



STATE OF ILLINOIS
OFFICE OF THE
AUDITOR GENERAL

William G. Holland, Auditor General

SUMMARY REPORT DIGEST

**IDOT'S LIFE-CYCLE COST ANALYSIS FOR ROAD CONSTRUCTION
CONTRACTS**

MANAGEMENT AUDIT

Release Date: May 2012

SYNOPSIS

Public Act 96-715, effective August 2009, required the Illinois Department of Transportation (IDOT) to *develop and implement a life-cycle cost analysis for each State road project under its jurisdiction for which the total pavement costs exceed \$500,000*. Legislative Audit Commission Resolution Number 140 required the Office of the Auditor General to conduct a management audit of the Illinois Department of Transportation's implementation of this Law.

Of the 313 road contracts under the State's jurisdiction awarded by IDOT in 2010 with pavement costs greater than \$500,000, 19 (6%) received a life-cycle cost analysis (LCCA), based on documentation provided by IDOT. While IDOT performs life-cycle cost analyses on new construction and reconstruction projects, it typically does not perform LCCAs on rehabilitation projects. **We concluded that given the requirements of Public Act 96-715 and the existence of pavement alternatives, IDOT should be performing LCCAs on rehabilitation projects involving structural overlays.**

Our audit also found that:

- **Eight of 15 contracts utilized LCCAs that were 3 or more years old** (at the time of project letting), ranging from 3 years to over 12 years old. Costs could have changed dramatically over the time period between when the LCCAs were prepared and when the projects were put out for bid.
- **Twelve of 15 contracts (80%) were missing unit cost support for one or more of the major pay items for concrete or asphalt.** Without the cost support, it would be difficult for IDOT's Central Office to perform its review and ensure that appropriate unit costs were used by each respective District.
- There were **21 instances** where costs were miscalculated in the LCCA. **Two of the errors resulted in a pavement being selected that actually had higher life-cycle costs than the alternative.**
- IDOT's maintenance and rehabilitation activity schedules in use during calendar year 2010 were based primarily on engineering judgment and not actual historical project schedules, and therefore, were not in compliance with the Act. They have since been updated and are based on historical schedules and actual pavement performance.
- **IDOT does not incorporate user costs into its life-cycle cost analyses.** Public Act 96-715 states that IDOT "may include estimates of user costs throughout the entire pavement life."
- IDOT's Central Office does not check to ensure that all eligible projects receive a LCCA.
- The Pavement Selection Committee was not functioning as required by IDOT policy.

FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

BACKGROUND

Life-cycle cost analysis (LCCA) is a process for evaluating the financial impact of a project by analyzing initial costs and discounted future costs, such as maintenance, user, reconstruction, rehabilitation, restoring, and resurfacing costs, over the life of the project. By taking into account all of the costs that would occur throughout the life of each alternative, LCCA helps identify the lowest cost alternative to the State to carry out the project and provides other critical information vital for the overall decision-making process.

Public Act 96-715 required the Illinois Department of Transportation (IDOT) to develop and implement a life-cycle cost analysis for each State road project under its jurisdiction for which the total pavement costs exceed \$500,000.

Effective August 25, 2009, Public Act 96-715 required the Illinois Department of Transportation (IDOT) to *develop and implement a life-cycle cost analysis for each State road project under its jurisdiction for which the total pavement costs exceed \$500,000*. The Act requires IDOT to design and award these paving projects utilizing the material having the lowest life-cycle cost. However, at the discretion of the Department, interstate highways with high traffic volumes or experimental projects may be exempt from the requirement. According to IDOT officials, the Department has been conducting life-cycle cost analysis for over 25 years for some projects. IDOT's Bureau of Design and Environment (BDE) is responsible for developing standards, specifications, and policies for the State's highway system. It also reviews the life-cycle cost analyses prepared and submitted by the Department's nine Districts.

Legislative Audit Commission Resolution Number 140 required the Office of the Auditor General to conduct a management audit of the Illinois Department of Transportation's implementation of the Public Act. To provide assistance in the technical review of IDOT's LCCA process, we contracted with a Consultant with expertise in both pavement design, as well as life-cycle cost analysis practices. (pages 6-8,14)

REPORT CONCLUSIONS

Of the 313 road contracts under the State's jurisdiction awarded by IDOT in 2010 with pavement costs greater than \$500,000, 19 (6%) received a life-cycle cost analysis, based on documentation provided by IDOT.

Although Public Act 96-715 requires a life-cycle cost analysis when a project's "pavement costs exceed \$500,000", of the 313 road contracts under the State's jurisdiction awarded by IDOT in 2010 with pavement costs greater than \$500,000, 19 (6%) received a life-cycle cost analysis, based on documentation provided by IDOT.

