Forecasting Travel Time Reliability in Road Transport
a new model for The Netherlands

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Marco Kouwenhoven
Significance

Pim Warffemius
KiM Netherlands Institute for Transport Policy Analysis

significance
quantitative research

Ministry of Infrastructure and the Environment
Reliability incorporated in CBA

• In The Netherlands, transport projects and policies are ex-ante evaluated by CBA

• Since 2004, extra benefits are added to account for reliability
  – 25% of travel time benefits due to reduced congestion
  – Only for road projects

• However this does not evaluate consequences of policies that especially affect travel time variability

• From the start this method was meant to be replaced by a better method
Capturing travel time reliability in CBA

We need:

• Value of travel time reliability
  
  Recent VTTS and VTTRS study for The Netherlands (2013)

• Model to forecast travel time reliabilities
  o with & without an infrastructure project / policy

  This study

• Model to predict changes in user behaviour
  o Route choice / mode choice / departure time choice

Future challenge
Towards a new model for The Netherlands

- A project was started in 2013 to adapt the Dutch national and regional transport models to capture reliability

- Objective was to find a (new) empirical relation between reliability of car travel times and other variables available in the transport model

- The improved modelling to forecast travel time variability will be implemented in Dutch policy making

- Incorporating consequences of policies affecting travel time reliability into CBA encourages proper consideration of options
Deriving an empirical relation for travel time reliability
Methodology (1)

- In the Netherlands, travel time reliability is defined as the standard deviation of the distribution of all possible deviations from the expected travel time
  - Practical considerations
  - Consistent with VTTRS study
  - Viewpoint of the traveller

- This is approached by compiling the travel-time distribution of all mean travel times on a number of days when departing at the same time
  - Door-to-door
  - Including a correction for the expected travel time
  - Excluding outliers
Travel time on a 224 km highway route in 2012

- Daily departure at 07:30
- Work days only

Travel time (minutes)
Travel time expectation

- We assume that the expected travel time is equal to the average travel time of the same day in the four weeks before and after.
Travel time expectation vs. observed
Exclusion of outliers

**Route 1**
Short, no congestion
L = 8.3 km
V = 113 km/h

**Route 2**
Short, congested
L = 11.5 km
V = 58 km/h

**Route 3**
Long, no congestion
L = 67.2 km
V = 98 km/h

**Route 4**
Long, congested
L = 39.7 km
V = 54 km/h

Average travel time
+ 3σ
150%
50%

Travel time (minutes)
Methodology (2)

- Use an empirical relation between standard deviation and other parameters available in the transport models to forecast reliability
  - Relation with travel time, mean delay, intensity, etc.
  - Post-processing
Reliability data for highways

250 Routes
Morning peak (average over 8 15-minute periods)
Best empirical relation for highways

250 Routes
Morning peak (average over 8 15-minute periods)

\[ y = -0.54 + 0.48 \cdot MD + 4.54^{10} \log(MD+1) - 0.009 \cdot L \]

\[ R^2_{\text{adjusted}} = 0.96 \]
Best empirical relation for other roads

40 non-highway routes
**Morning peak** (average over 8 15-minute periods)

\[ y = 0.499 \cdot MD \]

\[ R^2_{\text{adjusted}} = 0.69 \]
What to remember (1)

- Use consistent definitions
  - Valuation of reliability
  - Empirical relation for reliability
  - Transport model application

- Functional form of the empirical relation depends on type of road

- For Dutch highways, a combination of a linear and a logarithmic function works well

- Coefficients are significantly different between time-of-day periods

- No distinction made (yet) for freight traffic
What to remember (2)

- The marginal rate of reliability depends on length of the route

![Graph showing the relationship between mean delay and standard deviation for different route lengths.](image)
What to remember (3)

- The variation of standard deviation by routes may follow a different relation than the variation by 15-minute periods
What to remember (4)

- Outlier-exclusion and expected-travel-time-correction have a major impact on the coefficients, not on the functional form
- Be careful when comparing coefficients from different studies

*Functions estimated on 250 Routes
Morning peak (average over 8 15-minute periods)*
Implications for CBA
Implications for CBA

- Current practice: 25% of travel time benefits due to reduced congestion

- New instrument: benefits depends on
  - Type of travel time gain
    - shorter route versus reduction of congestion
  - Type of road
    - Highways versus other roads
  - Length of the route
  - Local maximum speed
    - Mean delay is defined with respect to maximum speed

- Test: reliability benefits are (roughly) between 15% and 60% of travel time gains
Test results

Ratio travel time / reliability benefits  PROJECT 1

Ratio travel time / reliability benefits  PROJECT 2

Ratio travel time / reliability benefits  PROJECT 3
Future steps

Short term:

■ Develop a similar methodology for public transport
■ Expansion for non-highway routes

Long term:

■ Study of specific policies that affect unreliability
  □ changing the maximum speed or ramp metering
■ Feed-back loop in the transport model
  □ Changes in reliability should lead to changes in choice behaviour
■ Study of robustness / extreme events