Developing new techniques in road safety project analysis on the Bruce Highway

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‘Out of the crises’

• The Bruce Highway accounts for more than 17% of deaths on the entire national network.

• In 2012, the Queensland Government set out a challenge to address critically important problems highway.

• Focusing on its entire 1,685km length, the study investigated three priority areas.
  - Flooding
  - Capacity
  - Safety.
Bruce Highway Action Plan (BHAP)

Without the luxury of more detailed investigation and assistance from staff in Transport and Main Roads regions, and in a short space of time, a detailed investigation was required of all of these proposals:

- 16 flood immunity projects
- 56 capacity projects
- 189 overtaking lanes
- Over 400 km of road widening and shoulder seals.
Bruce Highway Action Plan (BHAP)

- Key part of plan involved assessing 189 overtaking lanes proposed along the entire length of the highway.
- Given a short deadline and the vast number of projects, a new technique was devised to respond to this very unique challenge and advise the minister on value for money implications.
What was proposed?

- Brisbane to Cairns – 189 single overtaking lanes
- 10 programs of work in total
- Capital costs of $4.1 million per overtaking lane project.

The distance between overtaking lanes was based on Annual Average Daily Traffic (AADT) per link:

<table>
<thead>
<tr>
<th>AADT</th>
<th>OT/L lane Vision</th>
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<tbody>
<tr>
<td>2000 - 4000</td>
<td>= 20kms</td>
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<td>4000 - 6000</td>
<td>= 10kms</td>
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<tr>
<td>6000 - 8000</td>
<td>= 5kms</td>
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<td>&gt;8000</td>
<td>= 5kms</td>
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</tbody>
</table>
A program approach

Maryborough - Gympie
Gin Gin - Maryborough
Rockhampton - Gin Gin
St Lawrence - Rockhampton
Mackay - St Lawrence
Bowen - Mackay
Townsville Urban - Bowen
Townsville Urban
Innisfail – Townsville Urban
Cairns - Innisfail
Methodology and assumptions

Focused on the “program approach”

• The links were mostly defined by unique road characteristics

• The average cost per overtaking lane was multiplied by the number of projects to arrive at a final cost for each link

• Excluding the taper, each project site was around 1.2 km in length

• The evaluation period for each project was 31 years

• All projects are constructed simultaneously

• Project results were all valued in 2012 ($)
A new technique

• **Ten separate links** – Key inputs to the cost benefit analysis:
  - AADT
  - Model Road State
  - Growth (%)
  - Alignment
  - Roughness
  - Length
  - Environmental Zone
  - Accident rate
CARP – Concise Analysis of Road Projects

• We designed a tool that allows us to group projects together in a much simpler way

• Rapidly evaluates programs or packages of projects with minimal compromise to accuracy

• Project data that requires more time to acquire, and are not normally available are not required for input to this tool

• Focus on parameters with the highest sensitivity to project road user cost calculations.
About the tool

- Spreadsheet-based Cost Benefit Analysis tool developed in 2012 by Transport and Main Roads staff, compliant with Austroads/National Guidelines for Transport System Management.

**CARP Interface**

Input requirements broadly based on CBA6.1
Fields that are not expected to have a great impact on most CBAs are removed or simplified
Data entry on one page
Allows for multiple projects to be combined into a package of works
Inside the model

Microsoft Excel - CARPY1.xls

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
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<tr>
<td>Discount Rate</td>
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<tr>
<td>Internal Rate of Return (IRR)</td>
<td>15.83%</td>
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Selected Options

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<th>A</th>
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<tbody>
<tr>
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<tr>
<td>Discount Rate</td>
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<tr>
<td>Total Costs</td>
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<td>Capital Costs</td>
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<tr>
<td>Maintenance</td>
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<tr>
<td>Total Benefits</td>
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<td>Travel Time Cost Savings</td>
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<td>Other Externalities</td>
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<td>Internal Rate of Return (IRR)</td>
<td>15.83%</td>
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How were the benefits calculated?

- There are several sources of benefits:
  - Capacity
  - Travel time
  - Safety.

Benefits differ based on the type of overtaking lane under study.
Accident costs calculation

- Accident costs with respect to overtaking lanes are calculated by the following equations.

\[
\text{ReductionOTL}_{\text{Single}} = [(0.25 \times \text{SecLength})A_R \times \text{AADT} \times 365.2 \times 10^{-6}] \times \text{Av. Crash Cost}
\]

\[
\text{ReductionUP}_{\text{Single}} = [(0.025 \times 3)A_R \times \text{AADT} \times 365.25 \times 10^{-6}] \times \text{Av. Crash Cost}
\]

\[
\text{ReductionDN}_{\text{Single}} = [(0.025 \times 5)A_R \times \text{AADT} \times 365.25 \times 10^{-6}] \times \text{Av. Crash Cost}
\]

Where:
- \( \text{ReductionOTL} \) = reduction in crashes for the overtaking section
- \( \text{ReductionUP} \) = reduction in crashes for the upstream section
- \( \text{ReductionDN} \) = reduction in crashes for the downstream section
- \( A_R \) = base case crash rate for the relevant section (crashes per MVKT)
- \( \text{SecLength} \) = length of the relevant section (km)
Findings

BENEFITS (M )($)
Benefits / AADT

- Benefits m's ($)
- AADT

Locations: Cairns - Innisfail, Innisfail - Townsville Urban, Townsville Urban, Townsville Urban - Bowen, Bowen - Mackay, Mackay - St Lawrence, St Lawrence - Rockhampton, Rockhampton - Gin Gin, Gin Gin - Maryborough, Maryborough - Gympie
Sensitivity analysis

- Based on variability and risk in results
- 50% change in benefits
- 20% change in costs.
Sources and references

- Program Evaluation – *An Applied Case Study*, Wayne Davies, Australasian
- Transport Research Forum, ATRF, 2013
- ATC, 2006, National Guidelines for Transport System Management, Volumes 3 and 5
- Background material.
Conclusions

The Cost Benefit Analysis team (Portfolio Investment and Programming Division) was asked to advise on the magnitude of benefits associated with the construction of a very large program of projects proposed for the entire length of the Bruce Highway.

Building a specific tool to complete this task, our team successfully devised a new “program” based method, which was based on current relevant and accurate data and sound assumptions – the program approach.

**Key variables that influence the results:**

- Traffic volumes
- Location
Thank you