There are two primary reasons why most projects awarded in 2010 with pavement costs greater than \$500,000 did not receive a life-cycle cost analysis by IDOT. The first is that

While IDOT performs life-cycle cost analyses on new construction and reconstruction projects, it typically does not perform LCCAs on rehabilitation projects, such as resurfacing.

while IDOT performs life-cycle cost analyses on new construction and reconstruction projects, it typically does not perform LCCAs on rehabilitation projects, such as resurfacing. The law does not exclude or exempt rehabilitation projects, such as resurfacing, from receiving a LCCA. According to IDOT officials: “Simple resurfacing, which constitutes the vast majority of our so-called “paving” projects, does not lend itself to the production of equivalent sections.” To conduct a life-cycle cost analysis, at least two equivalent designs of pavement alternatives (with equal analysis periods) are required.

While pavement alternatives necessary to conduct a LCCA may not be feasible for thin types of resurfacing overlays, alternatives may exist for thicker “structural overlays” (which are at least 3.75 inches of equivalent HMA (asphalt) pavement for non-interstate highways and at least 5 inches of equivalent HMA (asphalt) pavement for interstate highways according to IDOT’s Bureau of Design and Environment (BDE) Manual). Chapter 53 (Pavement Rehabilitation) of IDOT’s BDE Manual recommends life-cycle cost analysis on certain rehabilitation projects. Section 53-5 states, “This section provides guidance on conducting Life-Cycle Cost Analyses (LCCA) for pavement rehabilitation projects to assess the long-term cost effectiveness of alternative rehabilitation strategies.” However, IDOT officials stated they do not require LCCAs for structural overlays and that they are conducted only on rare, if any, occasions. **We concluded that given the requirements of Public Act 96-715 and the existence of pavement alternatives for structural overlays, IDOT should be performing LCCAs on projects involving structural overlays.** (pages 20-23)

We concluded that given the requirements of Public Act 96-715 and the existence of pavement alternatives for structural overlays, IDOT should be performing LCCAs on projects involving structural overlays.

The other primary reason why certain projects do not undergo a LCCA is because IDOT has determined that a “special design” is required or another IDOT policy exemption to a LCCA exists. Public Act 96-715 exempts “interstate highways with high traffic volumes or experimental projects” from the LCCA requirement. IDOT has established by policy other exemptions to the LCCA requirement, such as high stress intersections, a need to match surface type of small projects with those of abutting road sections, and widening projects.

To determine whether IDOT was conducting life-cycle cost analyses as required by State law and in accordance with its own policies, we reviewed a sample of nine road project contracts awarded in 2010 for which documentation provided by IDOT showed that no LCCA had been conducted. In compiling information related to our requests for these nine projects, IDOT determined that, in fact, two of the nine did have LCCAs conducted on them and provided us with the documentation.

For the remaining seven projects, we determined the following:

- **Three projects involved structural overlays and should have received a LCCA.** For one project, the rehabilitation of Interstate 39 in Lee County, 5 inches of pavement were laid. Regarding the second project, a rehabilitation of Interstate 80 in LaSalle and Grundy counties, when it was originally designed, the project called for a non-structural overlay of 3.75 inches of pavement. However, the pavement thickness was subsequently revised to 6 inches of overlay, which would be considered a structural rehabilitation. No LCCA was conducted on the revised design. On the third project, the resurfacing of US 51 in Macon County, the pavement overlay was 3.75 inches. Since this is a non-interstate highway, a 3.75 inch overlay is a structural overlay.
- Two projects, with design approvals prior to September 2010, involved a process called rubblization (breaking existing concrete into small pieces and compacting it to create a uniform base which can then be repaved over). Up until September 2010, IDOT considered rubblization projects to be “experimental” and not subject to LCCA requirements. Public Act 96-715 specifically exempts experimental projects from undergoing a LCCA. **However, with the 2010 update to IDOT’s BDE Manual, rubblization projects are no longer considered experimental and will be required to undergo a LCCA.**
- The remaining two projects involved resurfacing which was not structural in nature.

We subsequently submitted an additional 20 projects to IDOT and, based on IDOT’s responses, we determined that: 6 involved a structural overlay for at least part of the project; 2 projects involved an experimental process and were thus exempt from LCCA; 2 projects actually had received LCCAs which were previously unidentified by IDOT; and the remaining 10 projects did not involve a structural overlay. (pages 24-27)

LCCA Data Inputs

We reviewed the data IDOT uses to complete the life-cycle cost analysis. Public Act 96-715 requires that “Actual, relevant data, and not assumptions or estimates, shall be used to the extent such data has been collected.” There are three basic types of project-specific data that go into a LCCA: the initial project costs, the maintenance and rehabilitation activity schedules, and the maintenance and rehabilitation costs.

