Delivering Taxpayer Value

Three Tools That Can Help Ensure a More Efficient, Cost-Effective Infrastructure

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Introduction

A major focus of the ongoing debate to reauthorize federal surface transportation programs has been performance management. Performance management tries by various means to ensure that funds are spent wisely and thereby ensure that needed infrastructure is constructed with quality materials at the lowest possible cost with the longest possible life span. Performance management is a multifaceted concept that includes, for example, improved project selection, more streamlined and efficient contracting, and improved accountability on the part of public officials and private contractors.

This paper addresses techniques that can be used as part of the performance management process that are focused on the pavement selection practices of a state Department of Transportation's (DOT) planning and contracting activities. These techniques are: life cycle cost analysis (LCCA), alternate design/alternate bid (ADAB), and use of the mechanistic-empirical pavement design guide (MEPDG). These techniques can be used separately throughout the planning and implementation process, or they can be used together. The greatest efficiency is realized when all of the techniques are used together. Further, and importantly, these techniques can also increase public transparency during the project selection and contracting process by bringing to light the full, long-term project costs from the onset. Each of the techniques discussed here is already in use in some states. Only a few states fully integrate the use of all three techniques in their contracting process.

Of the three, LCCA is the best known and most widely used. Its use is common throughout all facets of the construction industry, not just the transportation sector. It has been a very important tool in allowing state DOTs and other contracting agencies/firms to weigh various options on a long-term basis as they consider new construction and reconstruction projects.

The other two techniques, ADAB and MEPDG, are less frequently used at present, though their use is growing nationwide. They are also less intuitive, in the sense that the acronyms will mean little to even transportation professionals outside of the surface transportation contracting world. As will be discussed in more detail subsequently, ADAB and MEPDG, especially when used in concert with LCCA, offer state DOTs powerful tools for improved contracting and the possibility of significant cost savings. Depending on where and how these tools are used these savings could be substantial in dollar terms at both the state and national level, certainly in the millions of dollars at the state level, and perhaps, if widely adopted, in the hundreds of millions of dollars at the national level. In this time of constrained state and federal budgets all potential sources of cost savings are important, primarily because monies unnecessarily spent on one project are, obviously, unavailable for other very necessary projects.

This paper is written from the layman's perspective and is designed to inform those unfamiliar with these decision-making techniques. There is a significant body of literature on these methodologies written for engineering and contracting audiences with a more technical interest in these subjects. This literature can be accessed in major trade journals and through the work of major transportation professional organizations such as the American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board (TRB).

Economic Backdrop

The construction industry has been particularly hard hit by the ongoing recession. According to data from the Associated General Contractors of America (AGC), construction spending at the beginning of 2011 was at its second lowest level since July 2000.[1] Meanwhile the unemployment rate in the construction sector was on the order of 22.5%.[2] As a result, contractors nationwide are looking for work and it is well known that in certain markets the cost of all types of construction is down considerably from its pre-recession peaks. Taking advantage of the situation requires money, which at the moment is the one thing that many state DOTs do not have in abundance.

The budgets for many state DOTs have been cut in recent years.[3] And it is likely that this situation will continue until the nation experiences a full economic recovery. As a result of tight state budgets many states have relied heavily on federal funds to finance a growing portion of their surface transportation capital budgets. This has especially been the case the last two years as a result of additional surface transportation capital funding provided by the American Recovery and Reinvestment Act of 2009 (ARRA)(Public Law 111-5). By the end of this fiscal year (FY), however, ARRA funding will have largely been spent.

