Improving reliability on surface transport networks

Results from International Transport Forum study

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Presentation outline

• The study
• Reliability trends
• Measuring reliability
• What level of reliability?
• Reliability policy instruments
• Policy conclusions
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- The study
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Under the Joint Transport Research Centre of the OECD and the ITF

Contributions by a group of international experts from:
Australia, Austria, Canada, Denmark, Finland, France, Greece, Japan, Spain, Ukraine, United Kingdom, United States and The Netherlands

In cooperation with SHRP 2 Reliability program
The report

- Report reviews reliability policy and strategies across OECD/ITF countries
- Focus on interurban road and rail transport
- Emphasis on both person and goods movement
- Argues for giving more attention to reliability in policy making and project evaluation
- Published in 2010
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Reliability trends

“The central question of the report is whether appropriate levels of reliability are sought and supplied”
Demand for reliability has increased

- The decline in transport costs (following improvements in transport infrastructure, vehicles and equipment) has facilitated and complemented product specialisation (with outsourcing, regional warehouses and just-in-time systems).
- Increased importance of scheduling in freight and personal activities has grown.
  Women value reliability more than twice as highly as men (Brownstone & Small).
- These developments were possible as a result of affordable and reliable transport costs...
  ... but this has also created a dependence.
Reliability trends

Circularity of the demand for reliability

- High supply of reliability
- High demand for reliability
- High reliability expected
- High costs of unreliability

Increasingly complex scheduling, made possible through improved reliability, creates an ongoing need for reliability...... and “reliable fast” not “reliable slow”!
Reliability trends

What Counts

• Reliability will get more important
• But one size doesn’t fit all
• Heterogeneity “granularity” is critical
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Policymakers think about traffic conditions in terms of averages—but this is not how users remember it!

Figure ES1. Travellers’ perception of traffic conditions

How traffic conditions have been communicated to users

How users experience traffic…

... and what they remember
Previous policy focus on reducing average time

Distribution (not average) of travel times is the key—and provides a far better policy focus.
Definition of reliability

- The ability of the transport system to provide the expected level of service quality, on which users have organized their activities.
- In essence, a *reliable* network has consistent performance.
- Network users are more bothered by reliability, the more uncertain the travel time.
- Implications:
  - Reliability can be improved both from supply and demand side
  - Reliability can be improved through changing actual travel time or expectation of that travel time
Wide range of indicators exist ..... ...... but not clear which one to use!

Measuring reliability

Network vulnerability
Planning time
Buffer time indices
Network spare capacity
Coefficient of variation
Standard deviation
Probabilistic indicators
Skewness and width indicators
Delay time
Tardy trip
Punctuality
City evacuation capacity
95th percentile
Measuring reliability

It is important to monitor reliability (for providers and users)

Monitoring reliability

Network provider/operator perspective

- Network robustness
  - Link performance under changing conditions
    - Vulnerability index
  - Network performance under changing conditions

Network performance

- Punctuality of arrivals
  - Average delay

User perspective

- Travel time reliability
  - Travel time distribution
    - Focus on eliminating variability
      - Standard deviation
  - Focus on eliminating extreme values
    - Buffer time
    - 95th percentile
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Why is working out “optimal” reliability a problem?

Market mechanisms with standard products/services...

- consumers want different product quality
- reflecting that, suppliers offer quality differentiation
- …and this may lead to…
- price differentiation

Applying this to “reliability”…

- demand for reliability is “granular” so product differentiation could be efficient
- users would trade-off between reliability and price
Why is working out “optimal” reliability a problem?

Product/price differentiation:
• Possible for rail network
• Some opportunities exist for road (eg toll roads and HOT-lanes)

...but policy is challenged when product (reliability) differentiation is not technically or economically feasible
Why is working out “optimal” reliability a problem?

Asking users whether reliability matters does not really help in working out how much reliability to supply! Users will prefer high levels of reliability particularly if they do not have to incur the cost.

