CAMBRIDGE SYSTEMATICS

MnPASS System Study

Technical Memorandum #2

Evaluation Criteria and Financial Analysis Framework

technical

memorandum

prepared for

Minnesota Department of Transportation

prepared by

Cambridge Systematics, Inc.

with

URS Corporation

November 2, 2004

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technical memorandum

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1.0 Background

The evaluation of the effectiveness of potential MnPASS toll lane systems needs to consider impacts on system performance, the extent to which a scenario is financially self-supporting, and non-quantifiable factors. This memo described the evaluation criteria that we propose to use.

The analysis framework for the MnPass System Study provides for two rounds of analysis that are not identical in structure. The first round of analysis only considers traffic levels expected in 2030, whereas the second round will also consider traffic levels expected in 2010. This structure means that the evaluation criteria used for the first round cannot consider any time-stream effects.

Though we are evaluating five systems in the first round of analysis and three in the second, we also want to be able to distinguish individual elements of the systems that might be more or less viable than other elements of the same system. Therefore, we have also developed several measures that consider discrete parts of the system as distinct from the entire system.

Toll levels on the MnPass system are assumed to vary dynamically to ensure that the toll lanes are able to deliver free flow traffic at all times. This means that the toll rates will vary from day to day and from hour to hour.

With variable toll rates, Mn/DOT will be faced with the need to develop a tolling/pricing policy, which will determine the actual rates that will be charged. Potential tolling policies range from one which maximizes toll revenue to one that maximizes vehicle throughput. It may not possible to accomplish both objectives at the same time. We have structured our analysis to test a wide range of toll rates at different times of day. For this planning study, our detailed analysis will focus on a policy that maximizes revenue. We will also explore how revenue and performance measures might change if an alternative policy is chosen.

2.0 System Performance

System performance measures will be handled the same way for both rounds of analysis, since there is no time stream component. When looking at system performance, we are interested in both how the toll lanes system impacts the overall system, as well as the individual corridors being studied.

Systemwide Performance

From a system performance perspective we will look at changes between the baseline condition (2030 traffic levels assigned to a 2013 network) and the specific toll lane condition. Typically, there are several measures that are considered in evaluating system impacts:

- System vehicle miles of travel
- System vehicle hours of travel
- System average speed (total vehicle miles/total vehicle hours).

Since our modeling approach runs through the trip distribution model for each "build" scenario, looking at vehicle miles or vehicle hours by themselves will not reveal much change. This is because as improvements are made to the system, the gravity model will increase trip lengths to conform to the expected trip length frequency distribution.

However, looking at the total system speed (vehicle miles per hour) should reveal the extent of improvement in conditions brought about by the system changes. We propose looking at systemwide average speeds for:

- AM Peak Period (6:00 – 9:30)[1]
- PM Peak Period (2:30 – 6:00)
- Non Peak Periods.

Reliability Measures. We understand that there is also a strong desire to measure changes in reliability. As we review the literature on using system models to measure reliability, we have concluded that such measures really do not provide an independent measure of effectiveness from system congestion – and by extension, system speed.

System reliability relates to variation in travel times over expected times. Whereas delay due to excessive volume results in "expected delay," i.e., there is just too much traffic, "unexpected delay" results from conditions that are not easily modeled, e.g., crashes, construction activity. Travel demand models are good at forecasting volume. They are not good at forecasting unexpected delay. The literature does show some correlation between congestion (as measured by the "travel time index"[2]), and reliability (as measured by the "buffer time index"[3]).

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[1] The AM and PM peak periods are the ones showing meaningful levels of demand for toll lanes in our earliest model runs.