Although the ARRA has made the federal program for surface transportation larger these last two years, it has done so against the backdrop of a failed federal surface transportation reauthorization process. The last full-term authorization of the federal surface transportation program, the Safe, Accountable, Flexible, Efficient Transportation Act-A Legacy for Users (SAFETEA-LU, or more commonly SAFETEA)(Public Law 109-59), expired at the end of FY 2009. The federal program

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[1] AGC of America. "Data Digest: Construction spending sags in January; state DOT budgets shrink; more prices rise." March 1, 2011.
http://news.agc.org/2011/03/01/data-digest-construction-spending-sags-in-january-state-dot-budgets-shrink-more-prices-rise/

[2] AGC of America. "Construction Industry Loses 32,000 Jobs Between December and January as the Sector's Unemployment Rate hits 22.5 percent." Press Release. February 4, 2011. http://www.agc.org/cs/news_media/press_room/press_release?pressrelease.id=763

[3] For example see: Hunt, Jared. "State road fund revenues stagnant." *Charleston Daily Mail*. February 9, 2011.

continues to operate on the basis of several program extensions. At the time of this writing, Congress has enacted an extension that will keep the program funded through the end FY 2011, the Surface Transportation Extension Act of 2011 (Public Law 112-5).

The Obama Administration, as part of its FY 2012 budget proposal, is suggesting that the program be reauthorized for six years at a level of $556 billion.[4] This sum would represent a major increase in funding compared to the amount that was available for the program during SAFETEA. Unfortunately, for program supporters, the Administration's proposal was made without suggesting new sources of revenue that would make this level of spending possible. In fact, the expectation of many transportation professionals is that transportation funding in the years ahead will be limited to the income currently flowing into the highway trust fund account. This would mean a program of $36.8 billion in FY 2012 and a 6-year program of $230 billion.[5]

Recent polls have made it clear that Americans support road construction and reconstruction.[6] Unfortunately, these same polls find that Americans do not feel the same way about raising fuel taxes, which are the principal means for funding transportation improvements at the federal and at the state level.

Without a new source of funding, it is likely that reauthorization at the federal level will continue to be problematic from a political perspective. In the past, Congress has only been able to agree to reauthorize this program if new monies have been made available. Hence, any reauthorization bill that could pass in the near future would likely be devoid of new funding from traditional tax sources, leaving only nontraditional sources (e.g. public private partnerships (PPPs), various types of bonding, etc.) as potential sources of new revenues. And, because these nontraditional sources must rely on income streams associated with specific projects, most observers believe their application will be limited to very large projects.

States, therefore, are left with the problem of trying to maintain and improve their surface transportation systems with diminished funding. That means it is unlikely that they will be able to take full advantage of the somewhat depressed construction marketplace. Nonetheless, it is possible for states to use their constrained funds more efficiently, and the use of the techniques discussed here could assist in that effort.

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[4] U.S. Department of Transportation. "Fiscal Year 2012 Budget Highlights." http://www.dot.gov/budget/2012/fy2012budgethighlights.pdf

[5] Orski, Ken. "A Few Questions Concerning the President's FY 2012 Budget Submission to Congress." *Innovation Briefs.* February 15, 2011.

[6] "Poll: Yes on Highway Spending, No on Higher Gas Tax to Fund It." *The Wall Street Journal.* February 28, 2011.

Surface Transportation Contracting

Historically, transportation capital project contracts have been awarded to the lowest responsible bidder who has met all of the specifications put forward by the state DOT. In many parts of the country, this situation remains somewhat intact. Over time, many studies have identified problems with the low bidder process.[7] In some cases, for example, the low bidder is a contractor willing to take a chance that once a project is underway the firm will be able to receive additional funding for cost overruns. In other situations, the low bidder is planning to use the absolute minimum in terms of quality materials and other construction inputs in order to ensure a low bid. Use of these materials, if allowed, will result in subpar infrastructure that is unable to stand the test of time. In response to these problems, states have tried to put practices in place to make sure that the low bid is also a bid that will produce the expected results. In many states, however, overruns and product substitutions continue to be a problem.

States have become much more sophisticated in their contracting methodologies over time and are looking more often at preventing problems rather than responding to them. In part, this increased sophistication has been enhanced by policies and procedures implemented by the Federal Highway Administration (FHWA) through the federal-aid highway assistance program. FHWA provides detailed regulatory guidance for projects using federal money. Nonetheless, state DOTs continue to have considerable leeway in coming up with their own contracting methodologies so long as they comply with the basic requirements of federal regulations.

