Urban Freight Networks and Fleet Optimization

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IIT Bombay 10th April 2014
Common Network Structures by commodities
Commodity Types & Vehicles
Performance Based Standards (PBS) Vehicles
  PBS in Australia
  Simulating Benefits
High Performance Freight Vehicles (HPFVs)
  Dimensions and Configurations
  Benefits study
First & Last Mile Access
References
Common Urban Freight Network Structures
More Common Urban Freight Network Structures
Commodity Types that influence Vehicle design

- DG Tanker, Other Tanker
- Waste
- Containers
- Agricultural other
- Taxi Trucks
- Livestock
- Reefer
- Security
- Glass
- Horse carriers
- Concrete
- Mini Skips
- Earth moving construction
- Over dimensional
- Car Carrier
- Volumetric Parcels
- Grain
- Steel
- Logging
- Furniture
- Mining
A). With Adjacent CBD Inner Depot

B). With Outer Suburban Depot

**Effects of Logistics Sprawl**
Determining

Vehicle fleet (truck size mix)
Freight network structure
Blend of internal & outsource transport contracts
Common Questions

1. What is the best fleet mix if get a new contract with 20%+ more work than now?

2. What’s the impact of a larger vehicle that has good access potential?
Considerations

- Number of Depots
- Depot connections
- Customer Connections
- Vehicle access to Customers
- Types of Vehicles and Frequencies
- Growth potential etc…
PBS Impact on Bi Polar Urban Network:

Load Productivity 43%

Interchange

Load Productivity “Milk Runs” = +2 nodes per duty = 28%
• 8% less km per introduced vehicle per working shift
• When an “appropriate number” are seeded into a large urban environment the outcomes are:
  37% increase in productivity
  19% less rigid truck kms
  20% less rigid trucks
  9% cost saving per urban Km
Network Evolution Case Study

Network 1  1998  36 Links

CBD
Network 2  2003  Links 16
Restructuring Network Issues

- Can perceived critical time windows be relaxed?
- Can individual link runs be replaced by sweep or milk runs?
- Can the network be collapsed, or
- Is the fleet mix right?
PBS in Australia

- PBS developed to improve productivity, efficiency & safety
- Innovative vehicle designs promoted
- Criteria developed for safety & infrastructure protection
- Current assessment framework
  - National vehicle assessment & permits
What a vehicle should do...

Instead of what it should be like
• Ancillary and Hire & Reward operators considered
• Vehicles classified into 31 categories
• 10 vehicle classes forecasted to have significant PBS take up
Evaluation Methodology

- Vehicle operating cost savings
- Safety
- Environmental Benefits
- Costs
  - Compliance
  - Administrative
  - Infrastructure
- Flow on Benefits
• Vehicle usage depends on commodity carried & type of freight network
• 16 case studies simulations to estimate distance & vehicle reductions
• Growth rates by vehicle class for ancillary and hire and reward sector produced
Super B Double 30m

2 x 40’ or 4 x 20’ containers
Urban Port Scenario Simulation
Single Articulated Vehicles
Urban Port Scenario Simulation
Super B-Double Vehicles
### Simulation Results

#### To Port Super B-double vs Single Articulated Truck

<table>
<thead>
<tr>
<th></th>
<th>Single</th>
<th>Super B-double</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directional Trips</td>
<td>24</td>
<td>12</td>
<td>-50.0%</td>
</tr>
<tr>
<td>Kilometers</td>
<td>708</td>
<td>530.4</td>
<td>-25.1%</td>
</tr>
<tr>
<td>Vehicles</td>
<td>4</td>
<td>3</td>
<td>-25.0%</td>
</tr>
<tr>
<td>On duty hours</td>
<td>26.5</td>
<td>22</td>
<td>-17.0%</td>
</tr>
<tr>
<td>Ave kms per trip duty</td>
<td>29.5</td>
<td>44.2</td>
<td>49.8%</td>
</tr>
</tbody>
</table>

#### Other Data

- Container Mix: 60% TEU, 40% FEU
- Customers: 17
- Time window: 8 hour total shift operation
Distance Formula

New KMS = A \times \text{Change in Truck Capacity} + B \times \text{Change in Truck Numbers} + \text{Constant}

= -10\% \times (\text{Change in Vehicle Capacity}) + 75\% \times (\text{New Truck Number estimates post PBS}) + 25\% \times \text{Constant}

Example

Mini Skips = -10\% \times 1.000 + 75\% \times 0.62 + 0.25

= -0.1 + 0.465 + 0.25 = 0.615 \text{ (estimate)}

Actual = 0.559 or 56\% \text{ of pre PBS Network Km}

Savings = 1 - (NKms + \Delta \text{ (Capacity)} + \kappa)
New Kilometre Factors with PBS Takeup

