The Impact of Differing Door Widths on Passenger Movement Rates

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Structure of this Presentation

1. The Problem: Background & Previous Work
2. Work in Norway
3. Wider Analysis
4. Hypothesis
5. Conclusions
1 The Problem

• Increasing traffic puts pressure on capacity
• Urban rail capacity determined by station stops
• Many rail simulations make simplistic assumptions about station stops
• This paper demonstrates that an apparently-simple relationship isn’t
1 Factors Affecting Station Stops

• Detailed modelling undertaken
  – Harris, Graham, Anderson & Li (TRB, Feb 2014)

• Three types of variables
  – Passenger characteristics
  – Station characteristics
  – Rolling stock characteristics
1 The Impact of Door Width: Literature Review

- Prof. Weidmann: \( \text{Flow} = f(d^{-0.1}) \)
- Heinz: different types of movement, subject to edge effects
1 Previous Work: Data Available

- Ongoing multi-year joint RTSC/RCL project with c. 150 surveys
- Focussed at the critical door of metro and busy urban railways
- Each with 30 detailed observations of
  - Passenger movements
  - Passenger times
  - Times of other functions (e.g. despatch, door closing)
  - Train & platform characteristics
1 Previous Work: Analysis

- Formal statistical analysis using multivariate fractional technique to avoid issue of non-linearity
- Despite expectations, *door width was not a significant variable*
- Analysis of residuals
2 Work in Norway

- NSB runs up to 20tph through Oslo tunnel
- Commercially-critical part of their operation but punctuality lower than desired
- A mix of train services doesn’t help
2 Work in Norway

• Initial analysis showed that rolling stock clearly was a determinant of passenger movement rates
  – But was this door width and/or other features?
3 Wider Analysis

- NSB argued that door width alone was perhaps not a simple determinant of flow
- Supported by one of Heinz’s hypotheses
3 Wider Analysis

- Investigation of the full international dataset showed a step function in the impact of door width
3 Wider Analysis

• Platform management measures can be implemented e.g. boarders to stand aside
• But international nature of dataset showed that problems were also arising in “well-behaved” environments e.g. Taiwan
4 Hypotheses: 1

- Threshold door width values are important in determining flow:
  - 0.75m enables one movement
  - 1.25m enables two movements
  - 1.7m enables three movements
- …but standbacks are more important
4 Hypotheses: 2

- Detailed observations led to a different hypothesis:
- Door width is not critical because the gap left by boarding passengers is narrower than the door width.
5 Summary

• Door width has generally been assumed to be a linear determinant of passenger flow on/off trains
• Despite variations in culture, it is *not*
• A stepped function is appropriate in forecasting movement rates
• But these may not be achieved if boarding passengers do not keep back