Pavement Selection Issues

No facet of the decision making process has been as contentious over time as the decision about which type of pavement to use for a project. This is essentially a decision between using asphalt-based products and cement and concrete-based products.

Although asphalt and concrete are very competitive industries it is instructive that both industries are largely in agreement that the techniques discussed here can result in better and more transparent decision-making. And, while the industries may lobby for the use of certain data in the evaluation process, they are nonetheless, in accord with the concepts under discussion here, when based on technical merit and fairly applied.[8] A case in point is Missouri where the state DOT (MoDOT) has

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[7] For example: Harbuck, Richard H. "Competitive Bidding for Highway Construction Projects." *AACE International Transactions 2004.* ABI/INFORM Global. p. ES91.

[8] Asphalt Pavement Alliance. "Keys to a Successful Alternate Bidding Process." p. 6. http://www.equipmentworld.com/files/2011/02/Keys-To-A-Successful-Alternate-Bidding-Process.pdf

been engaged in a successful multiyear process to engage all industry stakeholders – FHWA, paving industry groups and contractors – in the creation of a new alternate bidding (ADAB) process for significant state highway projects. This process, as will be discussed later in this paper, is resulting in reduced project costs and doing so with the active consent of the state's paving industry.[9]

Life Cycle Cost Analysis (LCCA)

Using economic analysis to select projects and, ultimately, pavements has long been promoted by AASHTO and FHWA. The National Highway Systems Act of 1995 included a provision for LCCA on all National Highway System (NHS) projects costing $25 million or more. In implementing this provision, however, FHWA took the position that:

> "FHWA policy on LCCA is that it is a decision support tool, and the results of LCCA are not decisions in and of themselves. The logical analytical evaluation framework that life-cycle cost analyses foster is as important as the LCCA results themselves. As a result, although LCCA was only officially mandated in a very limited number of situations, FHWA has always encouraged the use of LCCA in analyzing all major investment decisions …."[10]

This initiative caused many states to add a life cycle cost component to their planning and construction bidding processes. States have been free to come up with their own methodologies and some states use intricate and robust processes to determine life cycle costs. To support LCCA, FHWA has developed software for state DOT use. Many of the states that use LCCA have modified this software for their own purposes or developed their own software packages.

A major project selected by a state should have already gone through a robust evaluation prior to its inclusion in the state's transportation improvement plan (STIP). The evaluation at this stage will typically use a benefit-cost analysis (BCA) to determine the lifetime value of, as the name suggests, the benefits/costs associated with a potential project in dollar terms.

As the FHWA quote above suggests, it is essential to view LCCA as a "part" of the overall decision-making process. LCCA is a subset of BCA type analysis and in some cases an LCCA may be performed at the project selection stage of state planning. The evaluation at this stage may also have included some analysis of what types of

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[9] Ahlvers, Dave. "MoDOT Alternate Pavement Approach" Power Point presentation at NCAUPG Conference. Feb. 3, 2010. http://cobweb.ecn.purdue.edu/~spave/NCAUPG/Activities/2010/Presentation/Ahlvers%20MoDOT%20Alternate%20Pavement%20Approach.pdf

[10] U.S. DOT. FHWA. "Life-Cycle Cost Analysis in Pavement Design." Pavement Division Interim Report, 1998. p. xi. http://isddc.dot.gov/OLPFiles/FHWA/013017.pdf

materials could be used to construct the project. The focus in this paper, however, is how LCCA is used in the pavement selection as part of its contracting process.

