

# Life-Cycle Cost Analysis



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**Office of Asset Management**



## Topics

- Transportation Asset Management
  - Definition
  - FHWA Office of Asset Management
- Life-Cycle Cost Analysis
  - Definition
  - Process
  - LCCA in Pavement Type Selection
  - National Practice
  - FHWA RealCost Software



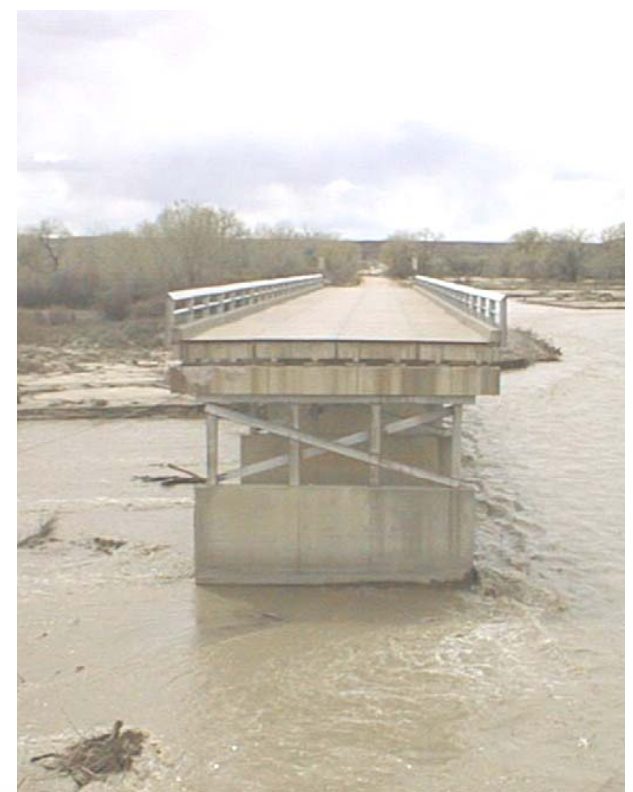
## Definition of Asset Management

Asset management is a systematic process of maintaining, upgrading, and operating physical assets cost-effectively. It combines engineering principles with sound business practices and economic theory, and it provides tools to facilitate a more organized, logical approach to decision-making. Thus, asset management provides a framework for handling both short- and long-range planning.

## FHWA Office of Asset Management

### Three Teams

- **Construction and System Preservation**  
responsible for construction and maintenance program policy, technical support, and national outreach. Specific areas of responsibility include quality management initiatives, transportation system preservation, and continuous quality improvement initiatives such as system preservation.





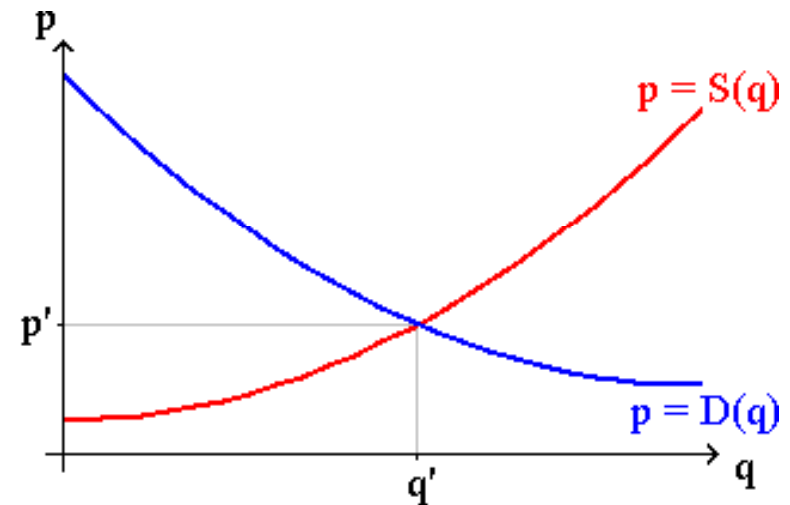
## FHWA Office of Asset Management

- **The System Management and Monitoring Team:** responsible for developing and promoting systematic approaches to the management of highway assets. This work includes refining and advancing the use of pavement and bridge management systems and developing systems where they presently do not exist, such as for tunnels and roadway hardware. The team is made up of a Pavement Management Group and a Bridge Management Group.

## FHWA Office of Asset Management

- **Evaluation and Economic Investment Team**

- development and promotion of an array of procedures for inclusion in an engineering economic analysis toolbox, identification and dissemination of alternatives for developing data systems to support asset management, and providing assistance with implementation of relevant standards issued by the Governmental Accounting Standards Board (GASB).





## Life-Cycle Cost Analysis Definition

- Life-Cycle Cost Analysis is a **process** for evaluating the total economic worth of a usable project segment by analyzing initial costs and discounted future costs, such as maintenance, user, reconstruction, rehabilitation, restoring, and resurfacing costs, over the life of the project segment.