IDOT used actual cost data for its cost inputs. **However, IDOT’s maintenance and rehabilitation activity schedules**

IDOT used actual cost data for its cost inputs. However, IDOT’s maintenance and rehabilitation activity schedules in use during calendar year 2010 were based primarily on engineering judgment and not actual historical project schedules, and therefore, were not in compliance with the Act.

in use during calendar year 2010 were based primarily on engineering judgment and not actual historical project schedules, and therefore, were not in compliance with the Act. In April 2011, IDOT updated its maintenance and rehabilitation activity schedules and, unlike the activity schedules used for the 2010 projects, the updated schedules are based on historical schedules. IDOT officials noted that the changes were based on actual pavement performance. According to IDOT officials, the maintenance and rehabilitation activity schedule updates were based on pavement survey data and long-term efforts between IDOT and the paving/construction industry between 2003 and 2009. IDOT officials said these changes were confirmed by data collected by IDOT in 2010 (interim report released in March 2011), as well as a review of other states’ data. (pages 30-33)

We found both the analysis period and discount rate used by IDOT to be reasonable and in line with those used by other states.

We reviewed the analysis period used in the LCCA calculations, which is the time period for which IDOT evaluates the future costs to maintain and rehabilitate the roadway for each pavement alternative. In 2010, the analysis period was 40 years; IDOT increased it to 45 years in 2011. We also reviewed the discount rate (3%) used by IDOT in conducting the life-cycle cost analyses. We found both the analysis period and discount rate used by IDOT to be reasonable and in line with those used by other states. **We noted that IDOT does not incorporate user costs into its life-cycle cost analyses.** Some states include user costs while other states do not. **Public Act 96-715 states that IDOT “may include estimates of user costs throughout the entire pavement life.”** (pages 33-35)

We noted that IDOT does not incorporate user costs into its life-cycle cost analyses.

IDOT reported conducting LCCAs for 19 contracts awarded in calendar year 2010. IDOT initially provided LCCAs for 15 contracts; however, IDOT identified 4 additional contracts with LCCAs at the end of fieldwork after auditors inquired about several projects that did not receive a LCCA. Because we did not receive the 4 LCCAs until after our testing was completed, our detailed LCCA testing primarily focused on the initial 15 contracts with LCCAs we received. (page 38)

We found that IDOT’s pavement design spreadsheet is generally sufficient to address the core issues of pavement design in Illinois and therefore produces equivalent designs. To assess the adequacy of IDOT’s design outputs from its pavement design spreadsheet, our Consultant carried out an independent pavement design using the Mechanistic-Empirical Pavement Design Guide (MEPDG) software. MEPDG is a national-level software package for pavement design. The Consultant’s results using the MEPDG software indicated a general consistency with the designs obtained by IDOT. (page 39)

Lack of Unit Cost Documentation

Twelve of 15 contracts (80%) were missing unit cost support for one or more of the major pay items for concrete or asphalt.

When reviewing the 15 contracts with LCCAs, we found many did not contain unit cost documentation for all of the major pavement pay items as required by IDOT policy. Unit cost documentation provides support for the unit costs used to calculate the initial construction costs of a project. **Twelve of 15 contracts (80%) were missing unit cost support for one or more of the major pay items for concrete or asphalt.** Our Consultant reviewed the initial construction material costs for 8 contracts and concluded that the values used by IDOT were reasonable and generally consistent with the practice in other states; however, without all of the unit cost documentation, we can not have complete assurance that the unit costs used were appropriate and reflective of District costs. Likewise, it would be difficult for IDOT's BDE Central Office to perform its review and ensure appropriate unit costs are used for each respective District. (pages 39-40)

Age of LCCAs

We found that 8 of 15 contracts utilized LCCAs that were 3 or more years old (at the time of project letting), ranging from 3 years to over 12 years old.

In our review of 15 contracts with LCCAs, we found that 8 of 15 contracts utilized LCCAs that were 3 or more years old (at the time of project letting), ranging from 3 years to over 12 years old. The average age for the 15 LCCAs was 3.7 years old. We found projects let and awarded in calendar year 2010 that had LCCAs prepared as early as 1998 and 2003. **Costs could have changed dramatically** over the time period between when the LCCAs were prepared and when the project was put out for bid. Public Act 96-715 requires the data used to be actual and relevant which would require up-to-date traffic data, material prices, and pavement designs to be used in the LCCA. (pages 40-43)

LCCA Calculation Errors

We found 21 instances where the costs were miscalculated in the LCCA. Two of the errors resulted in a pavement being selected that actually had higher life-cycle costs than the alternative.