LCCA is used throughout the construction industry. It is just as appropriate for a building as it is for a road or a bridge. The National Institute of Building Sciences, for example, provides considerable information to firms, governments, contractors, etc. on its use and application. Among the many findings of this work, the consensus is that LCCA is most useful: "when project alternatives that fulfill the same performance requirements but differ with respect to initial costs and operating costs, have to be compared in order to select the one that maximizes net savings."[11] This industry-wide view squares well with the FHWA's position on when it's appropriate to use LCCA.[12] Other federal agencies are also proponents of LCCA. By way of example, the Code of Federal Regulations (CFR) requires an LCCA process for evaluating federal building energy systems, water systems, and energy and water conservation systems.[13] Similarly, the U.S. Army Corps of Engineers requires LCCA on many major projects, specifically, "on selected features of projects requiring periodic maintenance to assure that design selection or rejection decisions give consideration to total life cycle economy (i.e., to total cost of ownership), in accordance with established policy."[14]

A key component of LCCA is choosing the costs (variables) to be evaluated. FHWA suggests that these should include: design and engineering, land acquisition, construction, reconstruction/rehabilitation, and preservation/routine maintenance. In some instances it would also be appropriate to add "user costs" associated with work zones, such as: delays, crashes, and vehicle operating costs.[15] As will be seen subsequently there are other variables that can come into play during an LCCA addressing pavement selection decisions.

A recent presentation by FHWA provides perspective on LCCA use nationwide.[16] According to an AASHTO 2007 survey, a significant majority of states perform LCCA at some point in the decision making process, whereas a smaller, but not

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[11] Fuller, Sieglinde. "Life-Cycle Cost Analysis (LCCA)." http://www.wbdg.org/resources/lcca.php

[12] U.S. DOT. FHWA. Office of Asset Management. "Economic Analysis Primer." August 2003. p. 14. http://www.fhwa.dot.gov/infrastructure/asstmgmt/primer.pdf

[13] 10 CFR Part 436 Federal Energy Management and Planning Programs. http://www.wbdg.org/references/code_regulations.php?i=116&r=1

[14] U.S. Army Corps of Engineers. "Engineering and Design: Cost Engineering Policy and General Requirements." March 1993. p. 3. http://140.194.76.129/publications/eng-regs/er1110-1-1300/entire.pdf

[15] Ibid. p. 15.

[16] Clemons, Tashia J. "National Practices" (National LCCA Practices). U.S.DOT. FHWA. Office of Asset Management. PowerPoint presentation. March 18, 2010. http://www.pavementse.com/TN_CPAT/3-2010%20presentations/National_LCCA%20-Coley.pdf

insignificant number of states do not use LCCA at all.[17] In a telephone survey of state DOT officials conducted for this paper in April/May 2011, only 6 states reported that they never use LCCA, whereas the remaining states used it in some form at some times (see Appendix).

As was the case in 2007, the 2011 survey confirmed that there remain wide variations in how states utilize LCCA with some opting to use the methodology only on projects of a certain size – using dollar or area measures – or determining its applicability on a project-by-project basis. Among the other discrepancies are the pavement life span subject to analysis, with most states responding to the survey using a 30 to 50-year analysis period, but with a few doing their analysis on only a 10 to 30 year basis. Also differing rather significantly in the AASHTO survey are the discount rates associated with projects, the use of software (which surprisingly in this computer oriented society is in the 50% range), and the cost elements included in the LCCA (less than half of the surveyed states, for example, considered user costs in their analysis). As a result of the AASHTO survey, FHWA made several recommendations including, an analysis period of between 30 and 50 years, use of software, a discount rate that reflects annual published rates by the Office of Management and Budget (OMB), through its Circular A-94, and the use of multiple data sources for inputs.

Contrary to what some may believe, there is no standard agreed upon design life for road and bridge construction at the federal level, even for the interstate highways. For the interstates the original design standard was that the road had to be able to handle traffic loads predicted for 1975 (construction began in 1957). Later this was changed to a requirement to meet the needs of traffic volumes predicted for 20 years after a new interstate section was constructed. Outside the United States there are also differing views on adequate design life. In the United Kingdom, for example, major roads are usually constructed with an LCCA using an analysis period of 40 years.[18]

The telephone survey conducted for this report shows that 10 states currently use a 50-year analysis period at least part of the time, 17 states use an analysis period of 40-years at least part of the time, but surprisingly, 8 states use periods of less than 30-years at least part of the time. Given the expectation of limited future funding that most states face it seems remarkable that some states continue to use an analysis period of less than 30 years as a basis for their calculations. In some states, special circumstances on certain road segments (e.g. extreme cold) have traditionally been held up as mitigating factors which have prevented those states

