



**Important Issues in Pavement LCCA**

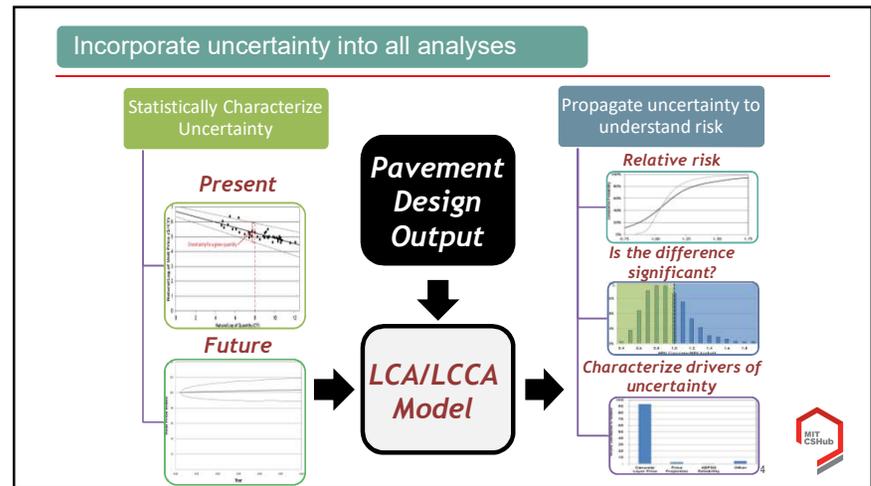
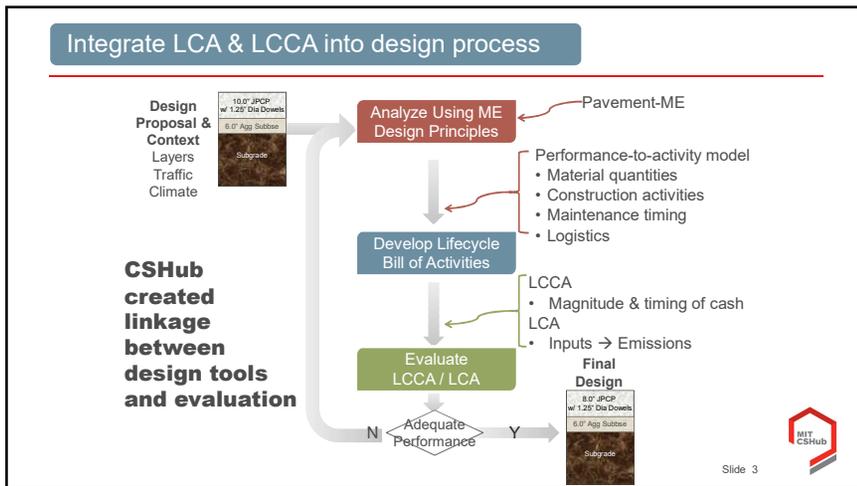
Jeremy Gregory  
Research Scientist and Executive Director, CSHub

