The UK Approach to Reliability & CBA

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An outline:

- Department for Transport’s aims and objectives
- Appraisal system
- General approach
- Theoretical challenges
- An analogy…
DfT’s aims and objectives

- The Department for Transport’s aim is transport that works for everyone. This means a transport system that balances the needs of the **economy**, the **environment** and **society**. In support of this aim the Department has five strategic objectives which focus on the core area of our business:
  - **One**: To support national economic competitiveness and growth, by delivering **reliable** and efficient transport networks.
  - **Two**: To reduce transport’s emissions of carbon dioxide and other greenhouse gases, with the desired outcome of avoiding dangerous climate change.
  - **Three**: To contribute to better safety, security and health and longer life-expectancy through reducing the risk of death, injury or illness arising from transport, and promoting travel modes that are beneficial to health.
  - **Four**: To promote greater equality of opportunity for all citizens, with the desired outcome of achieving a fairer society.
  - **Five**: To improve quality of life for transport users and non-transport users, and to promote a healthy natural environment.
‘New Approach To Appraisal’ – is the analytical framework used to appraise major transport schemes seeking funding and/or approval from DfT. NATA was introduced 10 years ago at the time of the Integrated Transport White Paper ‘A New Deal for Transport’ (DETR, 1998).

Four distinct parts:
- Appraisal Summary Table, AST (achievement of Government objectives)
- Achievement of regional and local objectives
- Effectiveness of problem solving
- Supporting analyses

Value for Money (VfM):
- Important factor in decision making, helps prioritization
- AST is starting point, includes information on all NATA objectives
What goes into a VfM assessment?

<table>
<thead>
<tr>
<th>Areas for development</th>
<th>Some valuation evidence</th>
<th>Monetized Values (BCR)</th>
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</thead>
<tbody>
<tr>
<td>Townscape</td>
<td>Wider Economic Benefits</td>
<td>Risk of death/injury</td>
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<td>Time savings</td>
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<td>Water Environment</td>
<td>Landscape</td>
<td>Noise</td>
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<td>Operating costs</td>
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<td>Accessibility</td>
<td>Reliability</td>
<td>Carbon</td>
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<td>Private sector impacts</td>
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<td>Social inclusion</td>
<td>Air quality</td>
<td>Physical fitness</td>
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<td>Integration</td>
<td>Journey ambience</td>
<td>Cost to Exchequer</td>
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<td>Biodiversity</td>
<td>Regeneration</td>
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<td>Heritage</td>
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## Scheme Appraisal – AST

### Appraisal Summary Table

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Problems</th>
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<tbody>
<tr>
<td><strong>OBJECTIVE</strong></td>
<td></td>
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<tr>
<td><strong>SUB-OBJECTIVE</strong></td>
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<td><strong>QUALITATIVE IMPACTS</strong></td>
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<tr>
<td>ENVIRONMENT</td>
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<td>Noise</td>
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<td>Local Air Quality</td>
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<td>Greenhouse Gases</td>
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<td>Landscape</td>
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<tr>
<td>Townscape</td>
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<tr>
<td>Heritage of Historic Resources</td>
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<tr>
<td>Biodiversity</td>
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<td>Water Environment</td>
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<td>Physical Fitness</td>
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<td>Journey Ambience</td>
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<tr>
<td>SAFETY</td>
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<td>Accidents</td>
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<td>Security</td>
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<td>ECONOMY</td>
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<td>Public Accounts</td>
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<tr>
<td>Transport Economic Efficiency: Business Users &amp; Transport Providers</td>
<td>Users PVB, Transport Providers PVB, Other PVB</td>
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<tr>
<td>Transport Economic Efficiency: Consumers</td>
<td>Users PVB</td>
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<td>Reliability</td>
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<td>Wider Economic Impacts</td>
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<tr>
<td>ACCESSIBILITY</td>
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<tr>
<td>Option values</td>
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<tr>
<td>Severance</td>
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<tr>
<td>Access to the Transport System</td>
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<td>INTEGRATION</td>
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<td>Transport Interchange</td>
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<td>Land-Use Policy</td>
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<td>Other Government Policies</td>
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### Present Value of Costs to Public Accounts £m

<table>
<thead>
<tr>
<th>Objective</th>
<th>Sub-objective</th>
<th>Qualitative Impacts</th>
<th>Problems</th>
<th>Present Value of Costs to Public Accounts £m</th>
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### Additional Notes:
- **Aims & Objectives**
- **Appraisal System**
- **General Approach**
- **Theoretical Challenges**
- **An Analogy**
Motivation for Reliability