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[17] Some of the states not previously performing LCCA are now investigating its application. Oklahoma, for example, is currently considering how to utilize LCCA as part of its proposed ADAB process:
http://trid.trb.org/view.aspx?id=979016

[18] O'Flaherty, C.A. "Highways: The Location, Design, Construction, & Maintenance of Pavements." 4th Edition. Butterworth-Heinemann. Great Britain. 2002. p. 252

from using the optimal analysis period of 50 years or more. However, there are roads and bridges which have far exceeded these lowered design life expectations, with several examples coming from some of the coldest states in the nation – including a road in Duluth, Minnesota which is over 100 years old.

With many states using analysis periods that underestimate the actual life span of these structures, it is clear that there is an opportunity to build infrastructure with a more accurate and realistic assessment of the long-term costs, which could increase budgetary certainty and allow officials to build more projects with available funds. Therefore, it would seem to make economic sense, especially when federal funds are used, to argue for a longer analysis period such as 50 years for most large new construction and reconstruction projects.

When an LCCA is used, each project must be analyzed by a uniform process. For example, the factors identified by the LCCA software that FHWA offers to the states is based on "best practices" as derived from experience with state use of the LCCA methodology. This does not mean that states should not add factors of their own to account for unique situations within a state. Rather, best practices suggest that there are core factors that should be part of every analysis.

Alternate Design/Alternate Bid (ADAB)

While LCCA is focused on providing project specific data to officials in order to help them evaluate a range of solutions as they seek out the most desirable alternative from a cost perspective, the goal of the ADAB process is to facilitate competition in project selection so as to arrive at the most cost effective project contract. FHWA encourages this process so long as the bids being proffered for projects are technically equivalent.[19] In this instance equivalence is viewed as creating a structure, be it a road, highway, or a bridge, which uses materials that are seen as being equally able to fulfill the contracting requirement. It should be noted that FHWA guidance applies to specific types of projects (National Highway System (NHS) projects).

ADAB fosters competition by allowing contractors using different paving materials to bid on the same work. This tool can be used both on new and existing construction projects large and small. In past practice, many states put out their project bidding requests with specifications that essentially indicated what type of pavement material would be used. With ADAB projects, however, state officials provide multiple, (presumably) equivalent designs for projects and contractors are then able to bid on whichever design type they choose. It is often the case that states have conducted an LCCA on each design type offered in the ADAB process, which allows state officials to evaluate the proposals from a life cycle cost

[19] U.S. DOT. FHWA. "Clarification of FHWA Policy for Bidding Alternate Pavement Type on the National Highway System." Memorandum. November 13, 2008. http://www.fhwa.dot.gov/pavement/081113.cfm

perspective as they work towards selecting a bid. According to the telephone survey, 33 states are currently using ADAB in some form, with most reports indicating positive experiences with the use of this process. Two states appear to be in the forefront of the ADAB movement.

Missouri[20]

Since 2002 Missouri has incorporated an ADAB process into its contract bidding. According to a study describing the first two years of ADAB use, projects bid using ADAB had significantly lower prices for asphalt and concrete than projects not utilizing the process.[21] In a more recent evaluation, MoDOT contends the process has resulted in "getting more bidders per job, it stimulates competition, and it has saved the state millions of dollars."[22]

The MoDOT process for using ADAB requires that the state design equivalent pavements for a project in both concrete and asphalt, based on a 45-year design life. MoDOT adds a life cycle cost adjustment factor to asphalt bids. The adjustment factor is calculated using a number of factors, including one that compares the cost of asphalt vs. concrete repairs. In the MoDOT evaluation, if the asphalt bid, including the life cycle cost factor, is the low bid, the asphalt bid is accepted. If the asphalt bid plus the life cycle cost factor is higher than the low concrete bid, the concrete bid is selected.

