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Exploring International Variation in Cost-Benefit Analysis Guidelines for Urban Rail Project Evaluation - Impact on Project Outcomes

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Agenda

1. **Introduction**

2. **Strategic Framework**

3. **Parameter Valuations**

4. **Case Study – Results and Discussion**

5. **Conclusions**

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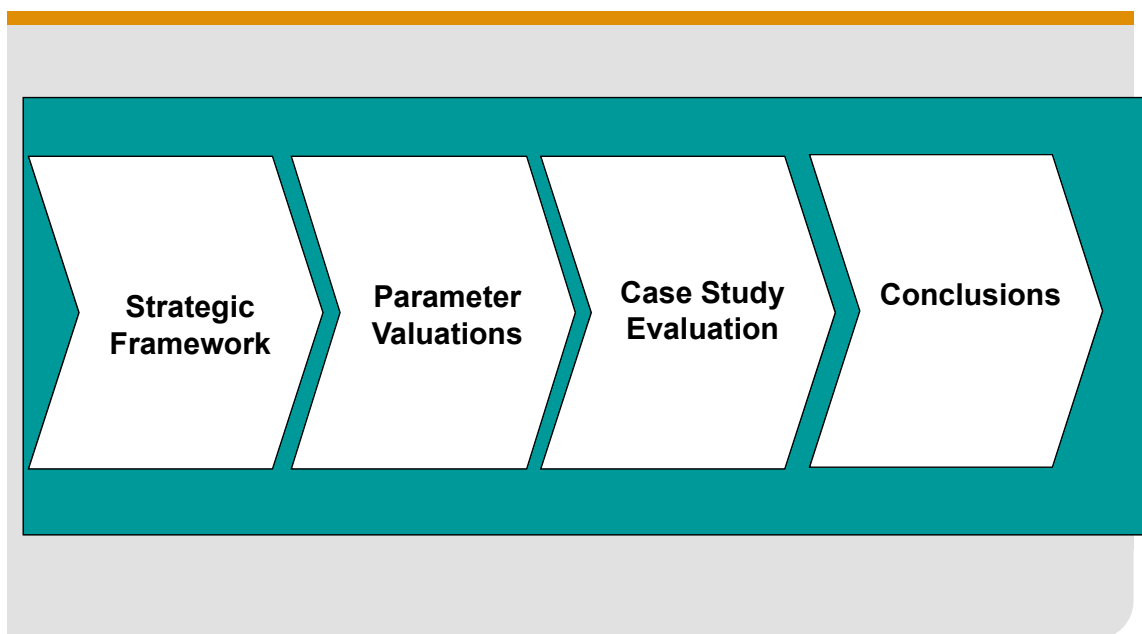**PTRG** PUBLIC TRANSPORT RESEARCH GROUP

This paper compares international urban rail CBA methodologies

- **This is background research for a PhD project examining new approaches in rail benefit assessment (notably agglomeration economies)**
- **Aim is to seek out alternative approaches**
  - Strategic Level (high level approaches)
  - Tactical Level (parameter valuations)
- **Differences are illustrated via a comparator evaluation project**

Across 12 countries using published sources

- **12 countries**
  - Australia, the US, the UK, Canada, New Zealand, Germany, Holland, France, Japan, Hong Kong, the Republic of Korea and Singapore
- **Sources – published evidence (including national guidelines and research papers) and communication with the relevant authorities**
- **Proviso**
  - national guidelines – many localised differences in approaches within countries
  - All aspects of methodology not fully documented

It is structured as follows:

Strategic Framework → Parameter Valuations → Case Study Evaluation → Conclusions

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All CBA's use multi-criteria analysis

Role of CBA

- **CBA is one key component of the multi-criteria analysis (MCA) for project evaluation adopted by all countries**
- **There is some variation in how CBA is used**
- **Project evaluation is usually supplemented by other specialised study e.g. Environmental Impact Statement**
- **MCA results are usually summarised in a tabular form – e.g. the Australian Appraisal Summary Table**

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Cost components are similar

Cost Components

- **All countries include capital, operating and maintenance costs in their CBA**
- **Land cost – considered as part of project cost; valued at market value**
- **Cost of corresponding mitigation measures are usually included in project cost**
- **Residual value of assets**
  - treated as a negative cost in the last appraisal year or as an initiative benefit
  - the UK and the Netherlands specify a criterion for its inclusion (project less than 60 and 100 years)
  - US, NZ Germany, Singapore have no residual value

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There is more variation in benefit assessment...

