

## LCCA Webinar – Questions and Answers (11/17/2020)

The questions submitted during the webinar follow with answers that our speakers have provided.

### Resources:

- EB011P: [https://wikipave.org/index.php?title=EB011\\_-\\_Life-Cycle\\_Cost\\_Analysis](https://wikipave.org/index.php?title=EB011_-_Life-Cycle_Cost_Analysis)
- OMB Circular: <https://www.whitehouse.gov/wp-content/uploads/2020/12/M-21-09.pdf>

1. Can you please say about the user cost comparison to the initial cost? I mean what is the percentage of user cost we expect for a 20-year design of asphalt and concrete pavement with respect to the initial construction costs? California

This is entirely dependent on traffic, as user costs are mostly related to traffic (work zone costs and vehicle operating costs)... In very high traffic situations, user costs can dwarf initial costs. For lightly traveled roads, user costs can be minimal.

2. How does the rate of excess fuel consumption change as more and more vehicles move toward electric? Does the battery consumption increase as the deflections and IRI of the roadway increases? Kansas

Great question. The excess energy consumption stays the same, but the energy now comes from a battery (that in turns gets its energy from coal, wind, gas or whatever source the grid in that area is powered by) rather than from gasoline or diesel. The excess energy concept remains valid as vehicle fleets transitions to electric, but the overall CO2 footprint may be different as the energy used is from a different source. In short, yes, battery consumption goes up as deflections and roughness increases.

3. How much is the difference between initial costs and future rehab & maintenance costs related to the design, materials or contractor quality control during construction? Is there a breakdown on the Florida example? Kansas

We do not account for contractor quality in determining the need for future maintenance and rehabilitation costs, but it is an interesting question. One would need to have a clearly defined relationship between future pavement deterioration rates and construction quality. The maintenance and rehabilitation schedules we used were determined by the consultant we hired to create the designs and schedules (ARA), who based them on DOT practices.

4. What functional unit would you propose to compare the following two road options in an LCA? Florida
  - Highway with 4,000 heavy vehicles a day and a useful life of 20 years.
  - A conventional road with 2000 heavy vehicles per day and a useful life of 40 years. Note that the carriageway widths are different.

I assume the question is about LCCA and not LCA, although the functional equivalence question applies to both. An LCCA is used to compare two options that

are functionally equivalent (i.e. equal benefits to the user). You should not attempt to use LCCA to decide between alternatives that provide totally different benefits. In your example, an LCCA would be inappropriate as the alternatives are not functionally equivalent. It's much like comparing apples and oranges. Instead, one should compare design alternatives for the same requirements. This is typically done using the same traffic requirements and the same design life (time until a major rehabilitation), even though the pavement designs and maintenance and rehabilitation schedules among the two alternatives will be different.

5. In respect of the LCA of a road pavement there is an ongoing debate as to whether to consider vehicle fuel impacts as road impacts or not. Please comment. Florida

Again if the question pertains to LCCA (and not LCA), it is our perspective that if user costs are to be included in the LCCA (and that is not always the case), excess fuel consumption (related to roughness and stiffness) is appropriate to incorporate in this user cost.

6. Generally, the AADT at the end of the design period will be higher than at the beginning. This means that the road must be sized for the amount of traffic expected on the road say 30 years from now. I would like you to reflect on this point. Do you have to size a pavement for your AADT at the end of its useful life, for your starter AADT or for an intermediate one? How does this affect the LCA for a road pavement? Florida

This is really a pavement design question. You should design a pavement for the total expected loadings it will be experiencing during its design life.

[www.PavementDesigner.org](http://www.PavementDesigner.org) does this in an intuitive and easy-to-use way. Again, an LCCA is an analysis technique used to evaluate the overall long-term economic efficiency between competing functionally equivalent pavements (i.e. equal benefits to the user). It is not a pavement design tool on its own – it is used in conjunction with pavement design.

7. What is the limitation of Real Cost software? Iowa

RealCost is free and robust tool for performing a Life-Cycle Cost Analysis. However, one limitation would be the program may be a bit too complicated for agencies that do not use it regularly. The introduction of user costs provides advanced users the capability to better predict and understand the impacts of construction activities, but does require additional information that may not be readily available. It is not as simple to get to the basic agency costs (including initial and maintenance / rehabilitation costs) because of this added complexity. Another basic limitation is the lack of default/example information in the tool. If RealCost had two modules, one basic and one advanced, the tool would be much more user friendly...

8. What software do you suggest for LCCA and LCA? Iowa

AND

9. What are the free software programs for LCCA? Quebec

There are several good options including FHWA's RealCost. APA's LCCA Express is also useful. Both FHWA's RealCost and APA's LCCA Express are free.

10. If EUAC is used, as opposed to NPV, unequal lives is not a concern, correct?

Wyoming

Correct, as long as both alternatives compared in the LCCA are functionally equivalent (i.e. equal benefits to the user), AND the analysis period encompasses the initial performance period and at least one major follow-up preservation/rehabilitation activity for both alternatives considered.

11. Could you please elaborate about what is considered the LESS RISK ALTERNATIVE and the main criteria to consider for its determination? California

In our case, risk is defined as the likelihood of exceeding a cost target. A lower-risk alternative will have lower costs but also lower uncertainty. The uncertainty is derived from many factors, but the largest determinant is the uncertainty in initial cost.

12. Considering ACPA's recommendation for 40-45-year analysis period, asphalt pavements are often designed for 20 years, so how is this situation handled in LCCA? Minnesota

Great question. Since LCCA is an analysis technique used to evaluate the overall long-term economic efficiency between competing functionally equivalent pavements (i.e. equal benefits to the user...), it is important to extend the analysis to a long enough period to capture the performance of both alternatives. The analysis period must encompass the initial performance period and at least one major follow-up preservation/rehabilitation activity for each alternative considered. As concrete pavement is often designed for an initial performance period of 30 years, the analysis period is often 40 or 50 years to capture at least one follow-up rehab activity.

13. Jeremy, could you please recommend some literature that discuss your topic? Minnesota

You can find MIT Concrete Sustainability Hub resources on our web page dedicated to the topic: <http://cshub.mit.edu/pavements/lcca>. ACPA's Engineering Bulletin EB011 also has a lot of good information. It is accessible on line at no cost. Many other sources are referenced in that document.  
[www.wikipave.org/index.php?title=EB011 - Life-Cycle Cost Analysis](http://www.wikipave.org/index.php?title=EB011_-_Life-Cycle_Cost_Analysis).

14. Overall, great presentations! I wish practical examples had been presented to drive the key points home. Minnesota

Thank you. Due to time constraints, we were not able to go through detailed case studies. However, we have several examples included in EB011 and on the CSHub LCCA web site (links above).

15. Vehicle operation cost (VOC) is a function of pavement stiffness. Given that asphalt pavements are less stiff than PCC pavements, can we say asphalt pavements induce higher VOC, all factors being constant? Minnesota

Exactly! And, we now have models that can tell you how much higher VOCs are, based on pavement characteristics. MIT CSH has a wealth of information about this phenomenon specifically! See: [www.cshub.mit.edu/pavements/pvi](http://www.cshub.mit.edu/pavements/pvi).