, mined and bored tunnels, immersed tunnels, and jacked box tunnels. This volume focuses on the civil elements of road tunnel design and construction; system elements are addressed in a separate volume.

Airport Engineering: Planning, Design, and Development of 21st Century Airports, 4th Edition

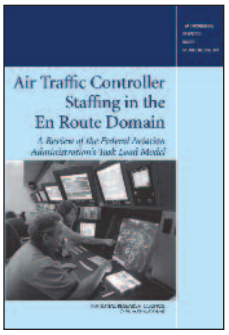


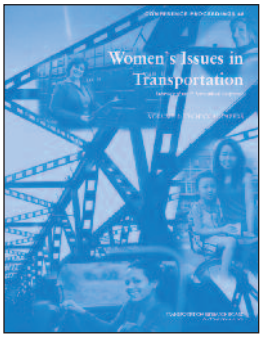
Norman J. Ashford, Saleh Mumayiz, and Paul H. Wright. Wiley, 2011; 768 pp.; $140; 978-0-470-39855-5.

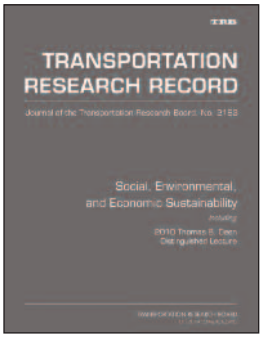
Construction of new U.S. airports has decreased in the past several decades as construction of airports abroad has risen. The latest edition of *Airport Engineering*—a text first published in 1979—responds to this shift in the global growth of airports, addressing best practices and tested fundamentals in airport engineering and planning. Subjects covered include the structure and organization of air transportation; forecasting air transportation demand; system planning and master planning; passenger terminals; drainage and pavement design; access; heliports, stolports, and vertiports; modeling and simulation; and environmental impacts.

The books in this section are not TRB publications. To order, contact the publisher listed.

TRB PUBLICATIONS







Air Traffic Controller Staffing in the En Route Domain: A Review of the Federal Aviation Administration's Task Load Model
Special Report 301

This TRB special report examines the structure, empirical basis, and validation methods of a Federal Aviation Administration model used to inform workforce planning by estimating how long controllers spend on various tasks when handling en route traffic. Although the model acknowledges traffic complexity, making it superior to past models, the report's authoring committee recommends more operational and experimental data on task performance to establish and validate many key model assumptions, relationships, and parameters.

2010; 70 pp.; TRB affiliates, $25.50; nonaffiliates, $34. Subscriber category: aviation.

Women's Issues in Transportation: Summary of the 4th International Conference, Volume 2: Technical Papers
Conference Proceedings 46

The papers from the 4th International Conference on Women's Issues in Transportation, October 2009, highlight the latest research on changing demographics that affect transportation planning, programming, and policy making, as well as the latest research on crash and injury prevention for different segments of the female population. Other topics include pregnant and elderly transportation users, efforts to address and increase women's personal security when using various modes of transportation, and the impacts of extreme events such as hurricanes and earthquakes on women's mobility.

2011; 287 pp.; TRB affiliates, $60; nonaffiliates, $80. Subscriber categories: planning and forecasting; policy; safety and human factors; society.

Social, Environmental, and Economic Sustainability
Transportation Research Record 2163

This volume includes the 2010 Thomas B. Deen Distinguished Lecture by Martin Wachs—a discussion of the history and future of transportation policy as it relates to poverty and sustainability—as well as papers on the equity implications of alternative transportation financing strategies, travel behavior patterns of different socially disadvantaged groups, measuring the jobs–housing balance, potential inequities of climate change abatement policies, transportation demand management, green credits versus environmentally sustainable traffic operations, the impact of transportation infrastructure on firm formation, and the impact of foreign aid on local institutional systems.

2010; 150 pp.; TRB affiliates, $51; nonaffiliates, $68. Subscriber categories: highways; pedestrians and bicyclists; public transportation; energy; environment; society; policy; planning and forecasting.

Concrete Materials 2010
Transportation Research Record 2164

The 17 papers in this volume explore engineered cementitious composites, time of set for concrete mix in cold weather, grid types used to strengthen reinforced concrete panels, cement kiln dust-activated fly ash binder, the AASHTO T336-09 coefficient of thermal expansion test method, porous concrete pavements, end-result specifications for concrete, pervious concrete overlay, freeze–thaw durability of pervious concrete, resistance of pervious concrete to deicing chemicals, concrete containing recycled concrete aggregate, and recycled concrete aggregate in pervious concrete pavement, and more.