The Eddington Transport Study (2005):

- Transport improvements can influence **reliability** …
- … significance of **reliability** increases as transport systems become more congested.
- … **reliability** is highly valued by business travellers and commuters.
- Journey **reliability** is becoming an increasingly important requirement for many transport users.
- … for motorway widening schemes, the total value of reliability benefits are in the order of an additional 50% above the value of total time savings …
Reliability in appraisal - guidance

- WebTAG Unit 3.5.7

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Standard deviation</th>
<th>Average lateness about scheduled arrival time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis</td>
<td>Continuous departures</td>
<td>Infrequent departures</td>
</tr>
<tr>
<td>Valuation</td>
<td>Value of 1 min SD JT = 0.8*VOT</td>
<td>Value of 1 min avg lateness = 3*VOT</td>
</tr>
</tbody>
</table>
General approach to appraising reliability on ....

Rail:
- More data collected (PSA targets)
- Transport user less responsible for performance
- Supply issues better understood (NMF model)
- Better confidence of reliability assessments
- Goes into Cost-Benefit Analysis!

Road:
- Data requirements are more complex
- Transport user responsible for performance
- Still seeking to understand supply side
- Less confidence of reliability assessments
- Goes into AST!

Source: Trainmountain

Source: RAC
Recent developments on highway ....

2001: Decision to trial hard shoulder running on the M42

**Objectives:**
- Optimise safety and performance
- Provide more consistent journey times
- Minimise harmful emissions and fuel consumption
- Reduce delays and disruption due to accidents and incidents
- Provide improved warnings and traffic management, routine maintenance operations

Phased operation began in January 2005 and dynamic peak period hard shoulder running was implemented in September 2006.
Managed Motorway – Dynamic Hard Shoulder Running

Requirements:
• lightweight gantries with Variable Message Signs around every 500m
• appropriate road markings and fixed signing
• continuous safety fencing
• Pan Tilt and Zoom (PTZ) cameras

• fixed CCTV cameras typically up to 250m intervals.
• MIDAS
• semi-automatic control system (SCS)
• lighting throughout the length of the scheme
• the necessary optical fibre cabling and communications links.

Source: Highways Agency (UK)
Managed Motorway – Dynamic Hard Shoulder Running

Main benefits:

• Congestion relief

• Improved reliability

But how to evaluate?
Managed Motorway – Dynamic Hard Shoulder Running

INCA: INcident Cost-benefit Assessment.

- Spreadsheet-based tool
- Add-on to existing modelling
- INCA calculates:
  - Delays due to queuing caused by incidents
  - Variability impacts of those queues
  - Residual day to day variability

(Incident = any reduction in capacity)
INCA: Link-based calculations

- Calculate max. delay per vehicle
- Total delay (vehicle hours)
- Probability of encountering incident
- SD of journey time
- Combine over incident types
  - Total incident SD
  - Total incident delay
- DTDV SD
- Total TTV

For each link/scenario/flow group/incident type

For each link/scenario/flow group
INCA: Benefit calculations

For each link/scenario/flow group

1. **Total SD by link**
2. **Total incident delay**
3. **Total SD by route**
4. **Difference between DM & DS**
5. **Route flows**
   - **Variability benefits**
   - **Delay benefits**
7. **Monetise, extrapolate to appraisal period, discount**
8. **Present Value of Benefits**
9. **AST**
Before INCA was used, it was assumed that reliability benefits = 50% of travel time savings.

With INCA, a more robust calculation can be made for reliability.
Why are highway reliability benefits from INCA not included in CBA?

- The incident database for different road types is key to the central calculations within INCA.
- However, there is currently limited understanding of the incident parameters to be used for new schemes such as the MM-DHS.
- Only recently been applied to understand reliability benefits for motorway improvement schemes.
- Presenting results in AST is first step to presenting relative reliability benefits delivered across different schemes, as we try to improve on the capabilities in estimating reliability.
- Over time, as we collect more evidence, fine-tune our techniques and gain more confidence of the results, we might then consider moving ‘reliability’ into the BCR metric.
Reliability in appraisal – Future work

Limitations
• Currently, reliability for highway and PT schemes appraised separately.
• Do not have the same approach across modes.

Way forward
• Develop better understanding of the relationship between reliability, demand and network characteristics, and valuation of reliability.
• Ensure that resultant guidance does not significantly increase burden of effort associated with appraisal by considering how it can be supported by appraisal tools.
We need to ensure that we provide the relevant tools …

Network changes → Assignment model → Demand model

Reduced incident rates

COBA

Safety
• Accidents

Flows

INCA

Economy
• Time & VOC savings
• Variability
• Tax revenues
• WEBs?