In creating its process, MoDOT worked with both the asphalt and concrete industries. To ensure pavement type equivalence MoDOT is using MEPDG (which will be discussed in the next section). Not only did MoDOT engage stakeholders in this process, but the Department implemented and carried out ADAB with transparency. This level of openness on the part of MoDOT allowed Department officials, industry leaders, and Missouri taxpayers to operate with knowledge of the process and a trust that ADAB was being implemented in an even-handed manner. MoDOT's experience shows that transparency and stakeholder engagement are crucial to the implementation of a successful ADAB program.

ADAB has been a clear money saver for the state. Between 2005 and 2008, the average number of bidders on ADAB projects rose from 3.7 to 4.8. More importantly, the average cost for paving projects over a 3-year period using ADAB

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[20] The discussion in this section is drawn largely from:
Brown, Daniel. "Inside Alternate Bidding: Missouri Department of Transportation formula creates competition and saves money, too." *Better Roads.* April 1, 2010. http://www.betterroads.com/highway-contractor-2/; and "Missouri DOT Pavement Design and Type Selection Process." An Independent Peer Review by the Transtec Group, Inc. http://www.MoDOT.mo.gov/newsandinfo/documents/Alt_Bid_Peer_Review_Report_Final.pdf

[21] Transtec. p. 2.

[22] Brown. p.1.

was between 5.1% and 8.6% below the price for non-ADAB projects.[23] Also notable was that materials prices for ADAB projects were uniformly lower on average than for all other state projects.

Louisiana

Louisiana uses a somewhat different approach in bidding its ADAB projects.[24] The Louisiana Department of Transportation and Development (LADOTD) uses its ADAB process for projects on which LADOTD has performed an LCCA and determined that the price difference between materials is less than 25%. For projects above this threshold, the project is bid with only the lower cost material. The ADAB process in Louisiana has 3 components, the so-called A + B + C. "A" represents the contractor's base bid. "B" represents a time-based bidding component which accounts for how long it will take to build the project – which may include incentive payments. And "C" represents a life cycle cost adjustment (rehabilitation costs, etc.), including a user cost component (work zone delays, etc.).

LADOTD has had a positive experience with its process. In the 2 years following Hurricane Katrina there were an average of 3.9 bidders for each ADAB project versus an average of 2.6 bidders for other projects.[25] For ADAB projects during the same period, bids came in on average 9% lower than estimated. For other projects the average was 20% higher than estimated. LADOTD believes that ADAB works and saves money – some estimates have the total savings realized through ADAB over a five year period at nearly $90 million.[26]

Mechanistic-Empirical Pavement Design Guide (MEPDG)

For the last half-century most states have based their pavement designs on methods promulgated by AASHTO and its predecessor organization, AASHO. The most recent edition of the Design Guide was published in 1993. Much of the data in the guide came originally from extensive road testing done in the 1950s and 1960s. Over time many states complemented the AASHTO guidance by developing their own pavement databases and standards, modifying their contracting requirement criteria accordingly.

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[23] Ahlvers, Dave. "MoDOT Alternate Pavement Approach." PowerPoint presentation at: NCAUPG Conference. February 3, 2010.
http://cobweb.ecn.purdue.edu/~spave/NCAUPG/Activities/2010/Presentation/Ahlvers%20MoDOT%20Alternate%20Pavement%20Approach.pdf

[24] Zeringue, Kirk M. "Alternate Design/Alternate Bids in Louisiana." PowerPoint presentation to AASHTO Joint Technical Committee on Pavements. December 7, 2006.

[25] Ibid.

[26] Temple, William. "Alternate Design-Alternate Bid." Presentation to ACPA Annual Meeting. November 30, 2007.

It was clear by the end of the last century that much of the information in the 1993 guide was dated and did not incorporate all of the changes in materials and improved information that had occurred over the intervening years. An effort was begun supported by AASHTO and FHWA to revisit and revise the standards. In 2004, the National Cooperative Highway Research Program (NCHRP) released the Guide for Mechanistic-Empirical Design of New and Rehabilitated Pavement Structures.[27] Since that time additional development has continued on the MEPDG and a new edition of the software program that performs the necessary calculations is currently available.

