Smart stations

Smart stations

- Many stations are operating over or near capacity and crowding at stations are connected to on-board crowding.
- Station performance is important for the efficiency and attractiveness of the public transport system.
- Develop methods to support station planning and operations with respect to
  - Passenger streams
  - Impact on crowding in vehicles
- The project supports the final stages of two PhD students.

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Modelling on-board crowding

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Background

Overcrowding at stations and on-board PT vehicles

- Discomfort
- Longer dwell times
- Denied boarding

Background

Uneven passenger distribution

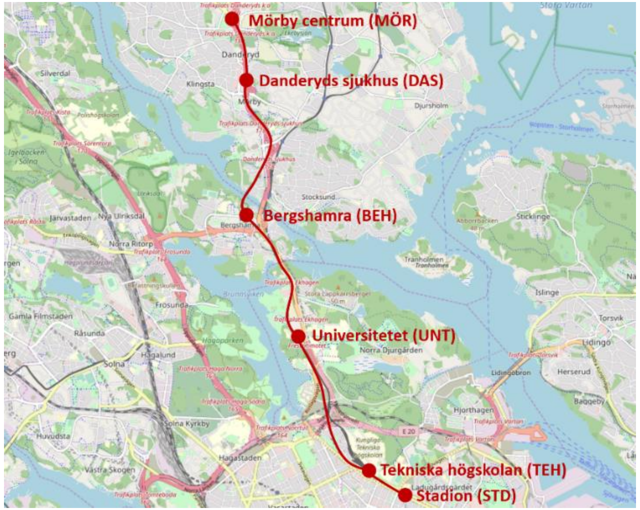
- Higher experienced crowding
- Larger fleet requirements
- Higher operating costs

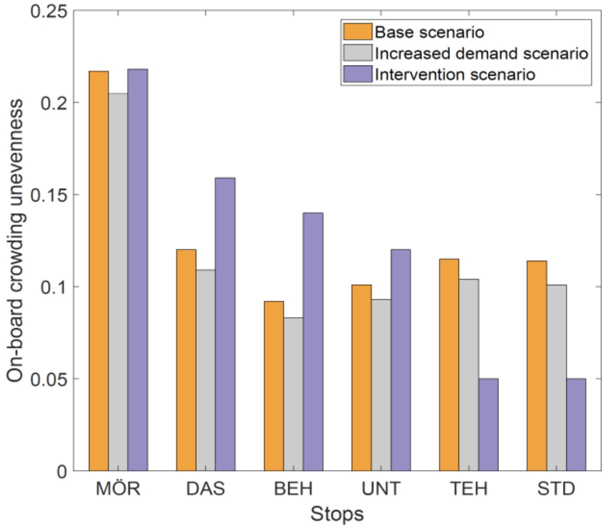
Modelling on-board crowding distribution

BusMezzo - Dynamic Transit Operations and Assignment Model

- Individual transit vehicle movements.
- Individual passenger car boarding choices.
- Experienced passengers wrt car crowding level.
- Captures on-board crowding distribution and evaluates user cost in a more realistic way.

Demand and infrastructure intervention effect





Increased demand →

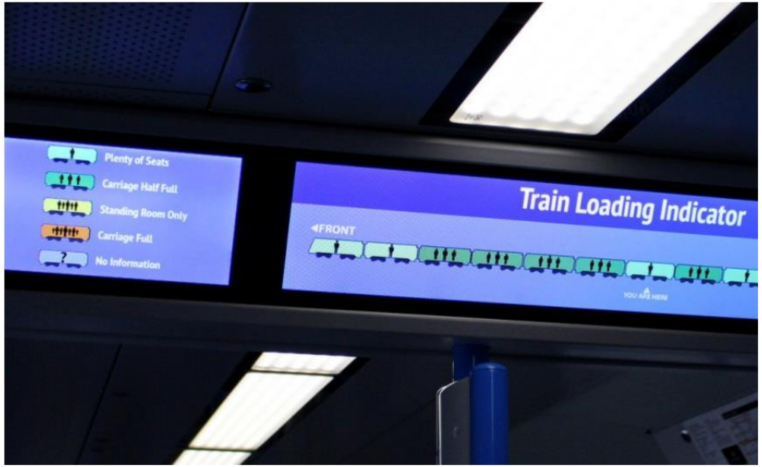
Experienced passengers board less crowded cars.

