Asphalt Value Proposition:

Data Driven Life-Cycle Cost Analyses

Knowing the Value at the End of Life: Salvage Value

"Life-cycle cost analysis (LCCA) is an evaluation technique applicable for the consideration of certain transportation decisions" (FHWA, 2002). This process includes the calculation of upfront development, capital and financing costs, discounted operating and maintenance costs, and end-of-life costs or the value associated with a specific asset or project (ASCE, 2014). To provide a reliable analysis of life-cycle costs, it is critical to ensure the right data and inputs are applied. While many states have databases of bid estimates for initial construction costing, the data to accurately estimate pavement maintenance and rehabilitation cycles, salvage value benefits, and end-of-life costs are more difficult to ascertain.

Recent guidance has been developed to aid roadway owners in applying a data-driven process to determine the true value of an asphalt pavement at the end of its life (Gu & Tran, 2019). It's estimated about one-third of state agencies currently consider the end-of-life of a pavement in their LCCA processes (SAPA, 2019); however, most agencies only look at the remaining service life of the last maintenance treatment not the salvage value (Gu & Tran, 2019). When considering pavement end of life in LCCA, Federal Highway Administration (FHWA) supports two primary methods for calculating the value: salvage value (or value of materials that can be recycled) and remaining service life (the amount of life left in the pavement structure) (FHWA, 2002). This document will focus on salvage value.

> **"Asphalt pavement's structure and materials provides a salvage value credit of $622,184.**

When considering salvage value, asphalt mixtures contain two recyclable ingredients: asphalt binder and aggregate. A recent study showed that the material components of an asphalt pavement have a salvage value of approximately $25.10 per ton, because both the binder and aggregate can be reclaimed to make new asphalt mixtures. Not only can the old aggregate directly replace virgin aggregates, the asphalt binder can be reactivated to replace a portion of virgin binder (Gu & Tran, 2019). Concrete pavements consist primarily of portland cement powder, sand, water, and aggregate. Once the cement powder is used, it cannot be reactivated; the concrete material can only be processed for

use as an aggregate. Because of this, the salvage value of recycled concrete aggregate is about $6.00 per ton (Gu & Tran, 2019). Despite this four-fold difference in value between reclaimed asphalt pavement and recycled concrete aggregate, current LCCA practices typically presume only a negligible difference in the salvage value between pavement materials, indicating a disconnect between LCCA practices and real-world experiences.

A review of Alabama Department of Transportation (ALDOT) LCCA practices found that the state uses a 28-year analysis period and assigns no salvage value (West et al., 2013). To study how considering salvage value would impact ALDOT's LCCA outcomes, reviewers determined the remaining service life, residual value, and removal costs and then calculated the net present value for both an asphalt and concrete pavement. The analysis period allowed for two rehabilitation cycles for the asphalt pavement, that did not need to be removed at the end of the performance period. The concrete pavement needed removal and replacement at the end of the performance period. Applying a data-driven salvage value approach to ALDOT's typical assumptions and LCCA procedure, the study determined that the asphalt pavement's structure and materials provided a salvage value credit of $622,184 at the end of the performance period (West, et al., 2013). Conversely, the concrete pavement had a deficit value of $74,112 at the end of its life because the concrete pavement structure could not be rehabilitated in a cost-effective manner, requiring the agency to spend money removing the old pavement (West, et al., 2013). The net difference of almost $700,000 is not typically captured in agency LCCA processes but makes up more than 30% of the total life-cycle costs associated with the project.

Using a data-driven salvage value approach helps state agencies demonstrate fiscal responsibility to taxpayers and lawmakers, and it provides agencies with an opportunity to ensure responsible use of resources. When properly designed and constructed, asphalt pavements are easily renewable fixed assets that serve the agency and communities into perpetuity.

Recommendations:

1. Review state agency's LCCA process to understand if salvage value is incorporated into current processes.
2. Conduct an internal study to understand how incorporating the salvage value concepts would impact agency LCCA practices.

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