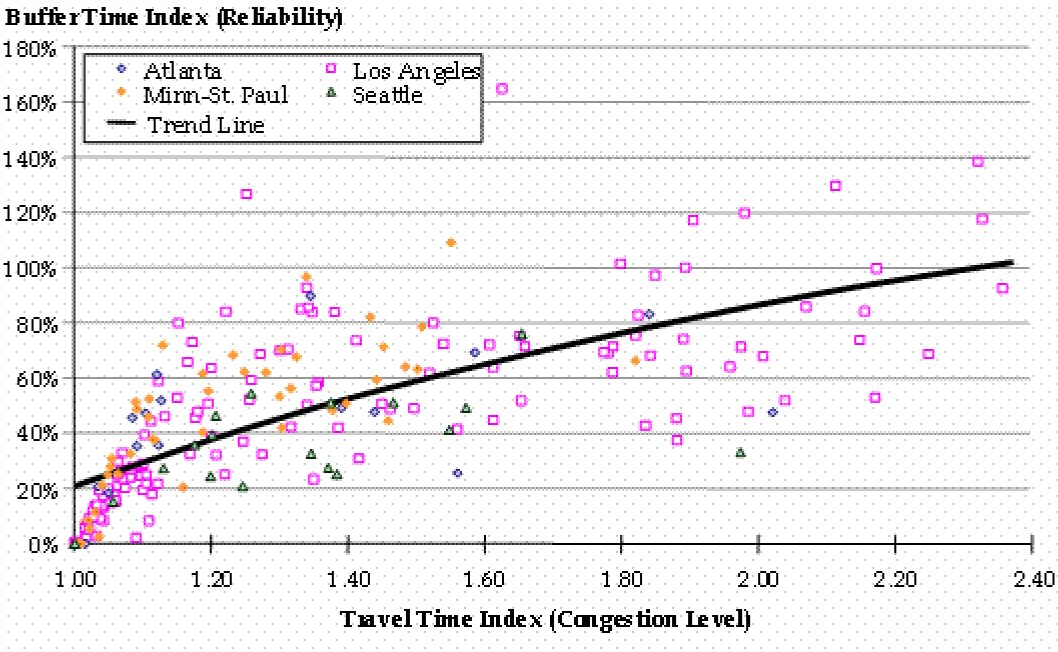
[2] Travel time index is the ratio of congested travel time to free flow travel time.

[3] The buffer index expresses the amount of extra "buffer" time neededto be on-time 95 percent of the trips (for example, late for work on one day per month). It is the difference between the travel time index and the planning time index, expressed as a percentage. The planning time index is the 95th percentile travel time index. More information on reliability measures can be found in *Monitoring Urban Roadways in 2002: Examining Reliability and Mobility Issues with Archived Data,* by Texas Transportation Institute and Cambridge Systematics, Inc., February 2004.

However, as the chart below shows, the relationship is fairly linear, and not really independent of congestion levels.

As a result, we suggest that reliability measures not be used for this analysis.

Figure 1
Relationship between Congestion Level and Reliability[4]



Corridor Performance

While system performance measures are important, the value of impacts in a particular corridor are diluted by the vast amount of travel in the entire metropolitan area. Corridor measures can provide a more "real world" perspective to those reviewing the work. Looking at performance measures at the corridor level also allows us to see which components of a particular system might be operating more or less effectively than others.

The most effective way to look at corridor performance is to compare the travel time on the tolled lanes to the travel time on the non-tolled lanes during different times of day. For the AM peak period, PM peak period, and non-peak period, we will identify meaningful corridor segments and provide the following information:

[4] *Traffic Congestion and Reliability: Linking Solutions to Problems*, prepared for Federal Highway Administration prepared by Cambridge Systematics, Inc. with Texas Transportation Institute, July 19, 2004

- Length
- Travel time (minutes) and vehicle-hours:
    - No-build condition
        - Main lanes
    - Build condition
        - Toll lanes
        - Main lanes
- Travel time savings (minutes and percent):
    - No-build condition main lanes versus Build condition toll lanes
    - Build condition main lanes versus toll lanes

Operational Considerations

For the most part, any unusual operational considerations will be captured in the cost estimate. However, if there are any operational issues worth noting, they will be flagged in this portion of the evaluation. We will provide information on any issues concerning operations, such as:

- Toll collection and enforcement
- Ease or difficulty of access to and egress from the toll lanes and related traffic operations issues, including signage.
- Maintenance issues, such as changes that would be necessary as a result of snow removal, sign replacement, and potentially more frequent restriping

Some maintenance and operational issues will relate to the tolling concept in general, while others might be corridor-specific. The corridor evaluation will focus on the unique issues associated with a particular corridor. The more general issues will also be addressed, but will not be reiterated for each corridor.