Benefit Assessment

- **Benefits are generally classified as Direct and Indirect benefits**

    – Direct benefits – benefits associated with the activity of travel itself and its effects on user

    – Indirect benefits – benefits that are generated over and above the direct benefits
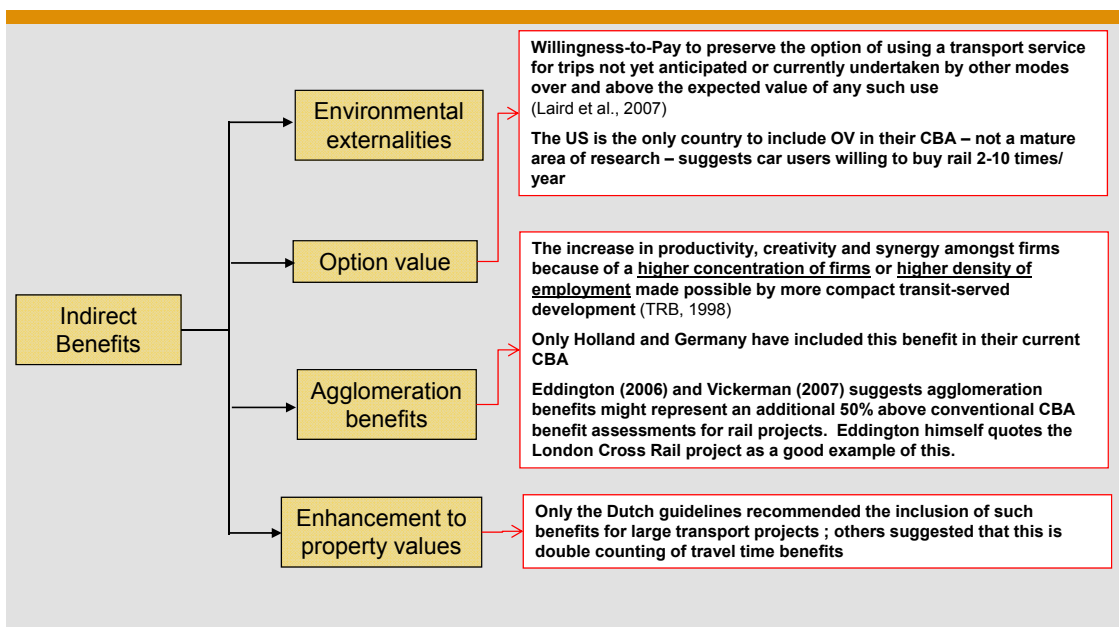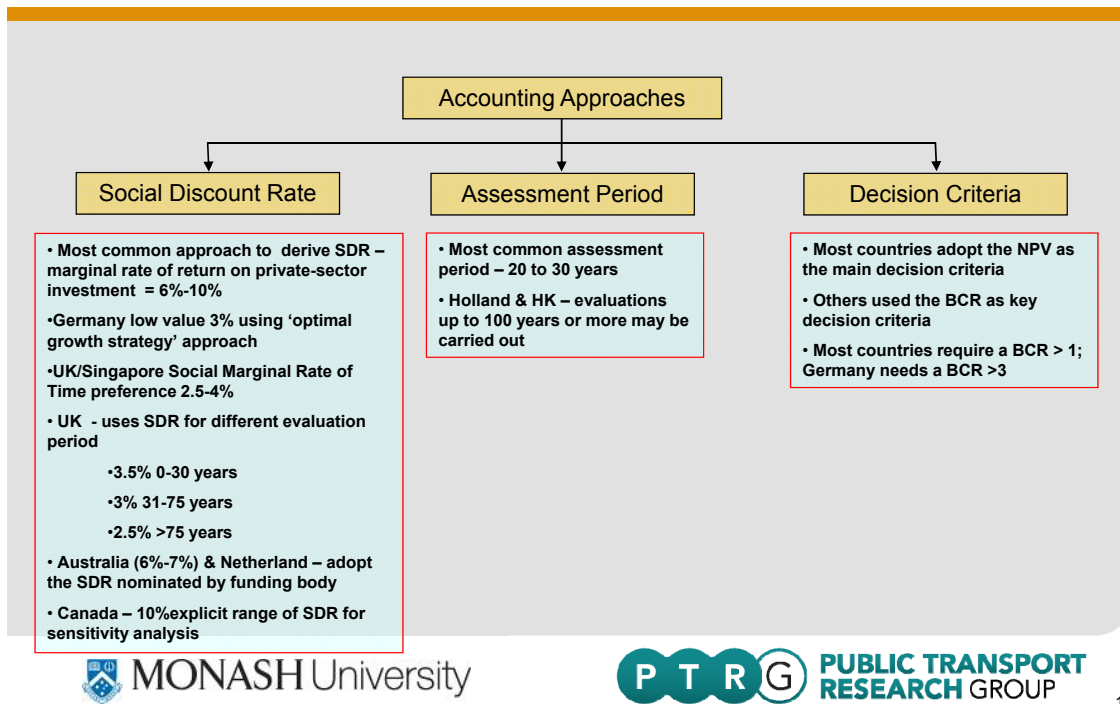
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...Direct benefits...