TUBA

Environment
• Air Quality
• Carbon
• Noise

Speeds

Spread-sheet

NB: only shows parts of appraisal that use model outputs
We need to ensure that we provide the relevant tools ...

**Network changes**
- Reduced incident rates

**Demand model**
- Flows
- Speeds

**Assignment model**
- Reduced flows
- Speeds

**Model outputs**
- COBA
- INCA
- TUBA

**Safety**
- Accidents

**Economy**
- Time & VOC savings
- Variability
- Tax revenues
- WEBs?

**Environment**
- Air Quality
- Carbon
- Noise

NB: only shows parts of appraisal that use model outputs
How can we value reliability?
How can we value reliability?

Valuation:

- How to derive a Value of Reliability?
- Based on Stated Preference and Revealed Preference surveys?

What value would you place on it?

What’s the standard deviation of your daily journey time?

What’s the standard deviation of your daily journey time?

What’s the standard deviation of your daily journey time?
How can we value reliability?

Valuation:
- How to derive a Value of Reliability?
- Ensure we capture representative distribution across income and educational level
How can we value reliability?

- How does it fit with the Value of Travel Time Savings?
- What about freight?
- What types of survey methods could be applied?
- What about appraisal?
- How do we deal with end-to-end journeys composed of different modes?
- Is it possible to have an overarching theory consistent across modes?
- How do we incorporate reliability into the modelling framework?

Aims & Objectives  Appraisal system  General approach  Theoretical challenges  An analogy
Travel time variability

Background studies
Back ground studies into travel time variability.

Highway travel time variability
Information on highway travel time variability.

INCA Research
INCA research documents.
Background studies

Travel time variability: Follow-on research

These reports describe the development and implementation of 3 alternative methods for incorporating the cost of variable travel times in assignment models. The background to and derivation of these methods can be found in reports 1.1 and 1.2. The conceptual and methodological issues report identifies and discusses the outstanding issues related to the understanding and modelling of traveller’s responses to TTV.

Multimodal travel time variability: final report (1 Mb)

This report contains a comprehensive review of the theory and evidence on: the impact of journey time variability on travel behaviour; the value that transport users place on increasing the reliability of journey times; and incorporating journey time variability into transport models. This review was commissioned in response to the 2006 Eddington Report. Institute of Transport Studies, University of Leeds, 11 November 2008.

Published: 23 April 2009

Advancing methods for evaluating network reliability

The detailed findings of a study funded under the Department’s “New Horizons” programme by David Watling, Agachai Sumalee, Richard Connors, Chandra Baijepalli - ITS, Institute of Transport Studies, University of Leeds. 30 April 2004.

Frameworks for modelling the variability of highway journey times - December 2003

Final report of research into frameworks for modelling the variability of journey times (JTV) excluding the predictable variation by time of day, day of week, and seasonal effects. Arup consultants.

Modelling and appraisal of journey time variability - interim report

Review in May 2002 of earlier research, research on this contract, and detailed proposals for further research. Arup consultants.
INCA Research

**Journey Time Variability: Working Papers 1 to 6**

DfT define travel time variability (TTV) as unpredictable variation in journey times. Hence TTV is confined to random effects. It excludes predictable variation relating to varying levels of demand by time of day, day of week, and seasonal effects. TRL and John Fearon Consultancy.

**Updating and validating parameters for incident appraisal model INCA**

Final report of research into updating and reviewing parameters in the INCA (Incident Cost-benefit Analysis) economic appraisal software. TRL and John Fearon Consultancy.

**Development of INCA to incorporate single carriageways and managed motorways (710 kb)**

This report provides an algorithm specifying how INCA can accommodate the analysis of inter-urban single carriageways and explores the sources of data for inter-urban single carriageway incidents. Additionally, it explains the incorporation of managed Motorways and Dynamic Hard-shoulder Running in INCA and improvements to the DTDV calculations for MM-DHS schemes.

**Published:** 09 September 2009
Imagine ....
Aims & Objectives

Appraisal system

General approach

Theoretical challenges

An analogy
Workshops with practitioners

How can we reduce this gap?

Aims & Objectives  Appraisal system  General approach  Theoretical challenges  An analogy
Aims & Objectives
Appraisal system
General approach
Theoretical challenges
An analogy
Better co-ordination
Thank you…

…Questions?