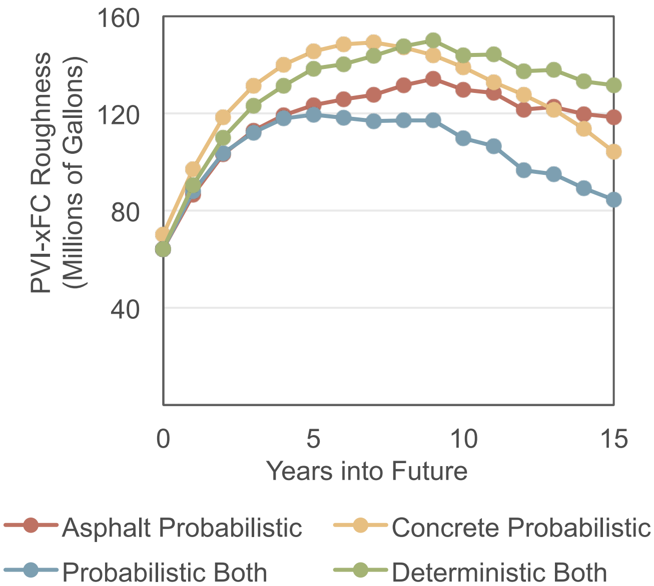
# Developing a Network-Level Pavement Management Model

## PROBLEM

Federal and state transportation agencies use pavement management systems to assist in the planning and prioritization of pavement repairs. Despite recent enhancements to these systems, several gaps exist in the current frameworks. For example, network level models typically do not consider pavement structural and material information despite their importance to roadway deterioration. Furthermore, CSHub research has demonstrated that present and future cost uncertainty is important for project-level decisions, but this is currently ignored in existing network level tools. CSHub research intends to address these gaps, leading to tools that can enable higher roadway performance and improved value for transportation agencies.

## APPROACH

Research at the CSHub has led to the development of a simple heuristic approach that has been shown to potentially lead to near optimal decisions in a fraction of the computational time of other approaches. This significant reduction in computational time has facilitated the ability of the model to accommodate design-specific information and a range of sources of variation. We implemented the model in a large case study (composed of approximately 3,000 pavement segments) with the objective of minimizing excess fuel consumption due to pavement vehicle interaction (PVI-xFC) with respect to only roughness. This objective was selected because it combines pavement condition and traffic levels and represents consumer fuel expenses. We ran the analysis for four scenarios related to cost uncertainty over a fifteen-year time-horizon and for a fixed available budget: a deterministic case using both materials and three probabilistic scenarios where asphalt, concrete, or both materials together were utilized. For the probabilistic case, we make the simplistic assumption that the level of cost volatility for both paving materials is the same but uncorrelated (e.g., an increase in concrete prices doesn't necessarily have to coincide with an increase in asphalt prices).




PVI-xFC due to roughness under four scenarios: a deterministic cost case using both materials and three probabilistic scenarios where either asphalt, concrete, or both materials are utilized.

## FINDINGS

The figure above shows the PVI-xFC results for the four scenarios and illustrates two important conclusions. First, a system that utilizes both asphalt and concrete tends to outperform a concrete-only or asphalt-only future. This is partly due to the consideration of a larger range of designs and rehabilitations with different costs and performance levels. Second, and perhaps more interesting, the probabilistic case using both materials outperforms the deterministic case. The reason behind the second finding is that in some simulations the cost of concrete and asphalt grow quite differently; if that happens, the ability to change between materials as uncertainty arises proves to be quite significant in the long-term.

## IMPACT

As DOTs continue to search for effective methods to maximize performance of pavement segments in the face of limited resources and a highly uncertain future, pavement management methods can serve as an excellent tool to meet those needs. The development of a model that can account both for uncertainty and for the diverse structural and material nature of pavements represents a major step forward for such systems.

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