2010; 140 pp.; TRB affiliates, $48; nonaffiliates, $64. Subscriber categories: highways; materials; geotechnology; environment.

Statistical Methods and Visualization
Transportation Research Record 2165

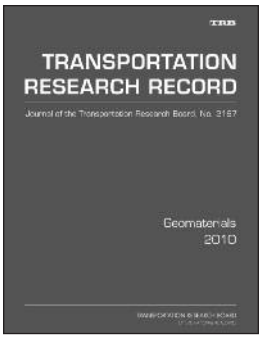
Modeling injury severity for multiple occupants of vehicles, methods to estimate crash counts by collision type, spatial correlation in multilevel crash frequency models, predicting rear-end crashes at unsignalized intersections, using incident management data to identify hot spots, a continuous logit for departure time choice with Bayesian methods, Gaussian processes for short-term traffic volume forecasting, the integration of traffic simulation into design visualization, and the combined effect of traffic and geometrics on rear-end collision risk are some of the topics investigated in this volume.

2010; 103 pp.; TRB affiliates, $42.75; nonaffiliates, $57. Subscriber categories: highways; safety and human factors; operations and traffic management; planning and forecasting; data and information technology.

Marine Transportation and Port Operations 2010
Transportation Research Record 2166

Authors present findings on ship-based greenhouse gas reduction negotiations, a web-based foreign waterborne cargo data system, global port operations and their influence on port labor, measuring the concentration degree of container port sys-

TRB PUBLICATIONS *(continued)*



tems, the resilience framework for ports, a systems approach to maritime transportation governance, container port competition, developing hinterland transport by container barge, emission reduction strategies for inland river tugs and towboats, an earthquake risk assessment for container ports, and more.

2010; 123 pp.; TRB affiliates, $44.25; nonaffiliates, $59. Subscriber categories: marine transportation; freight transportation; terminals and facilities; environment; security and emergencies; economics.

Geomaterials 2010
Transportation Research Record 2167

The eight papers in this volume examine red mud-based geopolymers, reclaimed asphalt pavement, recycled concrete materials, limestone screenings in roadway construction, unbound aggregate performance, and a shakedown limit derived from multistage permanent deformation tests.

2010; 82 pp.; TRB affiliates, $41.25; nonaffiliates, $55. Subscriber categories: highways; geotechnology; materials; pavements; environment.

Freight Transportation Modeling, Planning, and Logistics
Transportation Research Record 2168

Topics covered include multimodal network analysis and vulnerability assessment, agent-based combined traffic simulation of private cars and commercial vehicles, inland freight transportation modal choice, inventory routing systems under demand surges, transportation and logistics demand, identifying and characterizing truck bottlenecks, the cost impact of freight bottlenecks on the trucking industry, estimating the impact of congestion on freight, exclusive truck facilities, and building resilience into freight transportation systems.

2010; 145 pp.; TRB affiliates, $43.50; nonaffiliates, $58. Subscriber categories: motor carriers; highways; marine transportation; freight transportation; planning and forecasting; vehicles and equipment.

Maintenance Services and Surface Weather
Transportation Research Record 2169

Variable speed limit systems in work zones, the safety of mobile lane closures, temporary rumble strips for short-term work zones, simulation models for assessing the impacts of highway work zone strategies, alternative displays for speed limits in work zones, assessment of pavement marking visibility, the impact of cold temperature and snowfall on traffic volume, diagnosing road weather conditions with vehicle probe data, integrating the impact of rain into traffic management, structural control measures to mitigate avalanche hazards, a small unmanned aircraft for avalanche control, and the costs and benefits of tools to maintain winter roads are explored in this volume.

2010; 186 pp.; TRB affiliates, $54; nonaffiliates, $72. Subscriber categories: highways; operations and traffic management; environment; maintenance and preservation; safety and human factors.

Geology and Properties of Earth Materials 2010
Transportation Research Record 2170

Among the topics investigated are data quality assessments for manual pavement condition surveys, success factors of fish passageways, the effect of climate in mechanistic–empirical pavement design predictions, maintenance strategies to mitigate bridge end damage from water intrusion, a performance evaluation of storm water runoff sediment control devices, the effect of nondurable material on embankment settlement, expanded polystyrene block geofoam in slope stabilization and repair, and a laboratory measurement of diffusion coefficients for unsaturated soil drying and wetting.