Concrete
Forestry
DC-DC
City 2030
Steel Urban
Port to/from
Skips
Linehaul
Waste
Port Intra
Mineral Sands
Courier
Furniture
Tanker
Shuttle Parcel

Post PBS Kilometre Factor

Operation
• Vehicle usage depends on commodity carried & type of freight network
• 16 case studies simulations to estimate distance & vehicle reductions
• Growth rates by vehicle class for ancillary and hire & reward sector produced
## Average PBS Savings (%)

<table>
<thead>
<tr>
<th>Category</th>
<th>Reduction in Kilometres</th>
<th>Reduction in Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linehaul/Regional</td>
<td>25.2</td>
<td>28.3</td>
</tr>
<tr>
<td>Urban</td>
<td>19.1</td>
<td>21.0</td>
</tr>
</tbody>
</table>
Semi Trailer: Length 19m, Width 2.5m Height max 4.3m
Weight 42.5 tonnes GVM (45.5 Tonnes with MMA)

B-Double: 9 axle configuration
Length 25m, Width 2.5m Height max 4.3m
Weight 62.5 tonnes GVM (68 Tonnes with mass management accreditation)
B-Double Experience

• Have access to 99% arterial road network
• Productivity benefits for freight operators & their customers
• Reduced total number of freight trips
• Are safer: moving 45% freight task in loaded tkm, 23.6% large truck crashes
3000 PBS Vehicles (at 2014)

Forecast > 11,000 by 2030

Majority of these 3000 PBS Vehicles are:

- Operating on Regional Linehaul
- Outer Areas of Major Cities to Regional Cities
Access for HPFVs carrying cubic (lightweight) freight up to 68.5 tonnes on high quality duplicated roads

- These HPFV are no heavier than a standard B-double
WHAT ARE HPFVs?

26 metre combination

30 metre combination

36.5 metre combination

68.5 TONNES
HPFVs

- Offers significant potential to further lower costs, improve safety & protect environment by reducing number of truck movements
- Use concentrated on key strategic segments of road network on freeways & major highways
- No increase in truck mass required for ‘cubic HPFVs’ does not require costly upgrades to road pavements & bridges
Dimensions of HPFVs

*B Triples*: Approx. 33m long, 63t to 90t
Axle configuration dependent

*Super B-Doubles*: Approx. 30m long; 62.5t to 68t
Quad axles will be also used
Truck and 4 Axle Dog HPV – Soil, quarry, construction materials
Super B-Double – Quad / Quad Configuration – Port to container parks or large customers
A Double Bulk Grain HML/HPV – Regional to Urban Container Port
A Double container HML/PBS
A Double Bulk Grain HML / PBS – Regional to Urban container port
A Double container HML/HPV
A Double container HML/PBS
B Triple HML/HPV – outer Urban to Regional Centres
Container B-Triple – Container Port to large customers on high capacity roads
Usage of HPFVs

• Primary produce, intermodal containers & for transport of parts & components between major manufacturing establishments

• Suited to certain commodities & uses, on specific routes
  – Lighter commodities: eg. paper products & empty shipping containers
  – fill currently permitted trucks before they reach the current truck mass limit
Metro Routes

- For exclusive operation within metropolitan Melbourne HPFV limit of 30m length
For operations in regional Victoria, limit of 36.5 metres in length
MOVING MORE WITH LESS

• More efficient vehicles without infrastructure upgrades
• More flexibility for industry in HPFV configuration
• Recognition of country/city conditions
Direct Benefits

- Safety
- Productivity
- Environmental

Indirect Benefits

- Economic flow on
- Freight Exposure
- Pavement performance
Data Sources for the Study

Three *non public domain* data sources used for study:

- Insurance company accident data
- HPV fleet operators survey data
- Private vehicle operating cost data
Commodities Transported by HPV