*Source: Transportation Equity Act for the 21st Century*

## LCCA Defined

An analytical tool  
to provide a cost comparison  
between two or more competing design alternatives  
producing equivalent benefits  
for the project being analyzed.



## LCCA Defined

### When to Apply LCCA?

- Equivalent benefits
- Costs vary in amount and timing
- Decision support





## LCCA Defined

### Outputs

- Costs expressed in constant dollars with equivalent purchasing power
- Rational comparison of agency costs and user costs

**Better Alternatives!!!**

## LCCA Methodology

### Before the Process Begins...

- Policy decisions in place
- Secure decision to build the project
- Scope of project warrants the rigors of LCCA
- Establish requirements
  - Project level
  - Alternative level





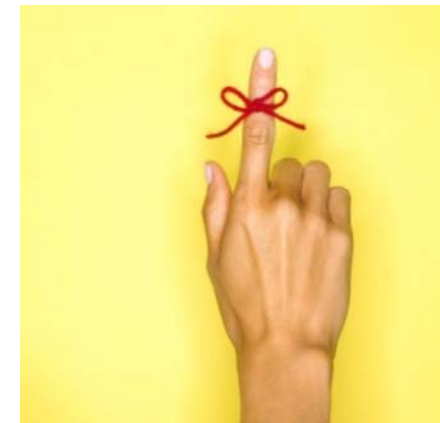
## Sample Project Level Data

- Specific roadway geometry
  - Number of lanes in each direction
  - lane widths
  - Work zone lengths
- Traffic data
  - AADT
  - Annual traffic growth
  - Percent trucks
  - Hourly traffic distributions
  - Lane capacities
  - Queue Dissipation capacities
- Agency Cost
- Service Life
  - Structural
  - Functional
- User Cost Data
  - Vehicle Operating Cost rates
  - Added vehicle operating cost and time
  - Value of user time delay
    - (passenger cars, single unit, comb. unit)

## LCCA Steps

### Steps

1. Establish Design **Alternatives**
2. Determine Activity **Timing**
3. Estimate Agency and User **Costs**
4. Compute **Life-Cycle Costs**
5. Analyze the **Results**



## Step 1: Establish Design Alternatives

### Activities to Ensure Performance

- Initial construction or rehabilitation activities
- Future rehabilitation and maintenance activities
- Analysis period long enough to demonstrate cost differences between alternatives



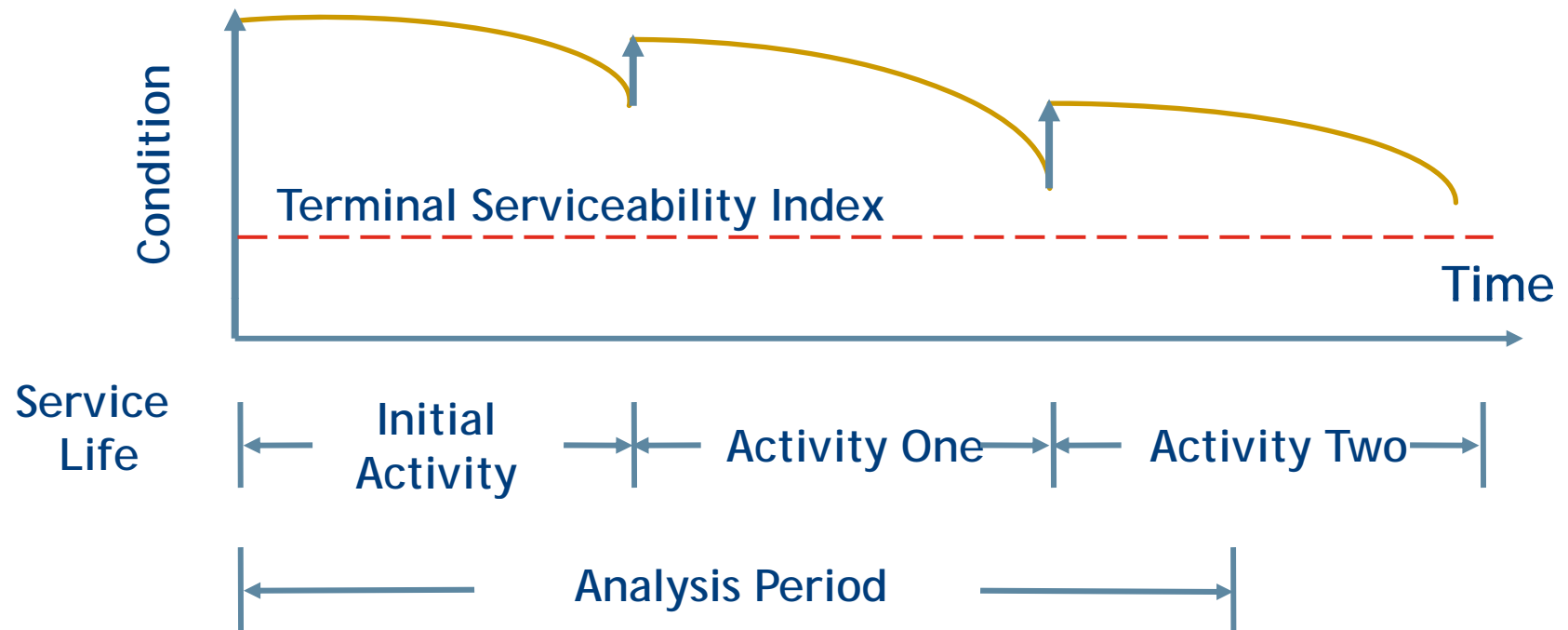
## Step 1: Establish Design Alternatives