The MEPDG process "considers the input parameters that influence pavement performance – including traffic, temperatures, and pavement layer thickness and properties – and applies the principles of engineering mechanics to predict critical pavement responses. The MEPDG changes not only the design process and inputs but the way that engineers develop and implement effective and efficient pavement design."[28] As this quote suggests, use of the MEPDG can represent a major improvement in the way state DOTs and contractors design pavements. MEPDG provides a level of customization and provides states with the ability to modify the MEPDG process to meet their own particular needs. Some states have begun to incorporate MEPDG into their processes, but at this juncture, wide MEPDG adoption is more promise than fact. Nonetheless our telephone survey finds that 16 states are now using MEPDG in some form and 6 states are in the process of implementing the process.

Indiana

After an extensive run up period of developing new procedures and training for Indiana DOT staff, Indiana began using MEPDG at the beginning of 2009. The state executed contracts for 23 projects using MEPDG standards between late 2008 and early 2010. The actual and estimated savings experienced for these projects was almost $10.3 million. Furthermore, INDOT officials estimated that use of MEPDG for maintenance and repair on existing pavement structures could generate savings of $20 million per construction season in Indiana.[29] They accomplished this in large part by utilizing MEPDG to bid the projects with reduced pavement thicknesses for both asphalt and concrete applications, and by shortening the distance between concrete pavement joints. In this instance, MEPDG gave the state the tools to design pavements in a more scientifically rigorous way that resulted in significant savings for INDOT and for Indiana taxpayers.

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[27] NCHRP. Transportation Research Board. "Guide for Mechanistic-Empirical Design of New and Rehabilitated Pavement Structures." March 2004. http://onlinepubs.trb.org/onlinepubs/archive/mepdg/Part1_Chapter1_%20Introduction.pdf

[28] Nantung, Tommy E. "Implementing the Mechanistic-Empirical Pavement Design Guide for Cost Savings in Indiana." *TR NEWS*. November-December 2010. p. 34.

[29] Ibid. p. 36.

Conclusions

MEPDG, LCCA, and ADAB (respectively) are tools that can help agencies design, evaluate, and bid projects in a more effective and efficient manner, often resulting in significant cost savings to public agencies. LCCA represents an economic tool, MEPDG a design tool, and ADAB a bidding tool. Used together, these techniques can help ensure that the constrained highway construction funds currently available are used in the most efficient manner possible by addressing inefficiencies throughout the process. It is difficult to estimate how much could actually be saved by heightened use of these techniques on a more consistent basis across all major state construction and reconstruction pavement projects. Nonetheless, using the examples here, which are from midsize states – Indiana, Missouri and Louisiana – it is quite clear that the savings can be very significant. Indiana realized actual and estimated savings of more that $10 million on just 23 projects using MEPDG. Each year hundreds of similarly sized projects are likely underway nationwide. Replicating these savings nationwide could result in savings in the hundreds of millions of dollars, in the short term. When seen in terms of a $42 billion federal program, these savings may not seem overly significant, however, these techniques could generate substantial savings for states beset by soaring deficits and fiscal problems. For states across the country – large and small – the savings discussed here will hardly make up for possible reductions in federal spending in the years ahead, but they will allow states to do more with the money they do have.

Concerns have been expressed that using these techniques will slow down an already arguably excessively lengthy contracting process at the state level. However, nothing in the state experience with these mechanisms to date, as reported in the trade press, would seem to indicate that this is the case. To the contrary, the tools discussed here can enhance an agency's ability to provide better value to the taxpayers they serve and, if implemented properly, can provide greater transparency to the contracting process which should, if anything, lead to improved public acceptance of state DOT spending decisions.

Outcome measurement is the crux of performance management. Accepting inefficiency in any stage of the contracting process ultimately results in a penalty for the states and for the driving public that is paying for infrastructure improvements with their taxes.