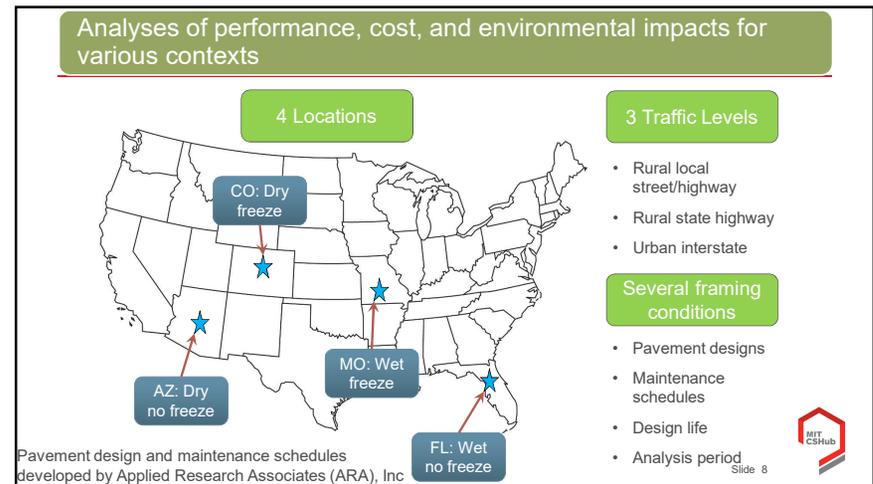
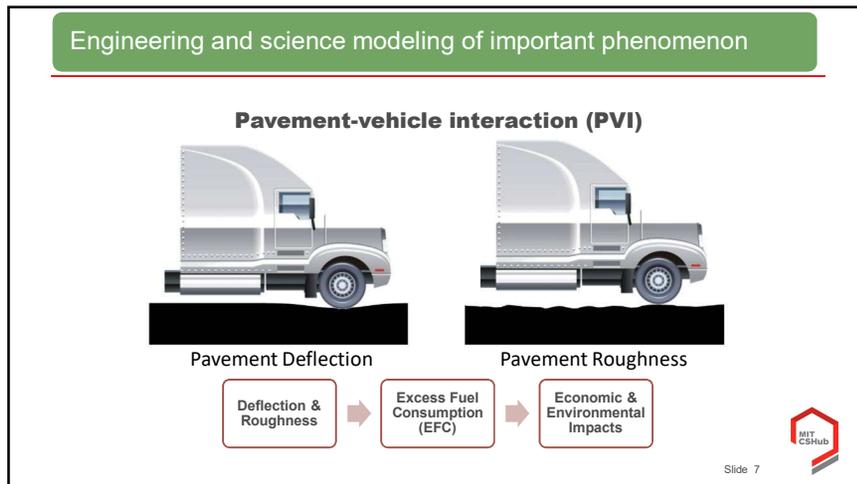
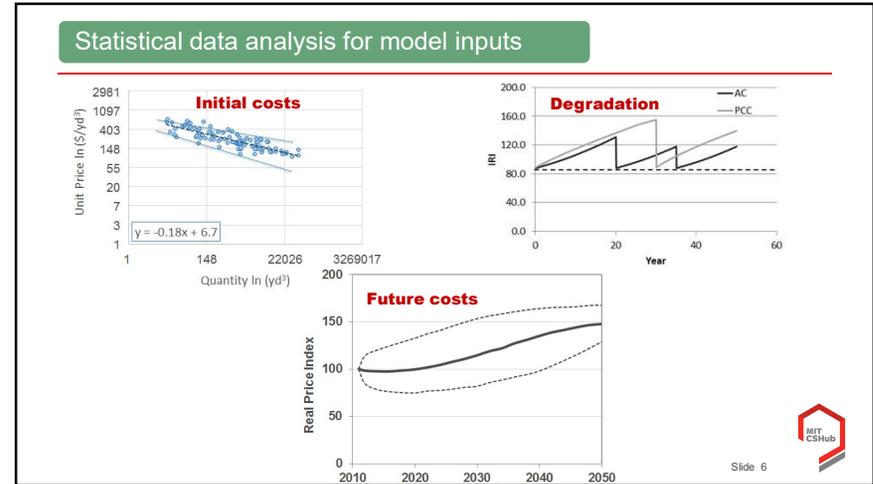
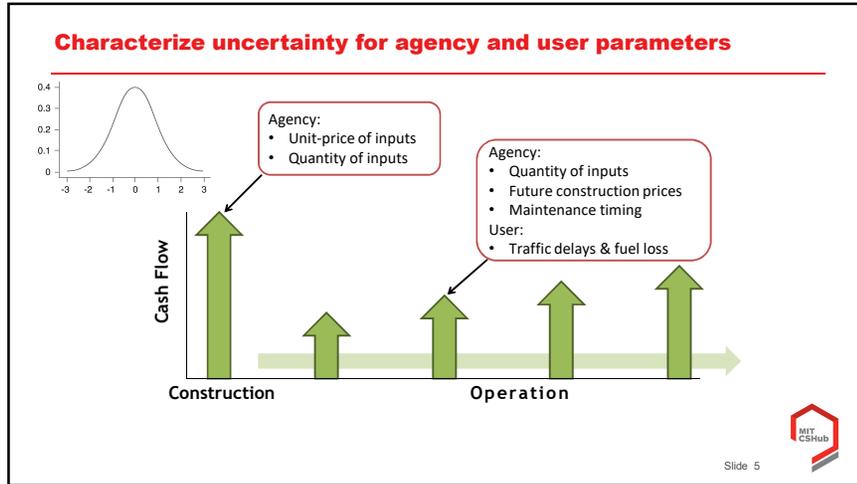
CP Tech Center Concrete Pavement Technology Webinar  
November 17, 2020

