

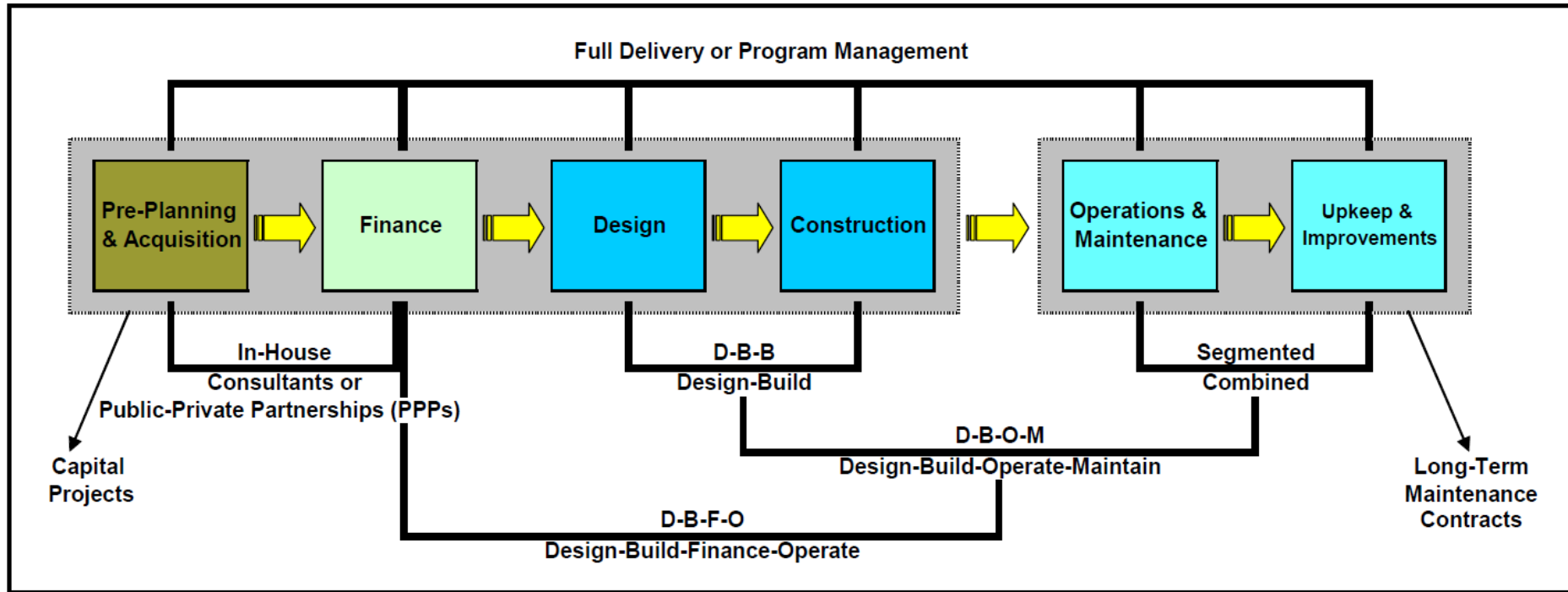
Use of LCA in different infrastructure delivery methods, some thoughts

John Harvey

University of California Pavement Research Center



Exhibit 1 Alternative Contractual Arrangements for Delivering Highway Infrastructure



Source: Pakkala, Pekka. *Innovative Project Delivery Methods for Infrastructure—An International Perspective*. Finnish Road Enterprise, Helsinki, 2002, p. 32.

Overview of infrastructure delivery methods

- Design/bid/build (DBB, low bid)
 - Design completed by owner or owner's consultant
 - Design approach may be selected based on life cycle cost
 - Contractor bids on construction of completed design, selected based on lowest total initial cost
- Design/build (DB)
 - Design requirements prepared by owner, pavement type may also be selected by owner
 - DB proposer submits partial design, may include life cycle cost analysis regarding design approach selected
 - DB contractor selected based on lowest initial cost or combination of partial design, qualifications, total initial cost (best value)
 - May include warranty (typically 1-7 years in US)
- Design/build/maintain (DBM)
 - Design and maintenance performance requirements prepared by owner
 - DBM proposer submits partial design and may also need to submit financial information regarding maintenance funding
 - DB contractor selected based on life cycle cost or combination of partial design, qualifications, life cycle cost (best value)

How can LCA fit into each of these?

