The Cost of Frugality

Oberstar Forum
David Levinson
October 8, 2007
Some Vignettes
August 1:
NSF Small Grant for Exploratory Research to study the traffic consequences of the collapse (Liu, Levinson, Harder)
Economic Effects

- We estimated the Twin Cities 7 county region daily vehicle hours of travel with and without the bridge under two assumptions.

- The first kept the trip table fixed. This means that people did not change the number of trips, or destinations, in response to the bridge failure. This should give an upper bound to the effects of the bridge failure.

- The second allowed trip destinations to vary (though keeping the number of trips fixed). This provides more of a lower bound of the effects. Clearly some people can switch destinations, or avoid trips altogether, if the cost of their previous destination are now too high. On the other hand, not everyone can do so. The exact number of people who change destinations is not something we can easily know.

- Note, these are direct model outputs, so while the precision is high, the accuracy is not nearly as high as implied by the precision.

- We monetize these numbers using OIM values of time from [http://www.oim.dot.state.mn.us/EASS/](http://www.oim.dot.state.mn.us/EASS/)

- Auto $12.63/hour Truck $20.41

- and we assume 80% auto 20% truck giving a composite value of time of $14.19

- I believe the OIM Value of Time for Trucks is very low, our estimates put the number at closer to $50 per hour. If we used that, we would get a composite value of time of $20.14.

### VHT

<table>
<thead>
<tr>
<th></th>
<th>Fixed Trip Table</th>
<th>Variable Trip Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>with</td>
<td>1,122,342</td>
<td></td>
</tr>
<tr>
<td>without</td>
<td>1,134,355</td>
<td>1,131,322</td>
</tr>
<tr>
<td>loss</td>
<td>12,013</td>
<td>8,980</td>
</tr>
<tr>
<td>Value /day</td>
<td>$170,425</td>
<td>$127,390</td>
</tr>
</tbody>
</table>
These are of course estimates.
However, the number is large and positive, which we expect.
And lead us to conclude that letting bridges fall down is bad public policy.
Which most of us already knew.

The number does have uses aside from beating people over the head, it tells us how much we should reward contractors for early completion, e.g.
The problem is ...
Those who benefit from the bridge (or lose from the absence of the bridge)
differ from those who pay for it, and are responsible for maintaining it.
If presented with the choice of paying and keeping the bridge up and not paying and letting it fall, ...
most users would have gladly paid more than was required to keep the bridge up.
Some will say it isn’t about money.
Throwing money at the bridge wouldn’t have kept it from falling.
Money is always a constraint on decision-making at MnDOT.

Phone call put brakes on bridge repair

Plans to reinforce the bridge were well underway when the project came to a screeching halt in January amid concerns about safety and cost.

By Tony Kennedy and Paul McEnroe, Star Tribune staff writers
Last update: August 18, 2007 – 4:36 PM

WEDNESDAY, MAY 16, 2007

STAR TRIBUNE: Pawlenty vetoes gas tax, income tax bills

By Patricia Lopez, Star Tribune

Gov. Tim Pawlenty struck swiftly and with strong language Tuesday to veto a gasoline tax increase and an income-tax-for-property-tax swap that were at the heart of the DFL's agenda for the session.

DFLers accused him of protecting the state's richest 1 percent -- those who would have borne most of the income tax increase, which would pay for the proposed property tax relief -- at the expense of everyone else. But they conceded that some of their top objectives are fast sliding out of reach.

http://timpawlenty.blogspot.com/
PREPARED BY PAWLENTY FOR GOVERNOR -
PO BOX 21887 - EAGAN, MN 55121
More money could have bought:

more inspections,
better, faster repairs,
the ability to replace the bridge sooner.
Money could have been spent more wisely

Insert Pork Barrel Project of your Choice here.