"Reliable freight service is critical"

Source: City of Chicago Department of Transportation (2003).
So... what is the ‘right’ level of reliability?

Determining this can be difficult because

- if costless to users, then a high level will be demanded by all
- if provided at a higher cost than is valued by users, then community welfare declines.

The policy challenge is to identify those options that increase reliability in a cost effective way

…which reinforces the importance of cost–benefit analysis
Cost-benefit analysis: ……what is required?

- Data representing existing average travel time + travel time variability
  - Indicator definitions, monitoring systems
- Data representing anticipated average travel time + travel time variability
  - Models that deliver travel time variability indicators
- Monetary values of travel time and travel time variability
  - VOR, disaggregated at the appropriate level of granularity
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Four government policy instruments influence reliability... ALL the policies should be considered—and be subject to cost–benefit analysis.
1. Build

The level and quality of infrastructure are reliability parameters... and allowing for reliability can alter what and how we build

Table 4.1. Economic evaluation of long life pavements: one km of 3-lane motorway surfacing (present value $000s)

<table>
<thead>
<tr>
<th>Contributing factors</th>
<th>Traditional surface</th>
<th>Advanced (low maintenance) surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial works costs</td>
<td>480</td>
<td>1440</td>
</tr>
<tr>
<td>Maintenance works</td>
<td>1080</td>
<td>280</td>
</tr>
<tr>
<td>User costs (delays)</td>
<td>1280</td>
<td>520</td>
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<tr>
<td>Traffic management costs</td>
<td>260</td>
<td>170</td>
</tr>
<tr>
<td>Residual value</td>
<td>-40</td>
<td>-90</td>
</tr>
<tr>
<td>Net Present Value</td>
<td>3060</td>
<td>2320</td>
</tr>
<tr>
<td>Difference in NPV of costs</td>
<td></td>
<td>-740</td>
</tr>
</tbody>
</table>

2. Manage

...for example, through coordination of activities
3. Price

Where it is practical to apply, prices can be crucial in delivering an efficient level and usage of reliability

- infrastructure managers inform users what it costs to deliver a given reliability
- users communicate how they value reliability and structure their network use accordingly
### Seattle Area Travel Times

Travel times as of 7:55 P.M. Thursday, July 1, 2010

<table>
<thead>
<tr>
<th>Route Description</th>
<th>Distance (miles)</th>
<th>Average Travel Time (minutes)</th>
<th>Current Travel Time (minutes)</th>
<th>Via HOV (min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auburn to Renton</td>
<td>9.8</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Bellevue to Bothell</td>
<td>9.7</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Bellevue to Everett</td>
<td>26.1</td>
<td>27</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>Bellevue to Federal Way</td>
<td>24.6</td>
<td>26</td>
<td>26</td>
<td>25</td>
</tr>
<tr>
<td>Bellevue to Issaquah</td>
<td>9.6</td>
<td>9</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Bellevue to Lynnwood</td>
<td>14.9</td>
<td>15</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>Bellevue to Redmond</td>
<td>6.0</td>
<td>8</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Bellevue to Renton</td>
<td>11.2</td>
<td>11</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>Bellevue to Seattle</td>
<td>10.6</td>
<td>11</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>
2. Use price to provide choice, such as tolled roads

3. Use information to mitigate the effects of unreliability
Reliability policy instruments

Examples of how governments are responding

Including vulnerability indicators in network planning methodology

Robustness Scanner (NL)
Reliability policy instruments

Examples of how governments are responding

Including reliability indicators in impact assessment studies

Impact of ramp metering on travel time and buffer time (F)

Source: Bhouri & Kauppila 2010
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Policy conclusions

- Reliability needs the policy attention such as is traditionally given to congestion.

- Monitoring and policy target setting are important starting points.

- The key reliability policies are:
  - monitor reliability
  - recognise the policy instruments of build, manage, price and inform
  - assess those policy instruments by cost-benefit analysis
Thank you