Delay User Costs in Spatially Distributed Transportation Asset Management

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Introduction

- User costs associated with highway construction and maintenance can be separated into four categories;
  - Increased probability of accidents
  - Increased wear and tear on vehicles
  - Decreased fuel efficiency
  - User delay time

- Assigning a value to user travel time is difficult due to personal variability

- Current practice is to take a percentage of the user’s wage rate
Introduction-Value of Time
Alternatives

- Leisure time analogy instead of wage rate, individuals value leisure equally despite having different wages

- De minimus cost associated with subsistence, possible comparison to incarceration or poverty statistics
Introduction-Network Considerations

- User delay costs during construction and future maintenance programs

- Secondary effects of detouring
  - Costs burdened by regular users versus detoured users

- Regional differences in prevailing wages
  - Cost of living variances should be neglected
Value of Time

• Because of the wide diversity of transportation users, assigning a value to user time saved is complex

“People value time differently, both on a fundamental basis, and by the purpose and mode of travel. In concept, how people value time spent in travel depends on the mode of travel, the purpose of the travel, the trip component (e.g., waiting versus riding), the total time, socioeconomic characteristics (which are often generally measured by income), and other preferences” (Transportation Research Board, National Research Council, 2002).
Value of Time

• User willingness to pay and personal perception

• When a transit user avails himself or herself of the system, that person is making a decision based on the evaluation that the cost of the trip is less than the perceived benefit (Transportation Research Board, National Research Council, 2002)
Wage Rate

• It is clear that the mix of occupants varies considerably across regions
  – Adjust for regional differences in wages and customize the BCA accordingly

• Contributions to the national GDP

• Cost of living correction

• Current approach
  – 20%-100% of national average permissible, with 50% most common
Service Industry Approach

• Saving user travel time can be viewed as increasing personal leisure time
  – Individuals value leisure time equally
  – Regardless of income, household responsibilities need to be fulfilled

• People can “buy” leisure time by purchasing home services
  United States Department of Labor Statistics:
  $10.66/hr. for home services including house and grounds keeping
  $19.20/hr. U.S. average across all industries
  Service approach equals taking 55% of national wage, mirrors conventional thinking and can be applied using highly localized labor data
Cost of Survival Approach

• Monetize the basic essentials of living
  – Daily cost of incarceration (and supervision)
    U.S. Bureau of Prisons: $2.76/hr.
    Approximately 14% of national wage
  
  – Poverty threshold and vehicle ownership and operation
    U.S. Department of Health and Human Services: $9740/yr.
    Redbook vehicle costs: $6240/yr. (15,000 miles driven per year)
    Total hourly rate of: $8.24/hr.
    Approximately 44% of national wage

Wages above $8.24 are considered a level of luxury in this context and are the source of user value of time variability
Construction and Maintenance Considerations

- User costs not borne by Agency are generally neglected from BCA

- Delay costs are typically only accounted for during construction.
  Life-Cycle costs due to maintenance programs could play a dominate role in overall BCA

- Permanent versus temporary benefits/costs

- Proper discounting of user delay
  - Social discount rate
  - Intergenerational fairness
Construction and Maintenance Considerations

- Time distribution of maintenance delays affects the magnitude of the associated user cost.

  “Do we see the value of time as linear or nonlinear with respect to the amount of time saved? I do not—I cannot usefully use one minute saved in the same way that I can use 20 minutes saved.” (U.S. Government Accountability Office, 2005)
Network Considerations

- Depending upon the location of the work, different user costs could be realized for the same activity (e.g., painting and/or paving), based on the variability of the network to alleviate congestion (i.e., longer delays)

- When calculating user costs, one must be cognizant of the delays experienced by users that are detoured as well as the collateral costs of regular users of the detour route that are not detoured but experience increased congestion

- Alternate detour routes and/or off-peak/season work may have to be considered
Network Considerations

• A typical design for highway networks around metropolitan centers incorporates an outer beltway with radial interchanges

• All highways in this network share common link and could experience delays from any one or combination of other segments which are also experiencing delays

• The present value of travel time reductions due to capacity improvements can be significant not only for travelers on the improved segment but elsewhere in the network as well due to congestion relief.
Network Considerations; Washington D.C.

- Washington D.C., for example, experiences significant congestion due to high traffic volumes and insufficient capacity. One critical point in this network is the Woodrow Wilson Bridge, which is part of Interstate 495 and spans the Potomac River.
Network Considerations; Washington D.C.

- Commuters and through travelers alike can either choose the considerable delay trying to cross the Wilson Bridge or an alternate route to bypass this crossing. Let us assume that a user traveling north on I-95 wants to cross the city and continue north on the interstate.
Network Considerations; Construction Time Delay Costs

- Three possible alternative routes: A, B, C
- Construction-induced delays estimated to be 15 minutes
- Current peak hour volume is 17,000 vehicles
  - Approximately $62,000 in delay costs for peak hour each day.
  - Approximately $30,000,000 in delay costs for peak hour over 18 month construction period
Network Considerations; Present Value of Time Savings

• Assumed time savings from building a new bridge: 41 minutes

• Increase service level from “F” to “B”

• B level specifies maximum service flow rate of 960 vehicles/hour/lane at a minimum speed of 60 mph

• Benefits of saving 41 minutes (during the peak hour) over 20 years: $326,000,000
Conclusions

• Efficient highway asset management requires knowledge of how network reacts to construction and maintenance delays

• User value of time must be rationally monetized

• Network capacity to support detours and alleviate delays is critical
The first Author, in his natural environment

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