Design/Build/Maintain

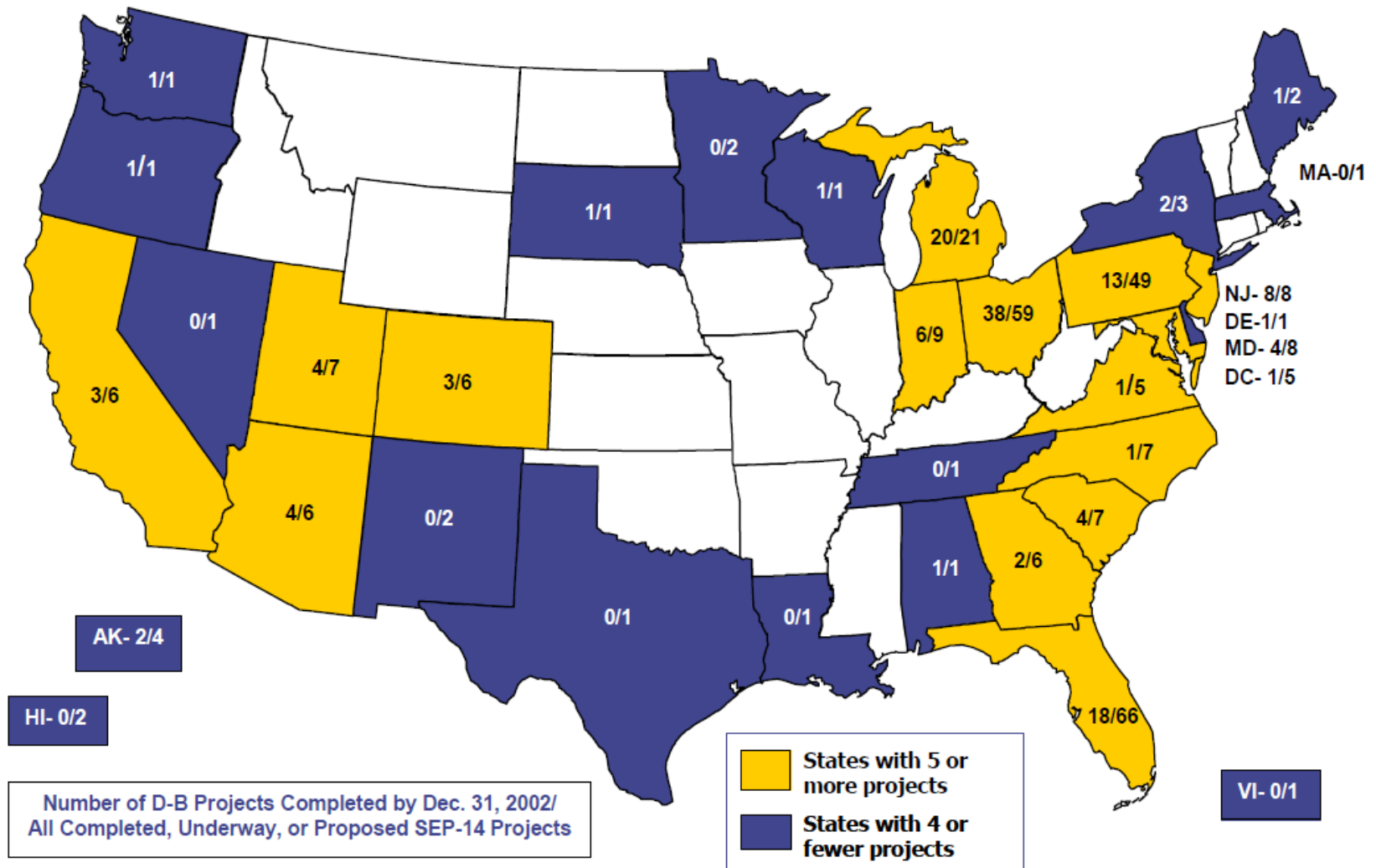
- Contractor prepares LCA and LCCA for proposed design and maintenance strategy for full life cycle
- Contractor selected based on LCCA, LCA and technical and financial qualifications
 - Contractor financially responsible for cost
 - Actual life cycle materials, construction and use phase impacts can be calculated from documentation of work and road condition
- DBM used for highest level routes in many national highway networks, including Province of Ontario, Canada
- DBM almost never used for public highways in US, although commonly used for water treatment plants and other civil infrastructure

How can LCA fit into each of these?

Design/Build

- Contractor prepares LCA and LCCA for proposed design and expected maintenance strategy for full life cycle
- Contractor selected based on LCCA or initial cost, LCA and technical and financial qualifications
 - Only responsible for initial cost and can track initial materials, construction and road condition
 - Not responsible for maintenance or road condition over life cycle
- DB used on high level routes in some national road networks
- DB used by many public highway departments in US to varying extents

Exhibit 2 SEP-14 Design-Build Projects by State (total and those completed by December 31, 2002 by STAs, toll agencies, or local public agencies)



Source: Design-Build Projects Approved Under SEP-14, Federal Highway Administration, July 2003

How can LCA fit into each of these?

Design/Bid/Build

- Owner performs LCA and LCCA to determine pavement design approach
 - Similar to current approach in California for pavement design approach based on LCCA
- Contractor selected based on lowest initial cost
- Rest of the process is the same as if only considering LCCA
- Based on prior analyses can include more sustainable practices in specifications
- No incentive to contractor to optimize environmental impact

Questions applicable to all methods

- How much weight to put on LCA?
 - In pavement design selection and optimization
 - In contractor selection (DB and DBM)
- When are we ready to proceed?
 - Databases, Software, Understanding
- Prioritization of impact categories (goal definition)?
- Cost versus benefit of doing LCA?
 - Level of assumptions, time, effort
- Alternative use of indices, like LEEDS for buildings?
- Alternative use of specifications for materials, or even structures tied to pre-determined LCA results such as EcoLabel



Questions in each approach

- Design/Bid/Build
 - Can implementation of LCCA in US be a model for use of LCA?
 - How much incentive for reducing environmental impact through innovation?
 - Scope of LCA? Materials and construction and end of life? Use phase?
- Design/Build and Design/Build/Maintain
 - Confidence in proposer supplied LCA? Same software? Auditing?
 - Extent to which assumptions of LCA can be verified in actual delivery?
 - Scope of LCA?