ABSTRACT

Ford, Kevin M., Ph.D. Purdue University, August, 2011. Incorporating Highway Asset Life Expectancy into Long-Term Planning – A Risk-Based, Probabilistic Approach. Major Professors: Samuel Labi and Kumares C. Sinha.

A vital aspect of cost-effective highway asset management is the estimation of asset life expectancies. Using reliable estimates of asset service life, agencies can modify replacement intervals, plan physical and financial work, and identify those designs best suited to the region. To aid agencies in these endeavors, this dissertation details a generalized, overarching framework for life estimation. While typical practice is to apply such life estimates deterministically, this study advocates the use of risk-based, probabilistic approaches towards making planning decisions. In demonstration of the developed methodologies, life expectancy models were calibrated for a variety of asset classes, with sensitivity and risk analyses conducted to quantify the uncertainty surrounding asset life. The propagation of such uncertainty was further quantified through the consequential effects on long-term, capital needs assessments. For example, to mitigate the uncertainty surrounding 15 year Indiana bridge replacement needs, it was found that a contingency fund of \$30-\$58 million is needed to have 90% confidence in having sufficient funds. It was further found that if expert opinion or deterministic applications of the developed models had been applied, that Indiana would likely have underestimated their needs by 25 to 162%. Such a range shows the danger in relying upon point estimates of life in planning practices. Instead, transportation agencies are encouraged to take advantage of the full information provided by riskbased, probabilistic approaches.