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...In-direct benefits...

Not included in HK and Singapore, UK recommend outside CBA

Indirect Benefits

- Environmental externalities
- Option value
- Agglomeration benefits
- Enhancement to property values

Air pollution
Common benefit - carbon monoxide, particulate matter smaller than 10 microns in diameter, hydrocarbons and oxides of sulphur and nitrogen

Japan – only measure the level of nitrogen oxide emissions

Greenhouse emission impact
Only Australia, NZ, France, Netherland, Japan and Korea include this in their CBA – not USA, UK, Germany, HK, Singapore

Noise impact
One of the most common externality benefits used. Most use the hedonic (willingness to pay) pricing method except Germany – uses cost of noise mitigation

Water quality impact
Australia & the US – include this as a benefit

Canada, Holland & NZ – separate assessment – Other no mention

Nature impact
Only Australia assess this impact quantitatively.

Others include the cost of mitigation measures as part of project cost

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...In-direct benefits...

Indirect Benefits

- Environmental externalities
- Option value
- Agglomeration benefits
- Enhancement to property values

Willingness-to-Pay to preserve the option of using a transport service for trips not yet anticipated or currently undertaken by other modes over and above the expected value of any such use (Laird et al., 2007)

The US is the only country to include OV in their CBA – not a mature area of research – suggests car users willing to buy rail 2-10 times/ year

The increase in productivity, creativity and synergy amongst firms because of a higher concentration of firms or higher density of employment made possible by more compact transit-served development (TRB, 1998)

Only Holland and Germany have included this benefit in their current CBA

Eddington (2006) and Vickerman (2007) suggests agglomeration benefits might represent an additional 50% above conventional CBA benefit assessments for rail projects. Eddington himself quotes the London Cross Rail project as a good example of this.

Only the Dutch guidelines recommended the inclusion of such benefits for large transport projects ; others suggested that this is double counting of travel time benefits

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...and accounting approaches

Accounting Approaches

Social Discount Rate

- Most common approach to derive SDR – marginal rate of return on private-sector investment = 6%-10%
- Germany low value 3% using 'optimal growth strategy' approach
- UK/Singapore Social Marginal Rate of Time preference 2.5-4%
- UK - uses SDR for different evaluation period
  - 3.5% 0-30 years
  - 3% 31-75 years
  - 2.5% >75 years
- Australia (6%-7%) & Netherland – adopt the SDR nominated by funding body
- Canada – 10%explicit range of SDR for sensitivity analysis

Assessment Period

- Most common assessment period – 20 to 30 years
- Holland & HK – evaluations up to 100 years or more may be carried out

Decision Criteria

- Most countries adopt the NPV as the main decision criteria
- Others used the BCR as key decision criteria
- Most countries require a BCR > 1; Germany needs a BCR >3

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Parameter values were adjusted to make comparisons valid across currencies/time

- **Examined in 3 broad categories:**
  - Value of Private Time (VOT),
  - accident costs; and
  - values of externalities