- Parcels: 1%
- General Freight: 15%
- Bldg Material: 3%
- Containers: 36%
- Quarry Gravel/Sand/soil: 8%
- Iron Ore/Steel: 2%
- Forrestry/Wood/Poles: 5%
- Agriculture/Grain/Fertilizer: 13%
- Livestock: 1%
- Waste: 1%
- Tanker Non Dangerous: 2%
- Tanker Dangerous Goods': 6%
- Containers: 2%
- Other: 2%
<table>
<thead>
<tr>
<th>PBS Vehicle Type</th>
<th>KM Savings factors (previous saving estimates)</th>
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<tbody>
<tr>
<td>6AA (20m) Single</td>
<td>0.091</td>
</tr>
<tr>
<td>7AA Single</td>
<td>0.207</td>
</tr>
<tr>
<td>Ave 6/7AA</td>
<td>0.149</td>
</tr>
<tr>
<td>EBD</td>
<td>0.273</td>
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<tr>
<td>SBD</td>
<td>0.365</td>
</tr>
<tr>
<td>A-Double</td>
<td>0.315</td>
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<tr>
<td>B-Triple</td>
<td>0.325</td>
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<tr>
<td>Quad Trailer</td>
<td>0.405</td>
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<tr>
<td><strong>Average Articulated Savings</strong></td>
<td><strong>0.375</strong></td>
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<tr>
<td>HR3ATD</td>
<td>0.129</td>
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<tr>
<td>HR4ATD</td>
<td>0.221</td>
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<tr>
<td>HR5ATD</td>
<td>0.264</td>
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<tr>
<td>HR6ATD</td>
<td>0.300</td>
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<tr>
<td><strong>Average Rigid Savings</strong></td>
<td><strong>0.226</strong></td>
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## HPV Fleet Outlook to 2030

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Area of Operations</th>
<th>Growth Scenario</th>
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</thead>
<tbody>
<tr>
<td>HR3ATD</td>
<td>Urban</td>
<td>312</td>
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<tr>
<td>HR4ATD</td>
<td>Urban/Outer Urban</td>
<td>1802</td>
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<tr>
<td>HR5ATD</td>
<td>Urban/Regional</td>
<td>666</td>
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<tr>
<td>HR6ATD</td>
<td>Urban/Regional/IS</td>
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<tr>
<td>Enhanced BD</td>
<td>Regional/IS</td>
<td>242</td>
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<tr>
<td>6/7AA Urban/Regional</td>
<td>Urban/Regional /IS</td>
<td>2555</td>
</tr>
<tr>
<td>Quad Trailer</td>
<td>Regional</td>
<td>295</td>
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<tr>
<td>Super-BD</td>
<td>Urban/Regional</td>
<td>729</td>
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<tr>
<td>B-Triple</td>
<td>Outer Urban/Regional/IS</td>
<td>1282</td>
</tr>
<tr>
<td>A-Double</td>
<td>Outer Urban/Regional/IS</td>
<td>1345</td>
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<tr>
<td>Bus 1 &amp; 2</td>
<td>Urban/Regional</td>
<td>916</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>10536</strong></td>
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<tr>
<td><strong>Growth Rate p a</strong></td>
<td></td>
<td><strong>13.8%</strong></td>
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<tr>
<td>Benefit Segment</td>
<td>Nominal ($m)</td>
<td>Discounted ($m)</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>--------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Value of Fatality savings (95 lives)</td>
<td>218</td>
<td>156</td>
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<tr>
<td>Insurance savings</td>
<td>89</td>
<td>63</td>
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<tr>
<td>Value of CO2 savings</td>
<td>200</td>
<td>142</td>
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<tr>
<td>HPV Operating Savings</td>
<td>9,164</td>
<td>6,529</td>
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<tr>
<td>Total Direct Benefits</td>
<td>9,671</td>
<td>6,890</td>
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<tr>
<td>HPV Economic Flow-on benefits</td>
<td>7,678</td>
<td>5,692</td>
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<tr>
<td>Total</td>
<td>17,349</td>
<td>12,582</td>
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</table>
VicRoads has developed a three stage process for First and Last Mile assessments of these combinations:

- **Stage One** – Desktop Study
- **Stage Two** – A Swept Path overlay
- **Stage Three** – A physical trial of the combination
First & Last Mile Access – Stage 1

News

THANKS FOR YOUR FEEDBACK
A big thank you to all of our users who took the time to complete the questionnaire. Your feedback will be invaluable for planning the next stages of the PBSRAT.

PBS ROUTE ASSESSMENT TOOL

The PBS Route Assessment Tool is an expert system for use by Local Government according to Performance Based Standards (PBS) guidelines.

The PBS RAT tool has been designed to guide local government in the process, focused specifically upon the road infrastructure environment.

The tool allows users to enter data on a specific route and assess the safe and efficient operation of PBS heavy vehicles over that route.

By conducting the assessment in this manner, Local Government is able to effectively plan and maintain local road infrastructure.

This site is for the classification of roads, and not for the classification of streets.

It should be noted that access to the tool is not open to the public.

To request access to the site please use the form provided on the website.
First & Last Mile Access – Stage 2
First and Last Mile Access on Local Council roads require written permission from the Local Council.

Vic roads provides assistance if a Stage 3 physical trial is required on a Local Road.
References


NTC (2008). Performance Based Standards Scheme, The Standards and Vehicle Assessment Rules, as at 10 November 2008 (incorporating all amendments consented to by the ATC up to that date), National Transport Commission, Melbourne, 2008.