Closure of an access point →

Skewed boarding distribution towards the single entrance at DAS which cancels out at the downstream stations.

Real-time crowding information

- Potential to reduce
  - crowding unevenness.
  - fail-to-board incidents in higher demand scenarios.
- There is still limited research on the inclusion of RTCI in passenger route choice and assignment models.



<u>Objective:</u>

Extend existing PT simulation models to account for passengers' access to car-specific RTCI.

Modelling car-specific RTCI in BusMezzo

- Record the crowding factor in each train car when train departs from a stop.
  – Crowding factor is a function of the car occupancy level.

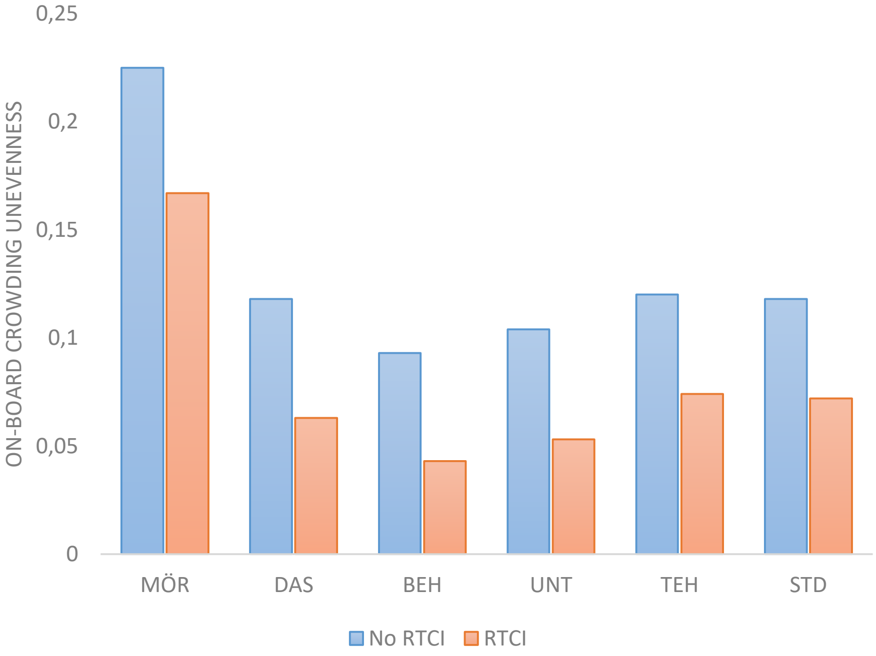
RTCI level	Car capacity utilization	Crowding factor
●○○○ (green)	<80% seated capacity	1.0
●●○○ (yellow)	<100% seated capacity	1.2
●●●○ (orange)	<80% total capacity	1.5
●●●● (red)	<100% total capacity	1.8

(Drabicki et al. 2020)

- Generate crowding information and update it for each trip segment every time a train trip departs.
  – Generated RTCI is based on the car crowding level of the **latest train run** only.

- Each passenger utilizes the generated car-specific RTCI, as an **in-vehicle time multiplier** of each given line segment, in the decision making process.

Effect of RTCI on crowding unevenness



- Positive statistically significant effects of RTCI on crowding unevenness.
- Improved vehicle capacity utilization - 2% less seats are left empty.

On-going work

- Extend the generation of RTCI, adding dependence on the crowding level of **multiple previous train runs**.
- Investigate the effect of other **control measures** on reducing crowding unevenness.