**Core elements of CSHub approach**

- Integrate LCCA & LCA into design process
- Incorporate uncertainty into all analyses
- Statistical data analysis for model inputs
- Engineering and science modeling of important phenomenon
- Analyses of performance, cost, and environmental impacts for various contexts

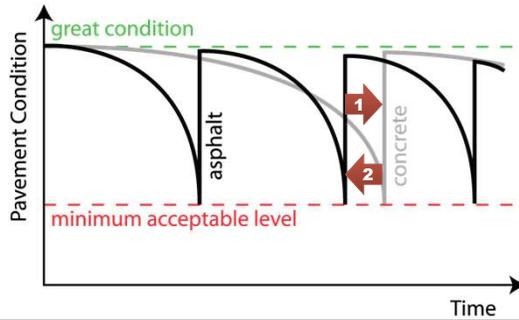
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**Functional equivalence is critical for pavement comparisons**

Design life equivalency: Time until first major rehabilitation  
 Combination of design and maintenance/rehabilitation schedule



These are *not* functionally equivalent

To create equivalence:

1. Increase asphalt design life, or
2. Decrease concrete design life



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**Key insights from research**

Life cycle perspective is important

Context is important

Excess fuel consumption drives user costs

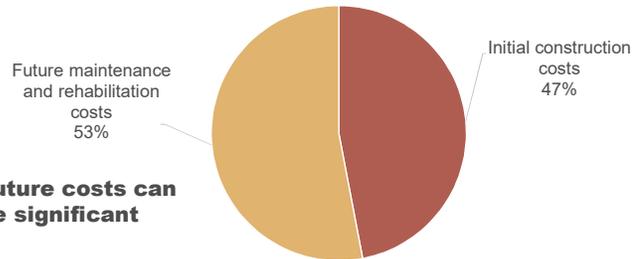
Uncertainty is important for inputs and outputs



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Life cycle perspective is important

**Total life-cycle costs for a state highway in Florida**

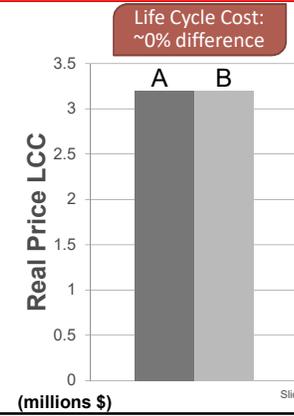
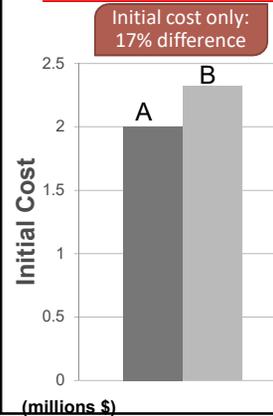


Flexible pavement design developed by Applied Research Associates (ARA), Inc.:  
 AADTT 1k/day; 4 lanes; Wet-no-freeze-FL; FDOT-based rehabilitation schedule;  
 Analysis period = 50 years.