2010; 118 pp.; TRB affiliates, $44.25; nonaffiliates, $59. Subscriber categories: highways; geotechnology; pavements; design; construction.

Operational Effects of Geometrics and Access Management 2010
Transportation Research Record 2171

Research is presented on acceleration and deceleration zones at traffic control intersections, interchange treatments to preserve the service life of narrow overpass and underpass roadways, parallel flow intersection and displaced left-turn intersection designs, offset improvements for left-turn lanes, public transit provisions in a state highway access management code, access management at major arterial intersections, and more.

2010; 74 pp.; TRB affiliates, $40.50; nonaffiliates, $54. Subscriber categories: highways; operations and traffic management; safety and human factors; design.

The TRR Journal Online website provides electronic access to the full text of more than 11,000 peer-reviewed papers that have been published as part of the Transportation Research Record: Journal of the Transportation Research Board *(TRR Journal) series since 1996. The site includes the latest in search technologies and is updated as new TRR Journal papers become available. To explore the TRR Online service, visit www.TRB.org/TRROnline.*

TRB PUBLICATIONS *(continued)*

Structures 2010
Transportation Research Record 2172

Authors share findings on topics including grouting materials and methods, barge–bridge collisions, the effects of wind gusts on sign support structures, staged posttensioning of concrete bridges, bond and anchorage of high-strength reinforcing steel in concrete bridges, flexural behavior of concrete bridges with high-strength bars, railway bridge field testing, shear and moment girder distribution factors with a built-in optical fiber sensor system, crack detectability and durability of coaxial cable sensors, seismic design of buried structures, the effect of bedding thickness on behavior of rigid pipes, and oxidation degradation of high-density polyethylene corrugated pipe resin.

2010; 209 pp.; TRB affiliates, $51; nonaffiliates, $68. Subscriber categories: highways; bridges and other structures.

Highway Capacity and Quality of Service 2010
Transportation Research Record 2173

The papers in this volume explore topics including arrival flow profiles and platoon dispersion for urban street segments, signalized intersections with short left-turn pockets, a new methodology for estimating performance on two-lane highways, left-turn spillover impact on through movement at signalized intersections, the consistency of stochastic capacity estimations, left-turn saturation flow rates and capacity at signalized intersections, the benefits of incident management systems, and pedestrian delay at signalized intersections with a two-stage crossing design.

2010; 138 pp.; TRB affiliates, $48; nonaffiliates, $64. Subscriber categories: highways; pedestrians and bicyclists; operations and traffic management.

Design of Roadside Barrier Systems Placed on Mechanically Stabilized Earth Retaining Walls
NCHRP Report 663

Although design procedures and standards vary among state highway agencies for the placement of roadside barriers on retaining walls, many engineers would characterize the standards as overly conservative. Part of the reason for this is an inadequate understanding of how barrier impact loads are transferred and distributed to the slab and wall system. This report details the development of standardized procedures for designing economical roadside barrier systems on mechanically stabilized earth retaining walls.

2010; 184 pp.; TRB affiliates, $49.50; nonaffiliates, $66. Subscriber category: bridges and other structures.

Identification of Vehicular Impact Conditions Associated with Serious Ran-off-Road Crashes
NCHRP Report 665

Roadside geometrics and safety features significantly affect the frequency and severity of crashes; designs for roadside geometrics, therefore, should identify the impact characteristics associated with serious injury and fatal crashes. Often, however, testing procedures represent a practical worst-case situation instead of real-world conditions. Crash data can be used to refine roadside safety countermeasures guidelines and to calibrate models of roadside safety and crash and vehicle dynamics. For this report, the Midwest Roadside Safety Facility identified data needs, developed a data collection plan, conducted a retrospective crash data collection effort, developed a relational database suitable for future research, and proposed an implementation plan for a long-term data collection effort.

2010; 69 pp.; TRB affiliates, $35.25; nonaffiliates, $47. Subscriber category: safety and human factors.

