Valuing freight transport time and reliability user benefits

Murray King and Ian Wallis
Murray King & Francis Small Consultancy; Ian Wallis Associates
The issue

- EEM currently (largely) omits the potential benefits to NZ freight shippers from road system initiatives
  - *Not even-handed between freight and person transport in methods for estimating economic benefits to transport users –items in red missing, in italics unreliable*

<table>
<thead>
<tr>
<th>EEM economic cost and benefit components: freight vs PT</th>
<th>Public transport</th>
<th>Freight transport</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transport operator costs (VoC)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time-related (crew hours)</td>
<td>Time-related (crew hours)</td>
<td></td>
</tr>
<tr>
<td>Distance-related (fuel, veh mtce etc)</td>
<td>Distance-related (fuel, veh mtce etc)</td>
<td></td>
</tr>
<tr>
<td>Vehicle capital &amp; overheads</td>
<td>Vehicle capital &amp; overheads</td>
<td></td>
</tr>
<tr>
<td><strong>Transport user benefits (travel time/ quality):</strong></td>
<td>PT passengers</td>
<td>Freight/cargo owners</td>
</tr>
<tr>
<td>In-vehicle time</td>
<td><em>Stock-holding costs - opportunity costs of goods in transit</em></td>
<td></td>
</tr>
<tr>
<td>Waiting time (service frequency)</td>
<td><em>Time value of early / late receipt of goods</em></td>
<td></td>
</tr>
<tr>
<td>Access/egress time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfer time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel time reliability</td>
<td><em>Travel time reliability</em></td>
<td></td>
</tr>
<tr>
<td>Station/stop quality aspects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle quality &amp; comfort aspects</td>
<td><em>Cargo damage / deterioration</em></td>
<td></td>
</tr>
</tbody>
</table>
Project sponsor and scope

• Part of NZTA research programme
• Researchers: Ian Wallis & Murray King (with Canterbury University)
• Covers freight markets
  • Within NZ (not international legs)
  • Road/rail only, not coastal shipping
  • Heavy freight movements only, not LCL or LCV
• Focus on valuation of benefits from shipper perspectives
  • Not concerned with transport operator costs (VOC)
  • Modally neutral between road and rail – not attempting to model mode choice aspects (though may gain useful insights)
Previous New Zealand research

- Very limited – only one significant study
- Coverage largely of manufactured goods segment, for domestic markets
- Primary focus on developing a freight mode choice model (road/rail/coastal)
- Used a combination of SP and RP methods, incl extensive market research – freight shippers, agents, transport decision-makers
- Discrete choice modelling to derive shipper valuations of travel time, reliability, and other factors
  - Expressed mode choice as a function of these factors and other company, commodity characteristics
Commodity groupings

- NZ domestic freight market very diverse – a challenge for market research
- Important to segment the market in terms of likely relative valuations of transport attributes, to derive mean values by segment
- Could then use these, with NFDS information, to derive weighted average values on national basis, or for specific road types, regions, etc
- 5 commodity groups (road & rail), consistent with NFDS
  - Retail, manufacturing, general freight
  - Perishable exports
  - Other containerised exports and their precursors
  - Bulk exports
  - Other domestic freight
NZ Land Freight Transport Task
Nett Tonne Km by Mode and Commodity Group (Source NFDS 2014)

1: Retail, manufacturing, general
2: Perishable exports
3: Other containerised exports
4: Bulk exports
5: Other domestic

Road
- Retail, manufacturing, general: 53%
- Perishable exports: 13%
- Other containerised exports: 13%
- Bulk exports: 33%
- Other domestic: 1%

Rail
- Retail, manufacturing, general: 6%
- Perishable exports: 27%
- Other containerised exports: 8%
- Bulk exports: 8%
- Other domestic: 2%
NZ market survey