Example Design Alternatives...



- Portland cement concrete pavement vs. Hot mix asphalt
- Mill and fill vs. overlay
- Preservation vs. major rehabilitation

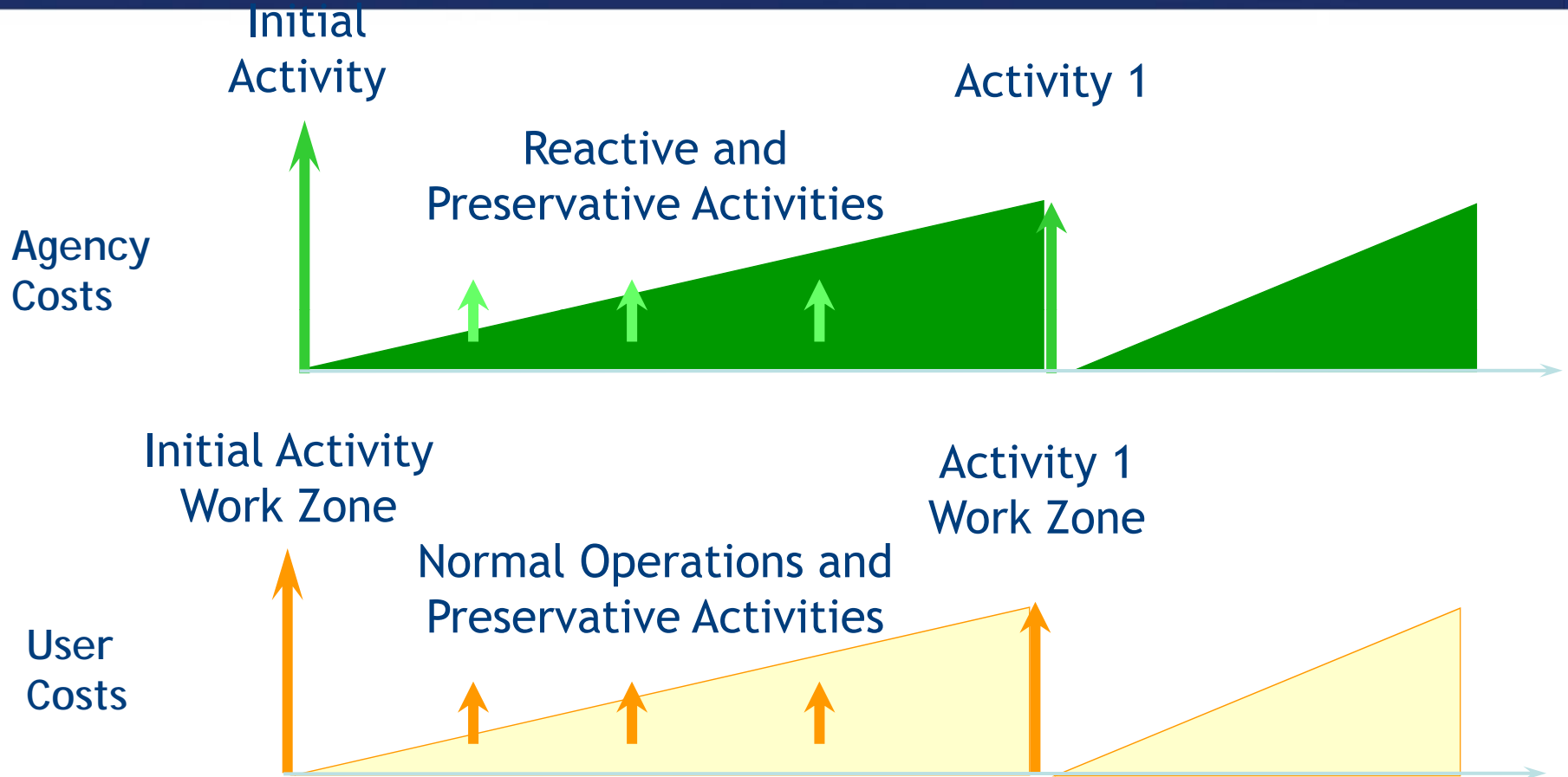
## Step 2: Determine Activity Timing



When will the future maintenance and rehabilitation costs be incurred?