Thank you

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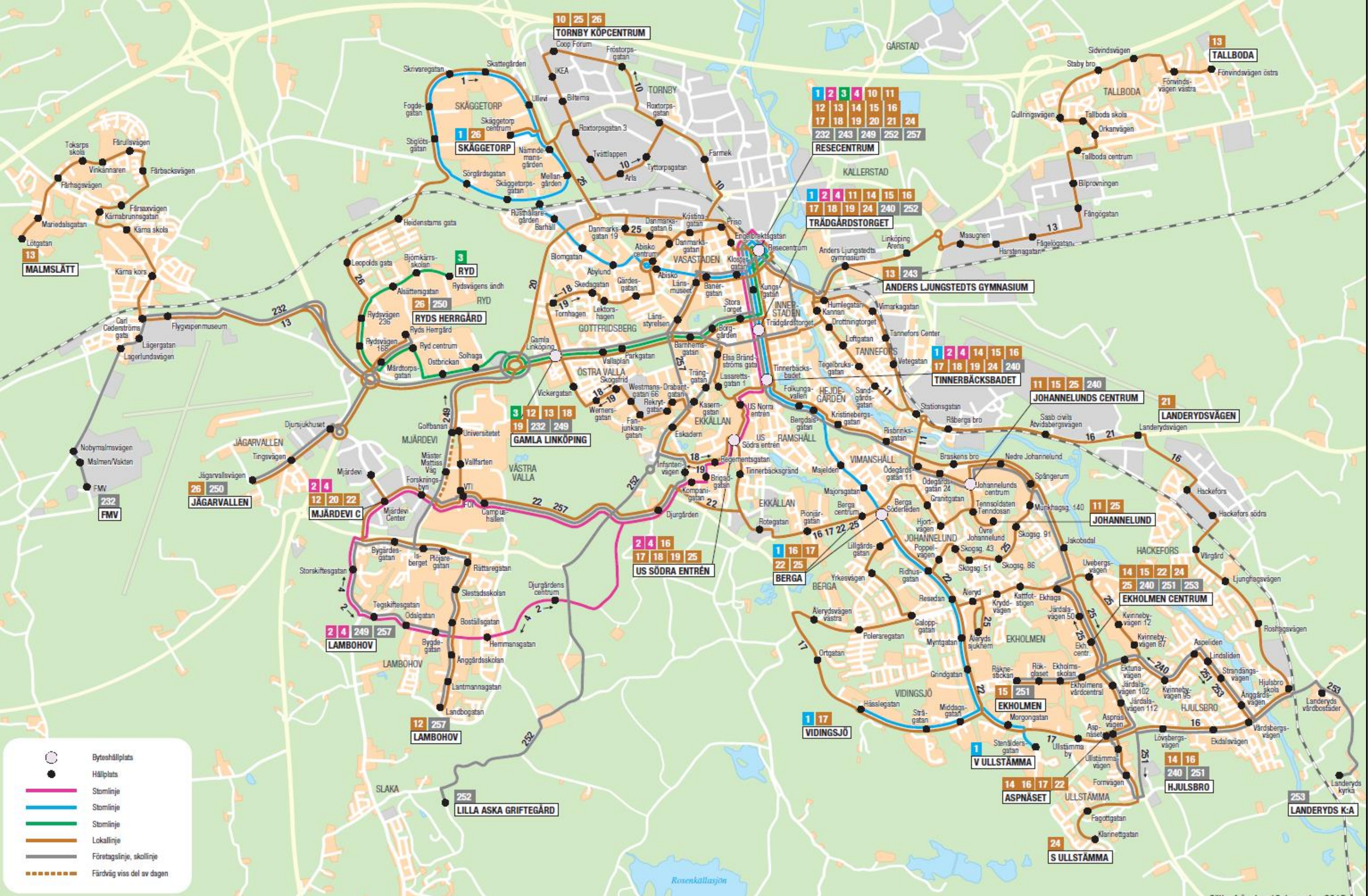
Foto Geran De Klerk, Unsplash