- **To aid comparison, parameter values are updated by :**
  - using the average wage increment of each country between the date the value was captured and Year 2006; and
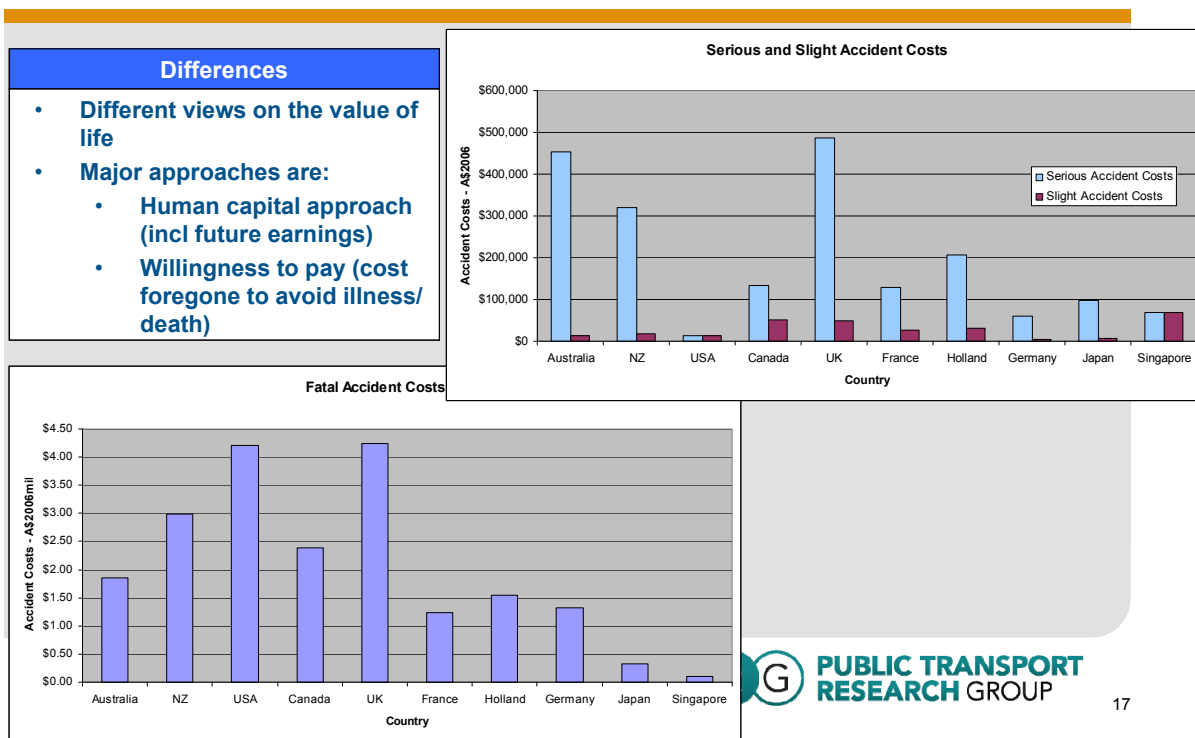 - converted to A$2006 values based on ARB's exchange rate

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VOT varies $5-$15 based on incomes – PT/car valuations are usually the same

Value of Private Time
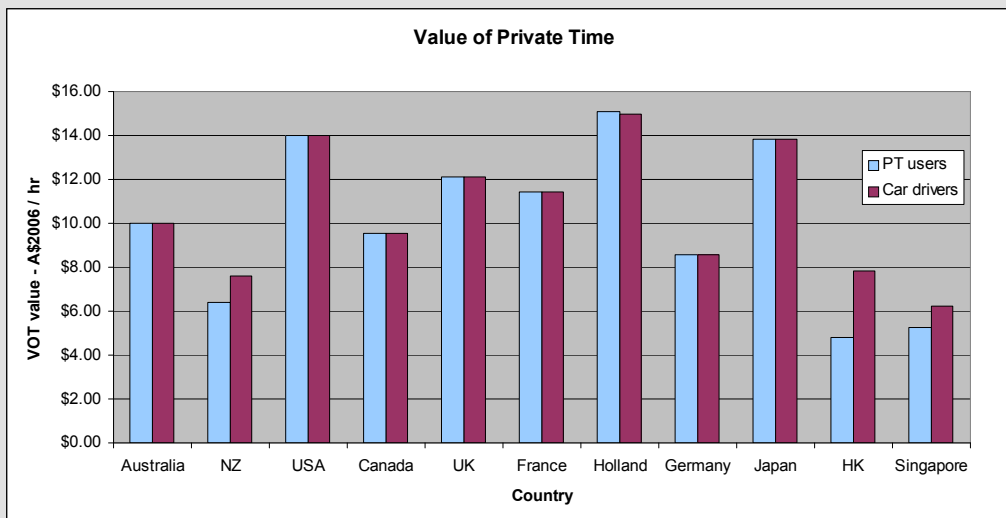
Differences
• **Wage rates (30-50%)**
• **Work to Non-Work Hour Ratios**
• **Tax Rates**

