

## Research Proposal

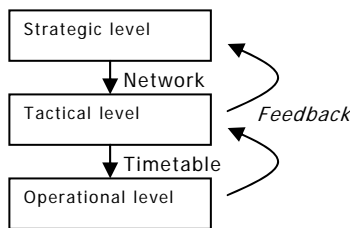
Public transport is a dynamic product. This is a result of driving behavior, interaction with other traffic, changes in level of demand, etc. Due to these differences, travel times fluctuate, resulting in a decrease in reliability and an increase in costs for the operator. This research deals with deviations in travel times and measures to prevent them in the planning phases: network and timetable design.

### Background and problem definition

Public transport, especially urban transport, has to deal with a lot of disturbances. This leads to less reliability, implying higher costs and lower income for the transport company and authority.

To increase reliability in public transport, the following questions have to be answered:

- What is the variation in travel times and what are their causes?
- Is it possible to control these deviations or their effects during the two planning phases of public transport: strategic and tactical and at the operational level?
- Which measures can be used in practice by a public transport company?



'Three phases of public transport'

### Expected practical and scientific results

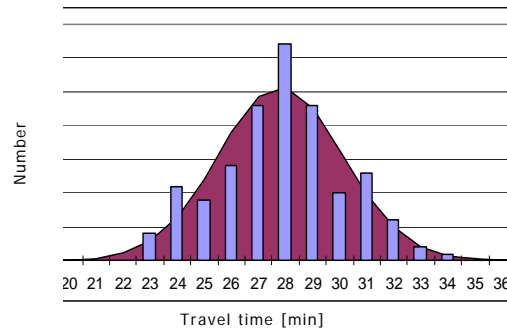
In this research an extensive analysis of empirical data of public transport operations will be made. This will provide detailed knowledge about deviations and their sources and effects.

Furthermore practical measures will be developed to prevent deviations and decrease their impact. These can be taken in the design phases of public transport.

### Scientific and societal relevance

Fundamental analysis of deviations in travel times in urban public transport: sources and effects.

Detailed insights in the mechanisms leading to deviations in urban public transport.



'Travel times tramline 12 in The Hague, during rush hour'

### Methodological approach

- Analysis of travel times in urban public transport with the use of TRITAPT, focusing on deviations: causes and effects;
- Analysis of the control possibilities of the deviations and their effects during the planning phases: network design and timetable planning;
- Developments of measures to prevent deviations and/or decrease their impact.

The focus is on urban public transport, but similarities with railways will be studied as well.

### Key publications

Oort, N van, & Nes, R van (2008). *Improving reliability in urban public transport in strategic and tactical design*, In 87th Annual Meeting of the Transportation Research Board. Washington DC: TRB

Oort N. van, & Nes, R van (2006). *Reliability of urban public transport and strategic and tactical planning, a first analysis*, TRAIL conference proceedings, Rotterdam

Oort, N van, & Nes, R van (2004). *Service regularity analysis for urban transit network design*, In 83rd Annual Meeting of the Transportation Research Board (pp. 1-24). Washington DC: TRB

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## Research Results

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### Case study

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Reliability is a key quality indicator for urban public transport. In case of unreliability travelers experience longer waiting times and thus longer travel times. Especially in urban areas, where the mean travel time is relatively short, the effect of increased waiting times is significant. Besides, unreliability leads to less comfort as well: due to bunching of vehicles the chance of having a seat decreases. A case study in The Hague reveals that unreliability has significant effects: examples of tram lines show an increase in travel time up to 25%. Nowadays, a lot of attention is paid to improving reliability at the operational level. However, possibilities for improvement also exist at the planning stages of public transport. During the network and timetable design reliability can already be taken into account, resulting in a higher level of service (or more easily achievable in practice).

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### Improvements at tactical level

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#### *Determining driving times*

A theoretical approach and a case study show the effect of design choices of timetabling on reliability. Analysis of actual data shows that the travel time is minimized if the 35-percentile value is used to determine the driving time out of historical data. This saves up to 75% of travel time for all passengers.