PASSENGER-CENTERED PLANNING AND CONTROL OF TRANSFER HUBS

Traffic planning at bus terminals

Therese Lindberg

CTR vti LiU LINKÖPING UNIVERSITY

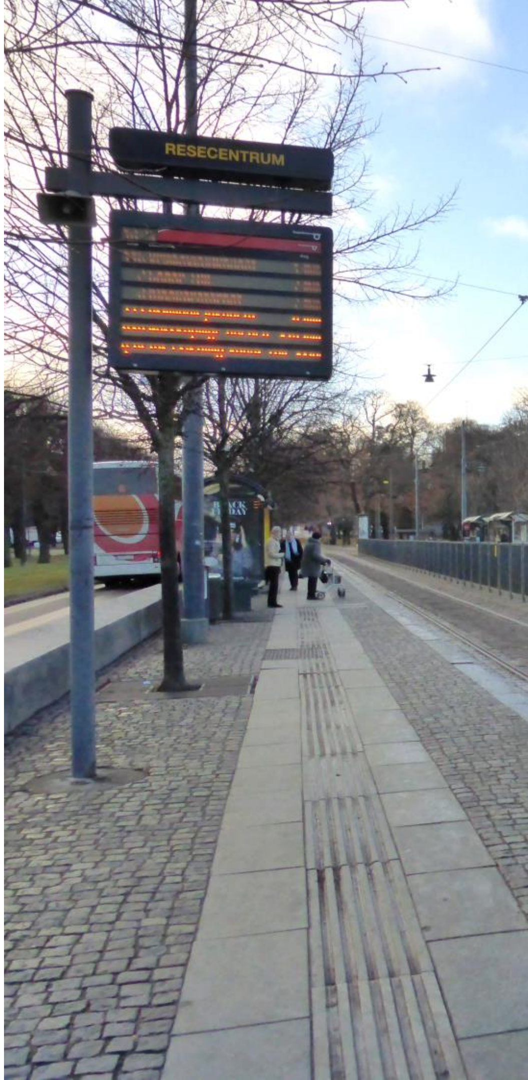


10 25 26
TORNBY KÖPCENTRUM
13
TALLBODA
1 2 3 4 10 11
12 13 14 15 16
17 18 19 20 21 24
232 243 249 252 257
RESECENTRUM
1 2 4 11 14 15 16
17 18 19 24 240 252
TRÄDGÅRDSTORGET
1 26
SKÄGGETORP
13
MALMSLÄTT
3
RYD
26 250
RYDS HERRGÅRD
13 243
ANDERS LJUNGSTEDTS GYMNASIUM
1 2 4 14 15 16
17 18 19 24 240
TINNERBÄCKSBADET
11 15 25 240
JOHANNELUNDS CENTRUM
21
LANDERYDSVÄGEN
3 12 13 18
19 232 249
GAMLA LINKÖPING
232
FMV
26 250
JÄGARVALLEN
2 4
12 20 22
MJÄRDEVI C
11 25
JOHANNELUND
2 4 16
17 18 19 25
US SÖDRA ENTRÉN
1 16 17
22 25
BERGA
14 15 22 24
25 240 251 253
EKHOLMEN CENTRUM
2 4 249 257
LAMBOHOV
12 257
LAMBOHOV
15 251
EKHOLMEN
1 17
VIDINGSJÖ
1
V ULLSTÄMMA
14 16 17 22
ASPNÄSET
14 16
240 251
HJULSBRO
253
LANDERYDS K:A
24
S ULLSTÄMMA
252
LILLA ASKA GRIFTEGÅRD
Byteshållplats
Hållplats
Stomlinje
Stomlinje
Stomlinje
Lokallinje
Företagslinje, skollinje
Färdväg viss del av dagen

vti

BACKGROUND

- No one likes to transfer
- Need to be well-functioning and facilitate easy transfers
- Previous research:
  - Methods to evaluate the physical planning
  - Could also be used to evaluate the traffic on the terminal
- Now:
  - Improve the planning of the traffic on the terminal
  - How to plan the allocation of buses to stops?



STOP ALLOCATION

What to improve?

- Congestion
- Robustness
- Walking distances

What should be allocated?

- Buses
- Lines

Allocation at what stage?