Target-Setting Methods and Data Management to Support Performance-Based Resource Allocation by Transportation Agencies, Volumes 1 and 2
NCHRP Report 666

Described in these volumes are methods that managers of state departments of transportation (DOTs) and other agencies can use to set performance targets and use data management systems to support performance-based decision making. State DOTs are applying performance measurements to improve efficiency and accountability; performance targets are a crucial step in the management process. Drawing on a range of private- and public-sector examples, this report presents a framework and specific guidance for target-setting and for ensuring that appropriate data are available to support performance management. Volume 3 of this report—NCHRP Web-Only Document 154—is available in electronic-only format.

2010; 128 pp.; TRB affiliates, $43.50; nonaffiliates, $58. Subscriber categories: highways; administration and management; data and information technology.

Recommended Procedures for Testing and Evaluating Detectable Warning Systems
NCHRP Report 670

The Americans with Disabilities Act of 1990 (ADA) mandates the use of tactile detectable warning systems at curb ramps to warn blind and visually impaired pedestrians of the transition to a vehicular road. ADA guidelines outline geometric, dome

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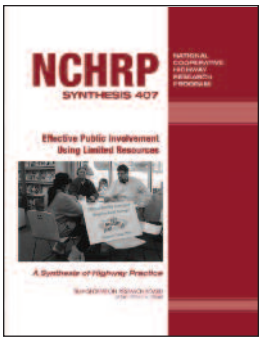

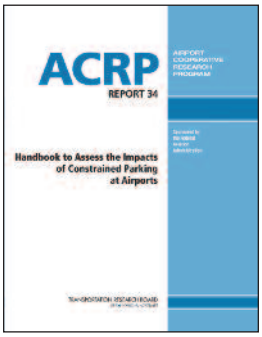

shape, and visual contrast guidelines for detectable warning systems, but little is known about the long-term durability of the many detectable warning systems on the market. NCHRP Project 4-33 developed standard durability testing methodologies and guidance for assessing test results. This report comprises a review of available literature and a survey of state DOTs, the development of testing methods, and a testing protocol.

2010; 105 pp.; TRB affiliates, $39.75; nonaffiliates, $53. Subscriber categories: pedestrians and bicyclists; safety and human factors.

Effective Public Involvement Using Limited Resources
NCHRP Synthesis 407

This synthesis documents the experiences of 31 individuals from 26 agencies in applying strategies to engage the public in developing transportation plans and projects. Responses to a survey quantified the cost of public involvement, described measures of effectiveness employed, and revealed a general state of the practice. Four subareas of public involvement are highlighted: organizational structure, staffing, cost quantification, and process.

2010; 97 pp.; TRB affiliates, $39.75; nonaffiliates, $53. Subscriber categories: highways; planning and forecasting; public transportation; society.

Pavement Marking Warranty Specifications
NCHRP Synthesis 408

Warranty specifications indicate the importance of pavement markings to traffic mobility and safety and establish goals for better performance and more cost savings. Compiling data from a literature review, a survey of transportation agencies, and interviews with pavement marking contractors and materials manufacturers, this synthesis presents information on agency specifications and how U.S. and Canadian transportation agencies apply pavement marking warranties. The perspectives of European agencies also are included.

2010; 56 pp.; TRB affiliates, $33.75; nonaffiliates, $45. Subscriber categories: administration and management; highways; operations and traffic management.

Handbook to Assess the Impacts of Constrained Parking at Airports
ACRP Report 34

This handbook provides a planning resource for assessing the impacts and understanding the effects of potential strategies addressing the complexties of constrained airport parking. The nature of parking constraints varies from airport to airport, as does the operating environment, customer base, goals and objectives, and the effectiveness of management strategies. This volume describes the types and causes of constrained airport parking and introduces mitigation strategies, as well as approaches for selecting the strategy most appropriate for an airport.

2010; 101 pp.; TRB affiliates, $47.25; nonaffiliates, $63. Subscriber category: aviation.

Airport–Airline Agreements: Practices and Characteristics
ACRP Report 36

By enhancing mutual understanding of the decision-making process on both sides during negotiations, this report assists airport operators and airlines in establishing business relationships—including use and lease agreements.

2010; 101 pp.; TRB affiliates, $39.75 ; nonaffiliates, $53. Subscriber category: aviation.

Identifying and Using Low-Cost and Quickly Implementable Ways to Address Freight-System Mobility Constraints
NCFRP Report 7

Evolving technologies, growing demand, changing business practices, shifting patterns of commerce, and government policies designed to address environmental and other public concerns have impacts—occasionally unintended—on freight system performance. Expansions of the freight transportation system can be complicated and expensive; private-sector firms and public policy makers often try to find operational improvements, organizational changes, or other low-cost and quickly implementable ways to address mobility constraints.