#### *Applying holding points*

If holding points are applied (and departing ahead of schedule is not allowed), travel time can be greatly reduced. A theoretical and a practical study show that designing 2 holding points, using a 30-60 percentile value minimize travel time (up to 60%), regarding both the waiting time at the stops and in the vehicle.

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### Improvements at strategic level

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#### *Line length*

Long lines offer many direct connections, thereby reducing the number of transfers. However, the variability of driving times is often negatively related to the length of a line, resulting in less schedule adherence. A case study in The Hague shows that in the case of long lines with large variability, splitting the line could result in less additional travel time because of improved reliability. This advantage compensates the extra time of transferring if the transfer point is well chosen: it could lead to a decrease in additional waiting time of about 30%.

#### *Coordination of lines*

This research describes the effects of coordination of two lines on the same track. It shows that during the design of the network with shared tracks, not enough attention is paid to the effect on the reliability of both lines combined. Already at the strategic level calculations should be made of the expected reliability. Forecast tools and feedback of the operational level are needed to make these calculations.

#### *Design of terminuses*

To achieve high reliable public transport, departing on time is necessary. This research shows an example of improving departure punctuality, leading to a decrease of 35% additional waiting time for all travellers on a tram line in The Hague. To enable departure punctuality, terminuses should be designed, regarding reliable operations. Choices made in the design process already determine which level of service can be maximally achieved during operations. Forecast tools are needed to assess the effect of the configuration on reliability.

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### All research papers at Website:

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<http://www.htm.net/Pages/DEF/533.html>

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## Publication list

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December 2008

Kanacilo, E.M., & **Oort, N van** (2008). Using a rail simulation library to assess impacts of transit network planning on operational quality. In J Allen, E Arias, CA Brebbia, CJ Goodman, AF Rumsey, G Sciotto, & N Tomii (Eds.), *Computers in railways XI* (pp. 35-44). Southampton, UK: WITpress. (TUD)

**Tahmasseby, S, Oort, N van, & Nes, R van** (2008). The role of infrastructure on public transport service reliability. In s.n. (Ed.), *Proceedings of the 1st international IEEE Conference on infrastructure systems: Building networks for a brighter future* (pp. 1-5). Delft: IEEE. (TUD)

**Oort, N van, & Nes, R van** (2008). Op tijd: dat telt. *Verkeerskunde*, 5, 48-53. (TUD)

**Oort, N van, & Nes, R van** (2008). **Improving reliability in urban public transport in strategic and tactical design**. In s.n. (Ed.), *Compendium of papers TRB 87th Annual Meeting* (pp. 1-17). Washington DC: Mira Digital. (TUD)

**Oort, N van, & Weeda, VA** (2007). Xpert + Xpert = 3 : Wat kunnen trein- en tramexploitatie van elkaar leren? In L Berkhout (Ed.), *De Xpert-factor; Bundeling van bijdragen aan het CVS* (pp. 361-376). Rotterdam: CVS. (TUD)

**Oort, N van, & Nes, R van** (2007). **Randstadrail: increase in public transport quality by controlling operations**. In IA Hansen, A Radtke, JP Pacht, & E Wendler (Eds.), *Proceedings of 2nd International Seminar on Railway Operations Modelling and Analysis* (pp. 1-13). Hannover: Leibniz Universität Hannover. (TUD)

**Tahmasseby, S, Nes, R van, & Oort, N van** (2007). **Public transport network design and reliability**. In HJ van Zuylen (Ed.), *Proceedings INSTR2007* (pp. 1-8). s.l.: s.n.. (TUD)

Muller, A, Temorshuizen, J, & **Oort, N van** (2007). **Het Lira-model in de praktijk**. In s.n. (Ed.), *Bijdragen Verkeerskundige Werkdagen 2007* (pp. 1-14). Ede: CROW. (TUD)

**Oort, N van, & Nes, R van** (2007). Betrouwbaar OV begint met goed plannen. In L Berkhout (Ed.), *De Xpert-factor; Bundeling van bijdragen aan het CVS* (pp. 397-416). Rotterdam: CVS. (TUD)