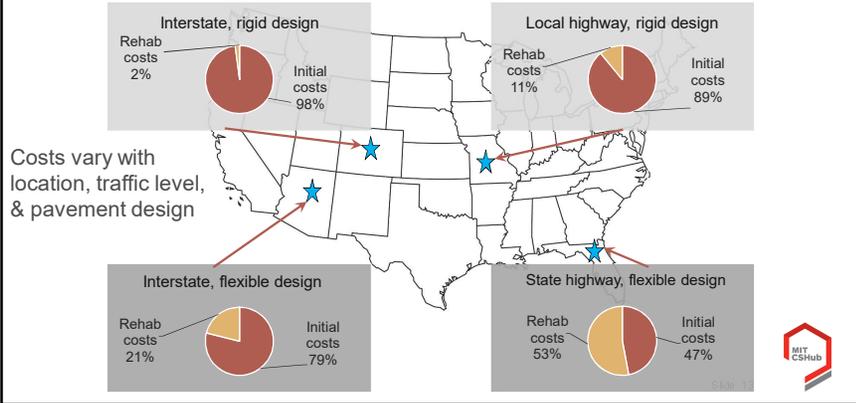
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**Life cycle perspective alters relative competitiveness**



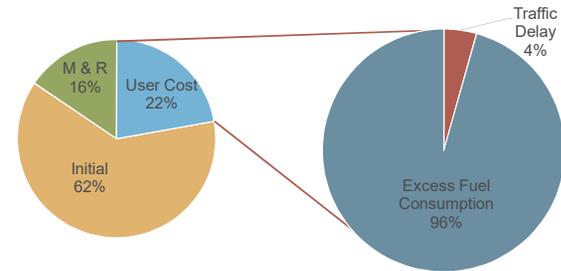
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Context is important

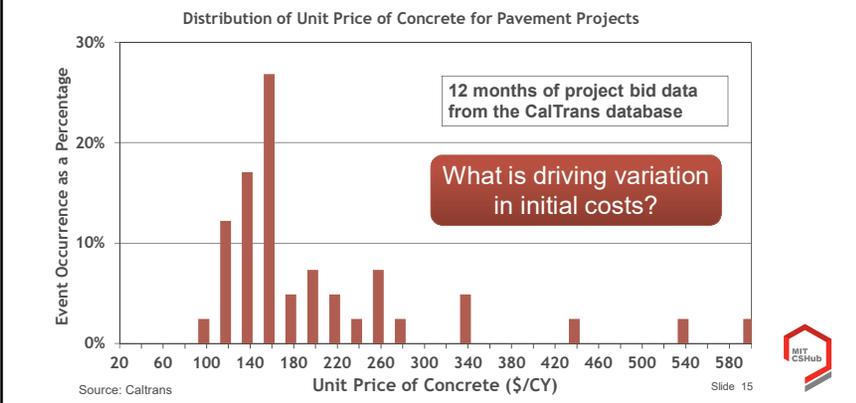


Excess fuel consumption drives user costs

Minnesota concrete pavement with asphalt shoulders  
Design developed by MNDOT

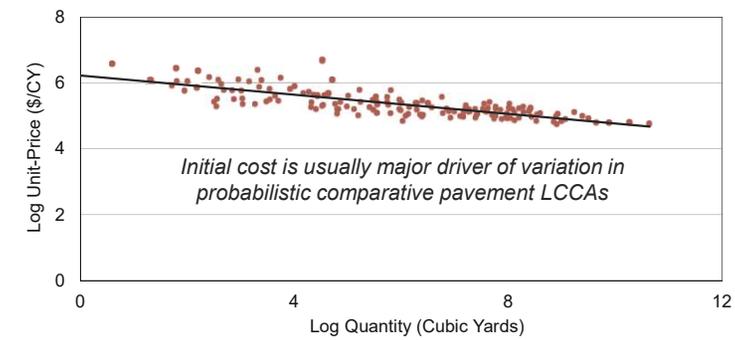


Uncertainty is important for inputs



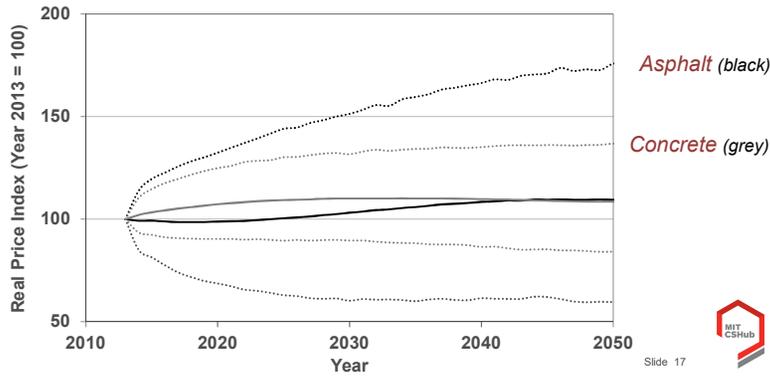
Capture drivers of initial cost and variation through statistical models

