

Abstract

Improving Pavement Sustainability through Integrated Design, Construction, Asset Management, LCA and LCCA [†]

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1. Three Dimensions for Integration of Solutions to Improve Sustainability

Improving the sustainability of pavements requires action across all stages of the full life cycle of the pavement:

- Materials extraction;
- Materials processing;
- Materials transportation;
- Construction;
- Use;
- End of Life.

Proposed solutions that do not look at the complete life cycle of the pavement, and do not consider the full system (all interactions of the pavement with other systems in each stage) may result in less-than-optimal positive outcomes and create the risk of negative unintended consequences. Negative unintended consequences mean that the proposed solution may in fact achieve the opposite of sustainability goals.

The focus of most efforts concerning pavements have focused on materials, which, while also important, is only one aspect of the steps in the project delivery process where changes can be made to improve sustainability. Proposed solutions must be found in every stage of infrastructure delivery:

- Planning (if new);
- Pavement management to select project (if PMR&R);
- Conceptual design (Scoping);
- Design (PS&E);
- Construction;
- Monitor performance.

Finally, new approaches for improving pavement sustainability do not change anything until they are completely implemented, meaning that the change is embedded in policies, specifications, guidance, tools, and is part of every practitioner's everyday practice. The steps of moving from an idea to complete implementation are:

- Conceptual idea
 - Feasibility analysis using life cycle assessment (LCA) and life cycle cost analysis (LCCA) to quantify expected outcomes and cost/benefit, and further assessment of the proposed change to assess which ideas are most promising to move forward



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- Research
 - Reassessment as the idea is developed using LCA and LCCA to better calculate its potential for beneficial outcomes and the cost per unit of beneficial outcome
- Development
 - Creating the databases, validated models, tools, policies, specifications, and training
- Implementation
 - Receiving approval for implementation, making the changes in all information that is part of the project delivery process, training all users, and supporting users in their daily practice
- Feedback
 - The above process concerns feedback for continuous improvement, and new concepts should be developed as the current ones are being implemented

2. Problems of Lack of Integration and Vision for Integrated Solutions

Recent research and development has advanced our knowledge regarding structural and material design technologies for pavements and improved methods for modeling their performance, cost and environmental impacts. However, many of these advances are not well integrated when implemented. Because of the lack of integration, advances implemented in different stages of the pavement project delivery process and network management system may not be recognized or considered in other stages. The lack of integration also results in difficulties in updating solutions in different stages of the delivery process that share common data types and models intended for the same purpose. Lack of integration presents implementation difficulties for new technologies when the implementation must be done separately for tools used in each stage of the delivery process. This presentation summarizes the overall vision and milestones reached to date for creating and implementing an integrated systems approach and continuous improvement process for the pavement enterprise in California, including structural design, materials specifications, construction specifications, network pavement asset management, life cycle cost analysis, environmental life cycle assessment, and prioritization of policies, to achieve state-wide environmental goals.

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