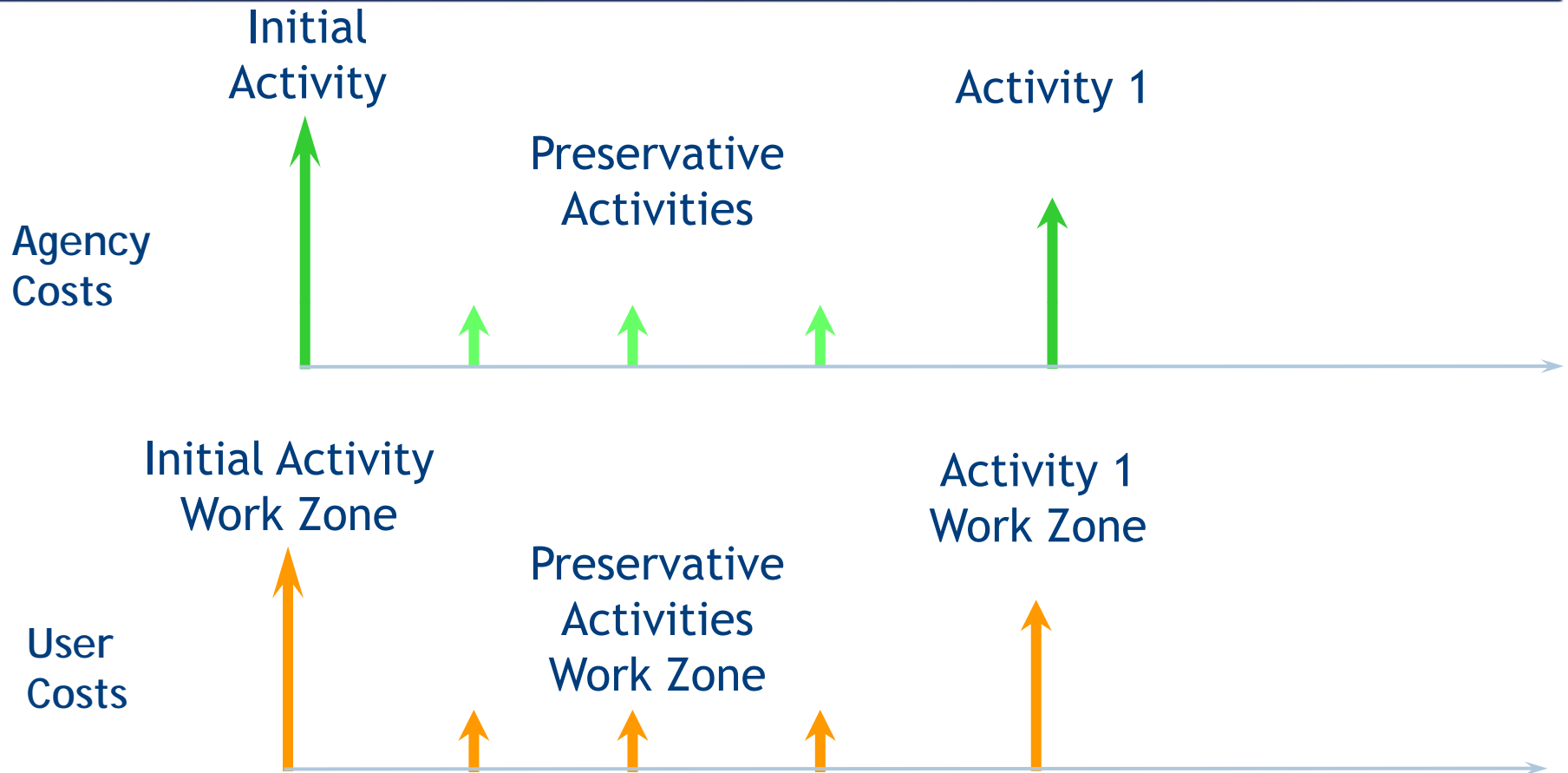


## Step 3: Estimate Agency and User Costs





## Step 3: Estimate Agency and User Costs





## Step 4: Compute Life-Cycle Costs

Present Value =  
of Costs

$$\sum_{k=0}^N \left[ (\text{Cost}_k) \times \left[ \frac{1}{(1+d)^{n_k}} \right] \right]$$

N = length of analysis period  
d = discount rate  
 $n_k$  = year of expenditure



Present Value  
Factor



## Step 5: Analyze the Results

- How do agency costs compare?
- How do user costs compare?
- Can trade-offs be made?