Finally, there is a wide body of literature that promotes the use of LCCA in capital project selection. As has been referenced here, there is also an impressive body of work that promotes the use of LCCA in the pavement selection process. Yet, nationwide, LCCA is not consistently applied in a rigorous, data driven manner. In some states these analyses are not applied at all. This seems like a missed opportunity. Similarly, states not using ADAB or MEPDG may also be missing an

opportunity to improve their bottom lines. Given the current fiscal conditions across the country, a state not fully utilizing well understood economic, design, and bidding tools to ensure that the selection process results in the most cost efficient project could be seen as cheating its citizens.

The goal, as is frequently the case, is to create a tide that raises all ships. As outlined above, the ideal outcome from a cost effectiveness standpoint would be for each state to adopt these mechanisms. The path towards that outcome is outside the scope of this analysis and is a good discussion for policy makers during the ongoing surface transportation authorization debate.

Appendix: State Use of LCCA, ADAB, and MEPDG

State	LCCA	Period of LCCA Analysis	ADAB	MEPDG
Alabama	*Limited**		Yes	**No**
Alaska	Yes	*30 years*	Yes	**No**
Arizona	*Limited**	*32 years*	**No**	*Implementing*
Arkansas	*Limited***		Yes	**No**
California	Yes	*20, 40, and 55 years*	**No**	**No**
Colorado	*Limited***	*40 years*	Yes	Yes
Connecticut	*Limited**	*40 years*	**No**	**No**
Delaware	*Limited***	*40 years*	**No**	**No**
Florida	*Limited***	*40 years*	*Limited**	Yes
Georgia	*Limited***	*40 and 50 years*	**No**	Yes
Hawaii	**No**		**No**	**No**
Idaho	*Limited***	*40 years or longer*	*Limited**	Yes
Illinois	*Limited***		Yes	**No**
Indiana	*Limited***		Yes	Yes
Iowa	*Limited***	*40 years*	**No**	**No**
Kansas	Yes	*40 years*	Yes	**No**
Kentucky	*Limited***	*40 years*	Yes	**No**
Louisiana	*Limited***	*40 years*	Yes	Yes
Maine	Yes	*12 years*	Yes	**No**
Maryland	Yes	*40 years*	Yes	Yes
Massachusetts	**No**		**No**	**No**
Michigan	*Limited***	*26 years*	Yes	**No**
Minnesota	Yes	*50 years for new construction*	Yes	**No**
Mississippi	*Limited**	*30 years*	Yes	**No**
Missouri	Yes	*5-30 years*	Yes	Yes
Montana	*Limited***	*40 years*	Yes	*Implementing*
Nebraska	*Limited***	*15, 20, and 35 years*	**No**	Yes
Nevada	*Limited**	*20 and 35 years*	Yes	Yes
New Hampshire	**No**		**No**	**No**
New Jersey	*Limited**		**No**	Yes
New Mexico	*Limited**	*50 years*	**No**	*Implementing*
New York	Yes		*Limited**	**No**
North Carolina	Yes	*20 and 30 years*	Yes	*Implementing*
North Dakota	Yes	*20 and 30 years*	*Limited**	**No**
Ohio	*Limited**	*35 years*	Yes	**No**
Oklahoma	**No**		**No**	Yes
Oregon	*Limited***	*40 years*	**No**	Yes
Pennsylvania	*Limited***	*50 years*	Yes	**No**
Rhode Island	**No**		Yes	**No**
South Carolina	Yes	*50 years*	Yes	Yes
South Dakota	Yes	*40 years*	Yes	**No**
Tennessee	Yes	*40 years*	Yes	**No**
Texas	*Limited**	*30 years*	Yes	**No**
Utah	Yes	*40 years*	Yes	*Implementing*
Vermont	**No**		Yes	**No**
Virginia	*Limited***	*50 years*	**No**	**No**
Washington	*Limited***	*50 years*	**No**	Yes
West Virginia	Yes	*50 years*	Yes	Yes
Wisconsin	Yes	*50 years*	**No**	**No**
Wyoming	*Limited**	*30 years*	*Limited**	*Implementing*

*Systems are in place but are rarely used

** LCCA use determined by project size or on a project-by-project basis

Source: Telephone survey of State DOT officials, April/May 2011