Environmental Considerations

As with operational considerations, environmental issues will show up as costs (due to mitigation). This study does not have an identified environmental analysis component. As it develops design concepts, URS will flag any readily identifiable environmental issues, and report on that information. Issues that may emerge from this level of analysis include:

- Noise issues near residential neighborhoods
- Environmentally sensitive areas

Some environmental measures can be extracted from the travel demand model. We will be using techniques developed for IDAS (ITS Deployment Analysis Software) to develop values for:

- 2030 network fuel consumption
- 2030 network emissions of:
    - Hydrocarbon and reactive organic gases
    - Carbon monoxide
    - Carbon dioxide
    - Nitrogen oxides
    - PM10
    - Sulfur dioxide

Due to the complexity of the model runs (i.e., the need to extract data for different toll rates for different time periods based on the toll rates that meet the toll policy criteria), we propose to use the IDAS techniques only for the Round 2 of analysis.

3.0 Financial Performance

A crucial element of the evaluation will be the financial performance of particular systems. As with system effectiveness, we will consider systemwide as well as corridor measures.

A complete financial analysis of toll projects requires an understanding of costs and when these costs are incurred, as well as timing of revenue streams. There are numerous assumptions that go into developing a finance plan for major infrastructure projects, including:

- Sources of funds and type of financing
- Interest rates
- Coverage ratios, capitalized interest, reserve funds
- Construction period
- Growth in revenue over time

For this planning study, we will not have the answers to all of these questions, but we can make some reasonable assumptions. Also, for the first round of analysis, we will have no information on the timing of revenue flows, because the entire analysis will be done at 2030 traffic levels. Therefore, we propose two different approaches for the first and second rounds of analysis.

First Round

Since the intent of the first round of analysis is to compare one system to another, and identify portions of systems that are most effective, we propose using a few simple indicators of financial performance. The measures shown in normal typeface are building block, while those in **bold underline** are composite measures that can be meaningfully compared between systems or corridors

1. **Systemwide measures:**
    a. Annual 2030 system revenue
    b. Annual 2030 system operation and maintenance expense
    c. Annual 2030 system net revenue (a-b)
    d. System capital cost estimate
    e. **Ratio of system capital cost to 2030 system net revenue (d/c)**
2. **Corridor measures:**
    a. Annual 2030 corridor revenue
    b. Annual 2030 corridor operation and maintenance expense (pro-rated based on mileage, unless special conditions warrant otherwise)
    c. Annual 2030 corridor net revenue (a-b)
    d. Corridor capital cost estimate
    e. **Ratio of corridor capital cost to 2030 corridor net revenue (d/c)**

All dollar values will be expressed at 2004 levels, and two levels of revenue will be shown, according to different toll policies:

- Maximize revenue
- Maximize throughput

Second Round

In the second round of analysis, we will have both 2010 and 2030 analysis years, enabling us to consider cash flows. As noted above, the financial analysis will involve making assumptions about things that are quite uncertain, especially since the finances will depend heavily upon the individual proposals that developers might present to Mn/DOT.

In order to treat each concept equally, we will make the following common assumptions:

1. Construction begins 2006

2. Open to traffic 2008

These assumptions are being used to provide a common basis for comparison. Some corridors may take longer to develop as they may require an environmental assessment or even an environmental impact statement.

We will then work with Mn/DOT to develop a reasonable set of assumptions related to potential finance structures that would form the basis of reasonable comparison among the alternatives.

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