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Accident rates show much variation

Differences
• **Different views on the value of life**
• **Major approaches are:**
• **Human capital approach (incl future earnings)**
• **Willingness to pay (cost foregone to avoid illness/ death)**

Serious and Slight Accident Costs

Fatal Accident Costs

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Externality use and valuation vary with estimation methods

- **Different countries have derived very different monetary values for environmental impacts due to different methods employed and costing principles (Nash, 1997).**
- **For example**
  - Noise Pollution
    - > US   = A$0.00115 / veh-km
    - > Australia   = A$0.00800 / veh-km
  - Greenhouse Emissions
    - > France   = A$0.0079 / pax-km
    - > Netherlands = A$0.0064 / veh-km
    - > Australia   = A$0.0032 / veh-km
- **Most guidelines advised that unit costs to be used with caution and to carry out a detailed impact assessment if necessary**
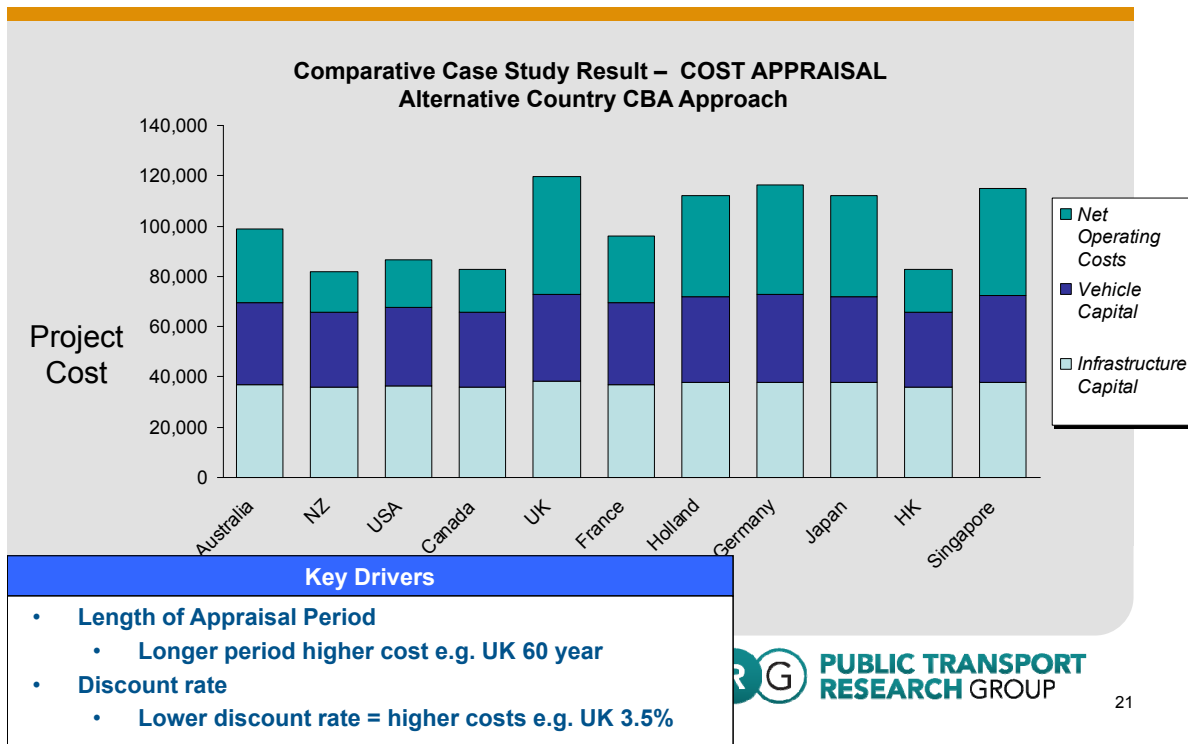
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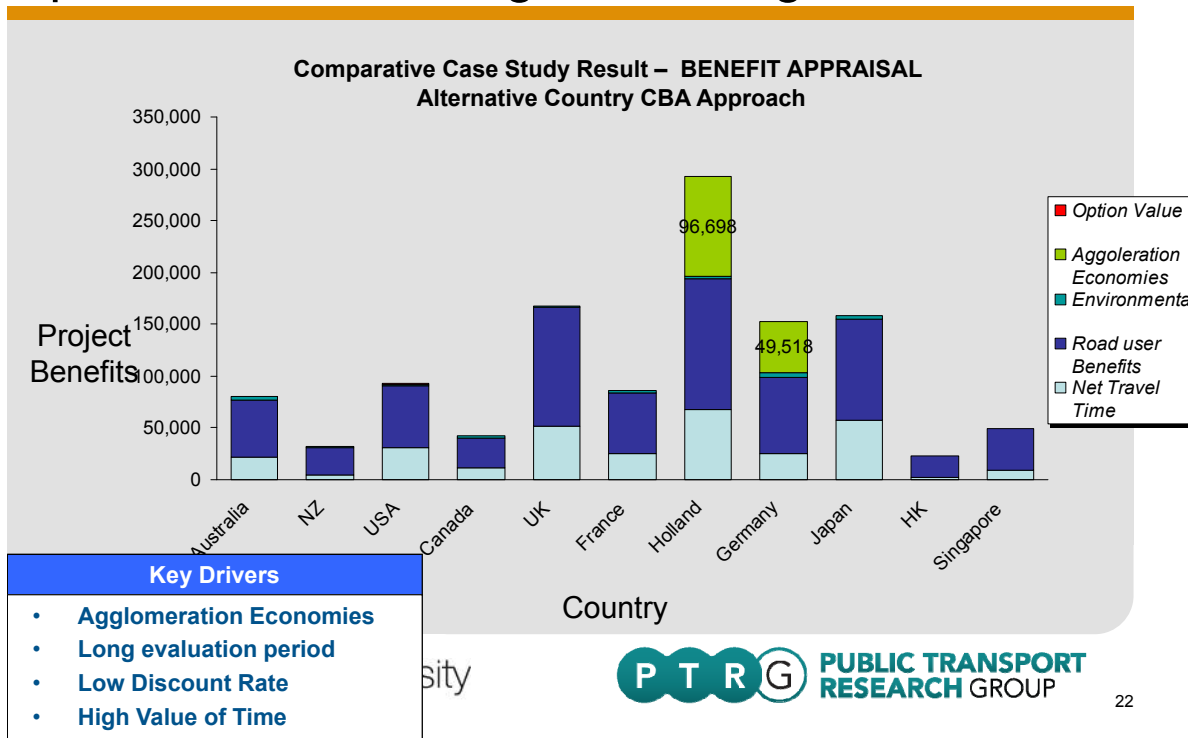PTRG **PUBLIC TRANSPORT RESEARCH** GROUP