Insert Pork Barrel Project of your Choice here.
It could have bought urgency
Some say the phrase “structurally deficient” raises needless alarm.
Apparently not enough, the I-35W bridge did fall down.
We are not good at dealing with low probability, high consequence decisions. We are not good at assessing the value of either.
Notable bridge failures on Interstate Highways, ... not so rare

<table>
<thead>
<tr>
<th>Location</th>
<th>Date</th>
<th>Facility</th>
<th>Proximate cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tampa Bay, FL</td>
<td>May 9, 1980</td>
<td>I-275</td>
<td>ship collision</td>
</tr>
<tr>
<td>Greenwich, CT</td>
<td>June 28, 1983</td>
<td>I-95</td>
<td>metal corrosion, fatigue</td>
</tr>
<tr>
<td>Oakland, CA</td>
<td>October 17, 1989</td>
<td>Bay Bridge</td>
<td>earthquake</td>
</tr>
<tr>
<td>Oakland, CA</td>
<td>October 17, 1989</td>
<td>I-880</td>
<td>earthquake</td>
</tr>
<tr>
<td>Milwaukee, WI</td>
<td>December 13, 2000</td>
<td>I-794</td>
<td>weather, traffic?</td>
</tr>
<tr>
<td>Webbers Falls, OK</td>
<td>May 26, 2002</td>
<td>I-40</td>
<td>barge collision</td>
</tr>
<tr>
<td>Bridgeport, CT</td>
<td>March 2003</td>
<td>I-95</td>
<td>car-truck fire</td>
</tr>
<tr>
<td>Oakland, CA</td>
<td>April 29, 2007</td>
<td>MacArthur Maze</td>
<td>truck explosion</td>
</tr>
<tr>
<td>Minneapolis, MN</td>
<td>August 1, 2007</td>
<td>I-35W</td>
<td>?</td>
</tr>
</tbody>
</table>
The Interstate is Mature

Cumulative Length (%) out of 42,795 miles (68,912 km)

Half the system is from 1965 or before
Strategies for maturity:

Replacement

Maintenance & Rehabilitation

Cash cow, using resources for the next big thing

Abandonment
Rushing the replacement

Now of course, the replacement bridge is being hurried.

This is good, a lack of a bridge costs money.

This is bad, lots of ideas are being missed.
No Snow Removal, No De-icing

Air Rights: Real Estate
Infrastructure should be fully exploited to its capacity, not beyond.

But this sign is not terribly reassuring.
Spring Load Restrictions
Cost/Benefit Study of Spring Load Restrictions
(Levinson, Marasteanu, Voller et al.)
The strength of asphalt roads varies seasonally.

During the winter, the layers of materials that make up the pavement structure harden when the temperature drops below the freezing point.

When spring arrives, the frozen aggregate base and then the soil under the aggregate base, thaw, and are in a saturated condition.

Under this condition, the pavement weakens and the bearing capacity of the roadway reduces.

Heavy vehicles driving on the roadway under these conditions damage the roadway more than most other times of the year.
To solve this problem, perhaps the most obvious technical solution is to improve the carrying capacity of all roads so that they can bear heavy loads (e.g. 10 tons/axle) even during the spring-thaw period.

But this is expensive for the responsible agency.

The spring load restriction policy was enacted in Minnesota in 1937 (Minnesota Statute 169.87)

The SLR policy regulates the axle load of trucks during the spring thaw. These restrictions impose costs on commercial vehicle operators while benefiting society by extending pavement life.
Flowchart of SLR Benefit/Cost Analysis

**Freight Demand Model**

- **SLR Survey**
  - Trip Generation Model
  - Value of Time for Trucker
  - Reasonable Assumptions
  - Truck Operation Cost

- **GIS Map**
  - Arc/Info, Matlab
  - Mn/DOT Freight Facility Database
  - Location
  - Number of Employees

- **Trip Generation**
- **Trip Distribution**
- **Mode Choice**
- **Trip Assignment**
  - Truck Volume on Each Link
  - Vehicle Kilometers of Travel (VKT)
    - (No SLR/With SLR Scenarios)
  - Costs to Trucker from Increased VKT
  - Benefit/Cost Analysis of SLR

- **Pavement Performance Model**
  - Pavement Material
  - Temperature
  - Thickness of Layer
  - Moisture, etc
  - Pavement Life Estimation
    - (No SLR/With SLR Scenarios)
  - Pavement Life Extension Benefit

- **Other Benefits and Costs**

- **Optimum Policy Selection**
8 kinds freight facilities are located in Lyon County using Mn/DOT freight facility database:

Farm
Agriculture Chemical Center
Grain Elevator
Manufacturing Plant
Retail Outlet
Trucking Facility
Wholesale Distribution Center
Other Freight Facilities

Road network of Lyon County in EMME/2
From the truck operator’s point of view, the SLR policy is detrimental to business.