**Oort, N van, & Post, MR** (2006). Stipt op tijd met Randstadrail. *Verkeerskunde*, 43-46. (TUD)

**Oort, N van, & Nes, R van** (2006). Service regularity analysis for urban transit network design. In RSK Kwan (Ed.), *Papers and abstracts accepted for presentation on the 10th International Conference on Computer-Aided Scheduling of Public Transport* (pp. 1-26). Leeds: CASPT. (TUD)

**Oort, N van, & Nes, R van** (2006). Reliability of urban public transport and strategic and tactical planning : a first analysis. In HJ van Zuylen (Ed.), *Conference Proceedings 9th TRAIL Congress, TRAIL in motion* (pp. 1-18). Delft: TRAIL Research School. (TUD)

**Oort, N van, & Post, MR** (2005). Randstadrail: Kwaliteitssprong in operationele kwaliteit door exploitatiebeheersing. In *Duurzame mobiliteit: hot or not? Bundeling van bijdragen aan het colloquium* (pp. 743-761). Rotterdam: CVS. (TUD)

**Oort, N van, & Nes, R van** (2006). Betrouwbaarheid in stedelijk openbaar vervoer in relatie tot tactische en strategische planning : een verkennende analyse. In *Samen werken is topsport, Bundeling van bijdragen aan het Colloquium* (pp. 425-444). Rotterdam: CVS. (TUD)

**Oort, N van, & Nes, R van** (2004). Service regularity analysis for urban transit network design. In *83rd Annual Meeting of the Transportation Research Board* (pp. 1-24). Washington DC: TRB. (TUD)

**Oort, N van, & Nes, R van** (2004). Regelmaatprognose bij het netwerkontwerp van stedelijk openbaar vervoer. In *Bundeling van bijdragen aan het colloquium. Innovatie: van inspiratie naar realisatie?* (pp. 877-896). Rotterdam: CVS. (TUD)

**Oort, N van, & Nes, R van** (2004). Regelmaat in het openbaar vervoer : Model biedt inzicht in operationele kwaliteit bij ontwerp lijnnet. *Verkeerskunde*, 55 (4), 42-47. (TUD)

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## In press

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Drost, M.P. & Oort, N. van (2008)

*LANS: Stad en regio weer mobiel*

Colloquium Vervoerplanologisch Speurwerk

Boterman, J.W. & Oort, N. van (2008)

*Sneller reizen door langer stilstaan*

Colloquium Vervoerplanologisch Speurwerk

Oort, N. van & Nes, R. van (2008)

*Betrouwbaar OV door integrale beheersing*

Colloquium Vervoerplanologisch Speurwerk

Oort, N. van & Drost, M.P. (2008)

*Planning van stedelijk OV: invloed van lijnennet op operationele kwaliteit*

Colloquium Vervoerplanologisch Speurwerk

Oort, N. van & Nes, R. van (2009)

*Controlling Operations of Public Transport to Improve Reliability: Theory and Practice*

Transportation Research Board, Annual Meeting, Washington

Oort, N. van & Nes, R. van (2009)

*Line Length Versus Reliability: Network Design Dilemma in Urban Public Transport*

Transportation Research Board, Annual Meeting, Washington

Tahmasseby, S., Oort, N., Nes, R. van (2009)

*Reliability Assessment of Urban Rail Transit Networks; Methodology and Case Study*

Transportation Research Board, Annual Meeting, Washington

Oort, N. van & Nes, R. van (2009)

*The Effect of Operations Control on Reliability*

RailZürich

Oort, N. van & Nes, R. van (2009),

*Evaluation of controlling measures for light rail applied in practice,*

CASPT: the 11th international CONFERENCE ON ADVANCED SYSTEMS FOR PUBLIC TRANSPORT, Hong Kong

Oort, N. van, Boterman, J.W., Nes, R. van (2009),

*Effect of driving time determination and holding points on reliability,*

CASPT: the 11th international CONFERENCE ON ADVANCED SYSTEMS FOR PUBLIC TRANSPORT, Hong Kong