The case study examined a rail electrification project

- **The project is evaluated using the CBA framework and parameter values of each country**
- **All appraisals are carried out in A$2006**
- **Capital and operating cost is assumed to be the same for all countries**
- **An average VOC of A$0.16/km is assumed for countries where no VOC information is available**
- **For Canada and Holland – air pollution, greenhouse effect and noise pollution are included**
- **For US – OV benefit is estimated based information from TRB (2002) (small)**
- **For Germany and Holland – Agglomeration benefits is assumed to be 50% of the direct benefits as suggested by Eddington (2006) and Vickerman (2007)**
- **The corresponding Australian rates are applied where no parameter values are available.**
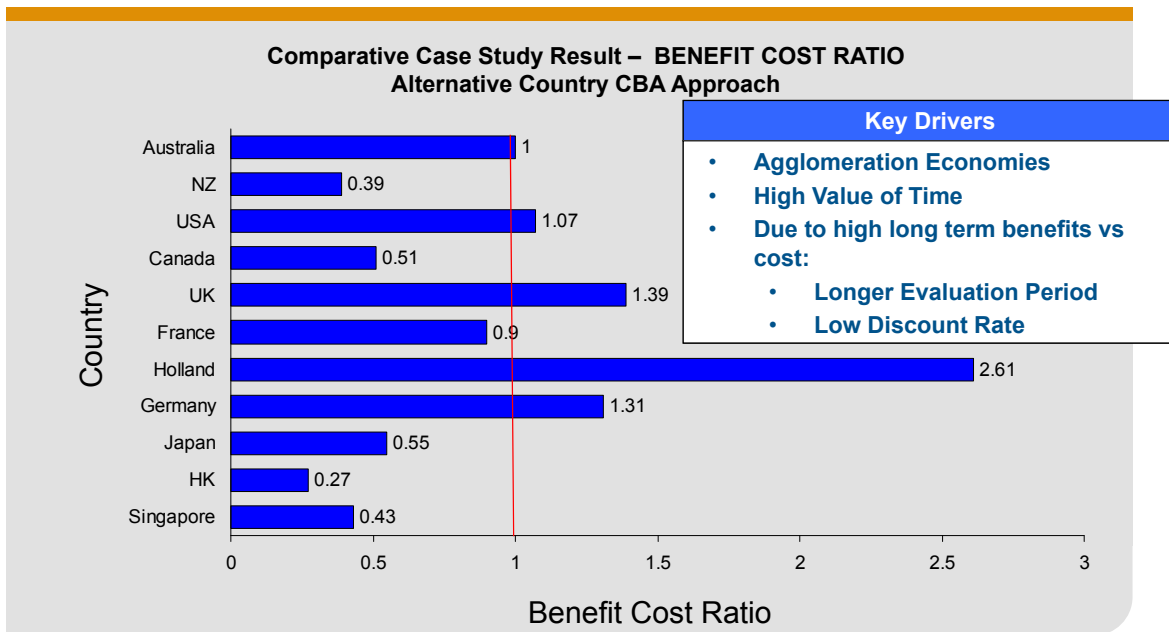
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UK had highest cost – longer evaluation period & lower DR's increase costs

Comparative Case Study Result – COST APPRAISAL
Alternative Country CBA Approach

Project Cost

Legend:
- Net Operating Costs
- Vehicle Capital
- Infrastructure Capital

Key Drivers
• **Length of Appraisal Period**
• **Longer period higher cost e.g. UK 60 year**
• **Discount rate**
• **Lower discount rate = higher costs e.g. UK 3.5%**

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Agglomeration impact, high VOT, evaluation period and low DR generate high benefits

Comparative Case Study Result – BENEFIT APPRAISAL
Alternative Country CBA Approach

Project Benefits

96,698

49,518

Legend:
- Option Value
- Aggoleration Economies
- Environmental
- Road user Benefits
- Net Travel Time

Country

Key Drivers
• **Agglomeration Economies**
• **Long evaluation period**
• **Low Discount Rate**
• **High Value of Time**

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Overall the project is positive in only 5 (4) of the 12 countries

Comparative Case Study Result – BENEFIT COST RATIO
Alternative Country CBA Approach

Country	Benefit Cost Ratio
Australia	1
NZ	0.39
USA	1.07
Canada	0.51
UK	1.39
France	0.9
Holland	2.61
Germany	1.31
Japan	0.55
HK	0.27
Singapore	0.43

Key Drivers
- Agglomeration Economies
- High Value of Time
- Due to high long term benefits vs cost:
  - Longer Evaluation Period
  - Low Discount Rate

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Key Findings

- **Aim: comparative international review of rail CBA**
- **Similarities:**
  – Framework (MCA), Handling of costs
- **Differences**
  – Direct/Indirect Benefits
  – VoT and agglomeration benefits significant
  – Length of evaluation period and discount rate significant
- **Comparative case study**
  – Aust, US, UK, Holland BCR>1
  – NZ, Canada, France, Japan, HK, Singapore BCR<1
  – Germany BCR = 1.86 below 3 threshold

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