This report examines standardized descriptions of the dimensions of the freight transportation system; identifies freight mobility constraints in a multimodal context; highlights criteria for swift, low-cost improvements; and includes a software tool to help decision makers in evaluating constraints and selecting appropriate improvements.

2010; 126 pp.; TRB affiliates, $51; nonaffiliates, $68. Subscriber categories: construction; design; economics; freight transportation; highways; marine transportation; motor carriers; operations and traffic management; planning and forecasting; railroads; terminals and facilities.

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TR NEWS

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FEATURES are timely articles of interest to transportation professionals, including administrators, planners, researchers, and practitioners in government, academia, and industry. Articles are encouraged on innovations and state-of-the-art practices pertaining to transportation research and development in all modes (highways and bridges, public transit, aviation, rail, and others, such as pipelines, bicycles, pedestrians, etc.) and in all subject areas (planning and administration, design, materials and construction, facility maintenance, traffic control, safety, geology, law, environmental concerns, energy, etc.). Manuscripts should be no longer than 3,000 to 4,000 words (12 to 16 double-spaced, typed pages). Authors also should provide appropriate and professionally drawn line drawings, charts, or tables, and glossy, black-and-white, high-quality photographs with corresponding captions. Prospective authors are encouraged to submit a summary or outline of a proposed article for preliminary review.

RESEARCH PAYS OFF highlights research projects, studies, demonstrations, and improved methods or processes that provide innovative, cost-effective solutions to important transportation-related problems in all modes, whether they pertain to improved transport of people and goods or provision of better facilities and equipment that permits such transport. Articles should describe cases in which the application of project findings has resulted in benefits to transportation agencies or to the public, or in which substantial benefits are expected. Articles (approximately 750 to 1,000 words) should delineate the problem, research, and benefits, and be accompanied by one or two illustrations that may improve a reader's understanding of the article.

NEWS BRIEFS are short (100- to 750-word) items of interest and usually are not attributed to an author. They may be either text or photographs or a combination of both. Line drawings, charts, or tables may be used where appropriate. Articles may be related to construction, administration, planning, design, operations, maintenance, research, legal matters, or applications of special interest. Articles involving brand names or names of manufacturers may be determined to be inappropriate; however, no endorsement by TRB is implied when such information appears. Foreign news articles should describe projects or methods that have universal instead of local application.

POINT OF VIEW is an occasional series of authored opinions on current transportation issues. Articles (1,000 to 2,000 words) may be submitted with appropriate, high-quality illustrations, and are subject to review and editing. Readers are also invited to submit comments on published points of view.

CALENDAR covers (*a*) TRB-sponsored conferences, workshops, and symposia, and (*b*) functions sponsored by other agencies of interest to readers. Notices of meetings should be submitted at least 4 to 6 months before the event.

BOOKSHELF announces publications in the transportation field. Abstracts (100 to 200 words) should include title, author, publisher, address at which publication may be obtained, number of pages, price, and ISBN. Publishers are invited to submit copies of new publications for announcement.

LETTERS provide readers with the opportunity to comment on the information and views expressed in published articles, TRB activities, or transportation matters in general. All letters must be signed and contain constructive comments. Letters may be edited for style and space considerations.

SUBMISSION REQUIREMENTS: Manuscripts submitted for possible publication in *TR News* and any correspondence on editorial matters should be sent to the Director, Publications Office, Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001, telephone 202-334-2972, or e-mail jawan@nas.edu.

◆ All manuscripts should be supplied in 12-point type, double-spaced, in Microsoft Word 6.0 or higher versions, on a CD or as an e-mail attachment.

◆ Submit original artwork if possible. Glossy, high-quality black-and-white photographs, color photographs, and slides are acceptable. Digital continuous-tone images must be submitted as TIFF or JPEG files and must be at least 3 in. by 5 in. with a resolution of 300 dpi or greater. A caption should be supplied for each graphic element.

◆ Use the units of measurement from the research described and provide conversions in parentheses, as appropriate. The International System of Units (SI), the updated version of the metric system, is preferred. In the text, the SI units should be followed, when appropriate, by the U.S. customary equivalent units in parentheses. In figures and tables, the base unit conversions should be provided in a footnote.

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