In 8 of 15 contracts reviewed, we found 21 instances where the costs were miscalculated in the LCCA. Fourteen of the 21 (67%) were errors of \$10,000 or more, and **two of the errors resulted in a pavement being selected that actually had higher life-cycle costs than the alternative.**

IDOT's Central Office does not check to ensure that all eligible projects receive a LCCA.

Furthermore, according to IDOT officials, IDOT's Central Office does not check to ensure that all eligible projects receive a LCCA. With the passage of Public Act 96-715, which now statutorily requires the completion of LCCAs, the recent revisions to the BDE Manual which will require a greater number of projects to undergo a LCCA, and the calculation errors identified by auditors in our review of LCCAs, IDOT's Central Office needs to strengthen its control and oversight to ensure that Districts are complying with State law and IDOT policy. (pages 43-46)

Pavement Selection Committee

We found the Pavement Selection Committee was not functioning as required by IDOT policy.

We found the Pavement Selection Committee was not functioning as required by IDOT policy. According to the BDE Manual, for projects awarded during calendar year 2010, if the difference in life-cycle costs between two equivalent designs was 10 percent or less, the pavement type and design selection was to be determined by the Pavement Selection Committee (comprised of one representative each from the Bureau of Design and Environment, the Bureau of Materials and Physical Research, and the Bureau of Construction and two from the respective IDOT District office). In response to a request from auditors for all Pavement Selection Committee decisions in 2010, IDOT officials responded that all LCCA projects went to the lowest cost alternative; therefore, the Pavement Selection Committee did not meet or make any pavement decisions in 2010. The IDOT officials also added that very few designs ever go to the Committee because Districts choose to accept most of the lowest life-cycle cost designs. The BDE Manual, however, gives the Pavement Selection Committee, not District staff, authority to formally make the pavement selection decision when the cost difference between the two alternatives is 10 percent or less. (pages 46-48)

Other States

IDOT's LCCA program compares similarly to other states' programs.

IDOT's LCCA program compares similarly to other states' programs. We surveyed the Illinois State Toll Highway Authority (ISTHA) and ten other states to determine their road construction life-cycle cost analysis practices for pavement type selection. Of those survey respondents regularly using LCCA as part of their pavement type selection, as few as 5 LCCAs (Pennsylvania) and as many as 100 LCCAs (Kentucky) were conducted in calendar year 2010.

Over half of the states' requirements to perform a LCCA are based on the type of project or work being done (i.e., new construction, reconstruction, pavement widening, etc.). Only two states (Michigan and Minnesota) are required by statute, like Illinois, to conduct LCCAs on road pavement projects. Also, only two states (Michigan and Pennsylvania) in addition to Illinois have a pavement cost threshold for projects to receive a LCCA. One state (Iowa) uses a square yard threshold that must be met before a LCCA will be conducted.

The types of projects required to have a LCCA as part of the pavement type selection process varied by survey respondent. Like Illinois, all survey respondents are required to conduct a LCCA for new construction and reconstruction projects; however, most require a LCCA for at least one other type of project in addition to new construction and reconstruction. (pages 52-54)

IDOT's LCCA program assumptions compare similarly to other states and the ISTHA. In CY10, IDOT used a 40-year analysis period when conducting the life-cycle cost analysis. The analysis period for other states and the ISTHA ranged between 35 and 50 years. IDOT uses a 3 percent discount rate. The discount rate used for other states and the ISTHA ranged between 2.7 and 5 percent. **IDOT does not include user costs in its analysis. Only three (Indiana, Michigan, and Pennsylvania) of the ten respondents reported including user costs in the analysis of life-cycle costs.** Like Illinois, eight of the survey respondents (ISTHA, Indiana, Iowa, Michigan, Minnesota, Ohio, Pennsylvania, and Wisconsin) reported using actual historical cost data in their LCCAs. (pages 54-55)

The process for pavement selection when competing alternatives have similar life-cycle costs varied by state. These different processes included pavement review committees, alternate bidding, alternate bidding with a bid adjustment factor, and letting other factors determine the pavement type (e.g., adjacent pavement type). (page 56)

Most other states surveyed, like Illinois, did not have a standard "shelf-life" defined in policy, or time after which a LCCA is no longer considered valid. However, responses indicated a maximum of 3 to 4 years prior to letting was a general practice. (page 57)

RECOMMENDATIONS

The audit report contains six recommendations directed towards the Department of Transportation. The Department of Transportation agreed with three recommendations, partially agreed with one recommendation, and disagreed with two recommendations. Appendix G to the report contains the agency responses.



WILLIAM G. HOLLAND
Auditor General

WGH:TEW

AUDITORS ASSIGNED: This Management Audit was performed by the Office of the Auditor General's staff with technical assistance from Kumares Sinha, Ph.D., P.E. and Samuel Labi, Ph.D., from Purdue University's School of Civil Engineering.