Concrete material prices highly dependent on quantity used on job



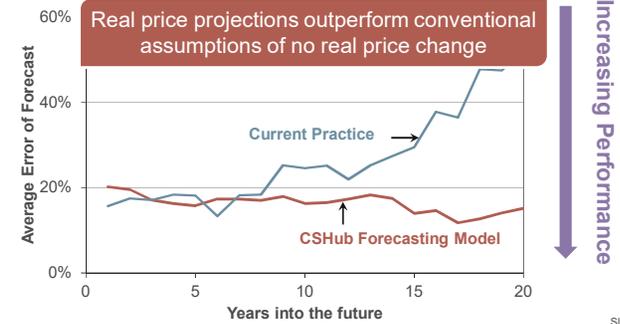
**There is uncertainty in future price projections**

But probabilistic projections are plausible



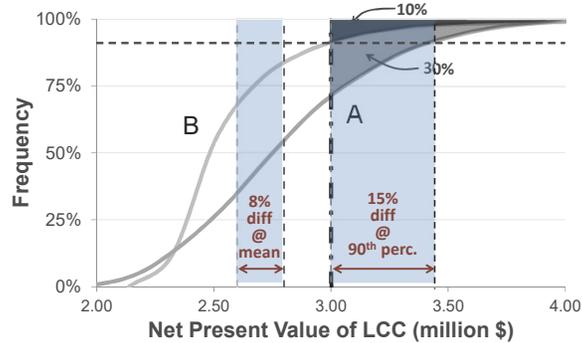
**CSHub forecasts have been shown to be more effective than current assumptions**

Testing the effectiveness of the model for the state of Colorado

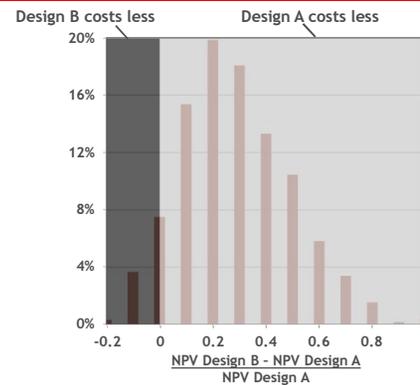


Uncertainty is important for outputs

**Probabilistic LCCA provides insight on relative risks**



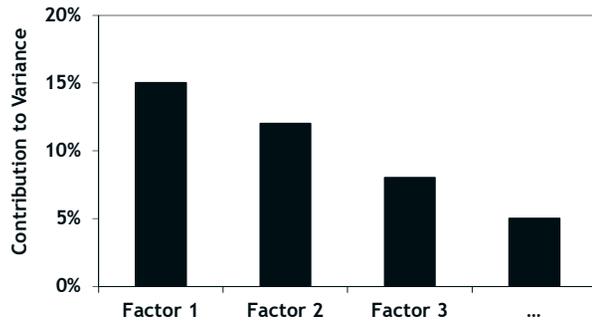
**Robust comparisons: confidence in a result despite uncertainty**



How frequently does design A cost less than design B?

Design A costs less than design B in 90% of simulations → statistically significant result

### Probabilistic analysis illuminates key parameters driving variation in final cost



*Initial cost is usually major driver of variation in probabilistic comparative pavement LCCAs*

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### Key insights from research

Life cycle perspective is important

Context is important

Excess fuel consumption drives user costs

Uncertainty is important for inputs and outputs

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We have worked with many agencies to review their LCCA practices. We'd be glad to work with you.