• Key part of project, to obtain shippers views and valuations on key attributes influencing their transport decisions
• Contingent valuation approach to determine willingness-to-pay for improved travel time, reliability etc for their major movements, categorised by segment, commodity, and length of haul
• Key questions (eg):
  • What is the maximum extra price (%) you would be **willing to pay** for a journey time 10%/25%/50% shorter than currently expected?
  • What is the minimum price discount (%) that you would be **willing to accept** for a journey time 10%/25%/50% longer than currently expected?
• Effectively a large pilot survey: aim to get c50 completed responses, each covering up to 4 commodity/distance combinations. About 10 completed so far
• Relatively long email questionnaire, phone-assisted completion, about 45 mins
International evidence review - scope

• Reviewing c. 160 papers etc for freight VOT and VOR
  • Plus lesser coverage of service frequency and loss/damage
• Evidence from shipper perspective
  • Current EEM focuses on carrier perspective – out of scope
  • Largely using SP methods to elicit WTP for improvements (or WTA for deteriorations) in transit time, reliability
• Desired outputs (by eg commodity/mode/containers/own account/third party)
  • VoT= $/tonne/hour reduction in average expected transit time
  • VoR= $/tonne/hour reduction in SD of transit time
  • RR (Reliability Ratio)= VoR/VoT
    • Reflects relative sensitivity (WTP) for reliability improvements vs expected time savings
• Very diverse, wide range of survey methodologies and presentation bases
Key international findings -- time values

• Scale of values: freight time values typically in the order of 20% of total transport costs
  • Often difficult to separate out

• Mode: typical order of VoT/tonne by mode
  • Air > truck > train > sea/canal
  • Higher value goods have higher VoT, use faster modes

• Commodities: for our 5 groups, indicative ranking of VoT/tonne is
  • Retail/general freight > perishable exports > containerised exports > bulk export > other domestic
  • Evidence from market survey so far is that time gains often not much valued – already have satisfactory journey time

• WTP vs WTA: not symmetric – tendency for WTA values to be higher than WTP (“loss aversion”) – implications for economic evaluation?
Key international findings -- reliability values

- Market research (SP) outputs
  - Different reliability definitions and measures eg % probability of ‘reliable’ delivery, % of trips >x mins late, 95\textsuperscript{th} %ile – mean (% or hrs), SD of arrival time
- Higher value goods have higher VoR/tonne (as for time)
- Reliability ratios (RR = VoR/VoT)
  - Measures relative importance of arriving on time (every time) vs minimising expected time
  - No clear variation of RR with value of goods
  - EEM uses RR=1.2 for freight, 0.9 for other traffic, to evaluate reliability benefits
- Very wide range of values -- typical range 0.2-2.0 or more
  - Wide range may well reflect different research methods as much as ‘real’ differences
  - Further research certainly needed here
Value of Time (VoT), Reliability (VoR), and Reliability Ratio (RR)
- by Commodity Group – Shipper Perspective (illustrative only)

VoR ($/tonne per 1 hr change in SD TT)

VoT ($/tonne per 1 hr change in mean TT)

Gp1
Gp2
Gp3
Gp4
Gp5

RR = 1.0
RR = 0.8
## International freight evaluation practices

<table>
<thead>
<tr>
<th>Country</th>
<th>Inclusion of freight cargo time costs</th>
<th>Inclusion of freight reliability benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Zealand</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>(but obscure and outdated!)</td>
<td></td>
</tr>
<tr>
<td>Australia (Federal)</td>
<td>Yes</td>
<td>Partial - not valued; need for further research</td>
</tr>
<tr>
<td></td>
<td>(but based on few commodities)</td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>Yes</td>
<td>Yes - world leading research (2011/12)</td>
</tr>
<tr>
<td>Sweden</td>
<td>Yes</td>
<td>Yes - not specific to freight</td>
</tr>
<tr>
<td>Germany</td>
<td>No</td>
<td>??</td>
</tr>
<tr>
<td>England</td>
<td>No</td>
<td>Partial - included in AST, but not in BCR</td>
</tr>
<tr>
<td>USA (Federal)</td>
<td>No</td>
<td>No - further research in progress</td>
</tr>
</tbody>
</table>
Closing thoughts

• Key output – new EEM values for freight time and reliability from shipper (user) perspective – enable better estimates of benefits for transport projects

• May be possible to develop typical values by commodity group

• Further work could involve developing values by region or roading type – but likely to need more extensive market research
Questions?

Source: ARTA