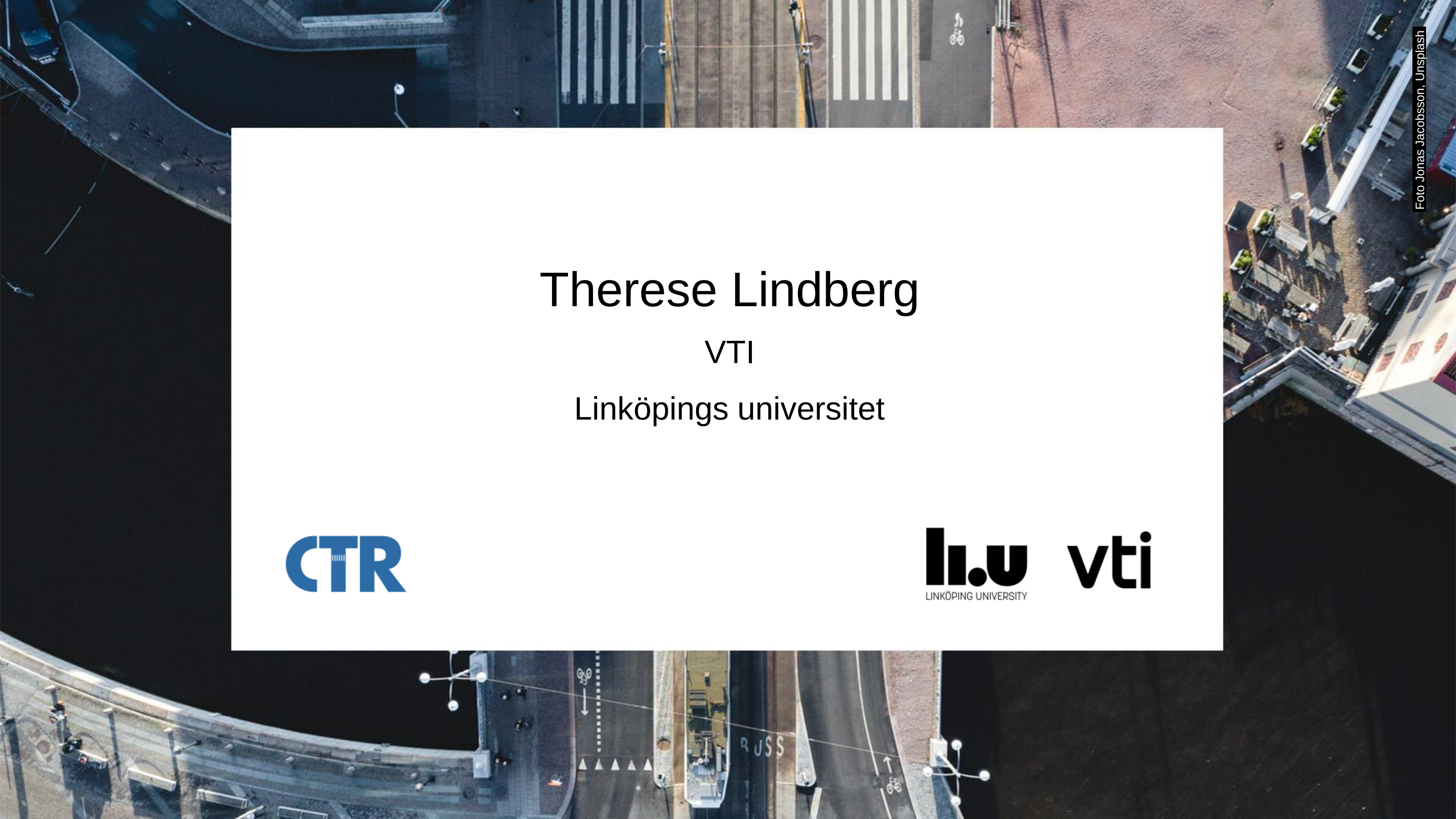
- Planning
- Real-time

A SIMPLE MODEL

- Minimize:

  The **walking distances** for all passengers on all buses from **entry** to boarding stop, from alighting stop to **exit** and between **transferring** buses

- Constraints:
  - Each bus uses exactly one stop
  - Two buses at the same stop can not have overlapping time windows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