Once the load limits are in place, (assuming they comply) most of the trucks must reroute and/or use more trucks or make more trips.

Producers and retailers are also affected by the SLR policy because they might be forced to store commodities for a longer time.

Other vehicles face the increasing number of trucks on the road network.
Cash flow diagrams

Pavement life extension = NPC2 - NPC1
<table>
<thead>
<tr>
<th>Link 1</th>
<th>From node id</th>
<th>To node id</th>
<th>Length (km)</th>
<th>Cost per km ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.584</td>
<td>$42,112</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No SLR scenario</th>
<th>With SLR Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated life (year)</td>
<td>14.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Overlay</th>
<th>Year</th>
<th>Cost ($)</th>
<th>NPC ($)</th>
<th>Year</th>
<th>Cost ($)</th>
<th>NPC ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; overlay</td>
<td>7.1</td>
<td>66,706</td>
<td>52,248</td>
<td>7.3</td>
<td>66,706</td>
<td>51,962</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt; overlay</td>
<td>21.3</td>
<td>66,706</td>
<td>32,053</td>
<td>21.8</td>
<td>66,706</td>
<td>31,530</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt; overlay</td>
<td>35.5</td>
<td>32,839</td>
<td>9,680</td>
<td>36.3</td>
<td>28,455</td>
<td>8,161</td>
</tr>
</tbody>
</table>

| Sum of NPC Savings due to SLR | 93,981 | | |

\[
\text{NPC2-NPC1} = 93,981 - 91,652 = 2,329
\]
The cost to the truckers due to SLR is calculated as the increased VKT multiplied by total truck operating cost per kilometer.

SLR caused additional 30,628 km of truck VKT per day.

Our survey shows the total truck operating cost is $0.69 per km

The total cost to all freight shippers and carriers is $21,133 per day.

Assuming 8 weeks enforcement of SLR, the total annual cost is $1,183,447.

The net present value of the cost to truckers in the following 42.5 years adds up to $25,977,572, assuming a 3.5% discount rate.
<table>
<thead>
<tr>
<th>Assumption (default life of road)</th>
<th>Cost (Increased pavement cost incurred by road agency) ($)</th>
<th>Benefit (Reduced cost to trucker) ($)</th>
<th>Benefit/Cost Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>278,446</td>
<td>6,057,602</td>
<td>21.76</td>
</tr>
<tr>
<td>17</td>
<td>438,642</td>
<td>6,057,602</td>
<td>13.81</td>
</tr>
<tr>
<td>20</td>
<td>500,782</td>
<td>6,057,602</td>
<td>12.10</td>
</tr>
<tr>
<td>25</td>
<td>644,082</td>
<td>6,057,602</td>
<td>9.41</td>
</tr>
<tr>
<td>30</td>
<td>763,415</td>
<td>6,057,602</td>
<td>7.93</td>
</tr>
</tbody>
</table>
According to the analysis, the benefit/cost ratio of lifting SLR on 9-ton roads in Lyon County is 13.81 in our base case, which supports lifting the SLR on those roads.

The above result is based on our assumption of 100% compliance with SLR, which of course differs from reality.

However a reduction in compliance reduces both benefits (if roads are already “overloaded”, the SLR has less effect than shown here) and costs (if trucks are violating the SLR, they don’t save time by the elimination of SLR).

The cost of lifting SLR (increased pavement overlay cost) is borne by the road agencies.

The benefit of lifting SLR is apportioned among thousands of road users (trucking industry).

The interests from both parties make this issue a political one.

If the trucking industry were to benefit from lifting SLR more than the costs imposed on road agencies, there are “gains from trade” to be had.

A tax, toll, or user fee on trucks to pay for the additional road damage that would be caused without SLR is a win-win solution compared to the current situation with SLR.
There should be more money for transportation.
If there isn’t … we should spend our money more carefully, taking care of the existing systems and users first.
As your mom might have said ... If you can’t take care of your toys, and play nicely, they will be taken away.
If by couetousnesse or negligence, one withdraw from them their ordinary foode, he shall be *penny wise*, and *pound foolish*.

[1607 E. Topsell Four-footed Beasts 609]
The sad thing is, there will probably be a ribbon cutting for the I-35W replacement bridge.
Bridge Failure

Pavement Failure

“Failing” Traffic Conditions

All bad, all different, some more serious than others.
Thank you

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- transportationist.org