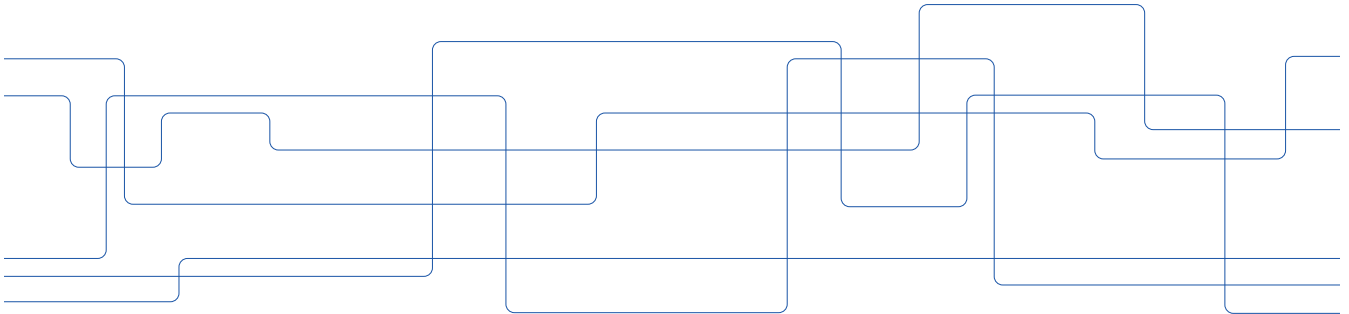# Smarta bytespunkter:
Metoder för utformning och drift av bytespunkter i kollektivtrafiken

Soumela Peftitsi, Erik Jenelius och Oded Cats
jenelius@kth.se

Projektet

- Utvecklar metoder och verktyg för att stödja stationsplanering och -drift med avseende på passagerarströmmar, omgivande trafiksystemet och påverkan på trängsel

- 2019-

- Therese Lindberg (LiU/VTI): Bussterminaler

- Soumela Peftitsi (KTH): Tågstationer (tunnelbana)

- Fredrik Johansson (VTI, projektledare), Anders Peterson (LiU), Erik Jenelius (KTH)
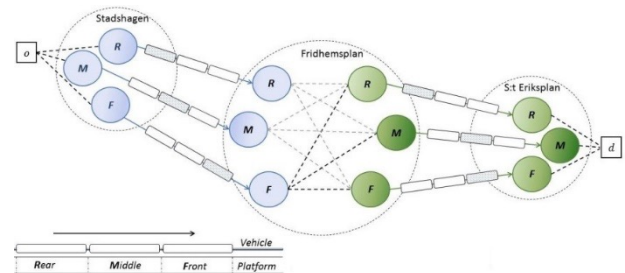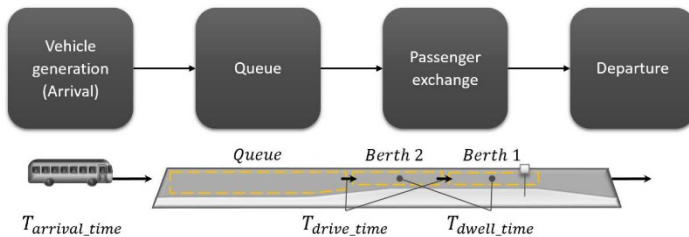
Motivation

Uneven passenger distributions

- ➢ Travel demand spatial distribution
- ➢ Inter-vehicle arrival distribution
- ➢ Within-vehicle distribution


Source: Fang et al 2017

- ➢ Inefficient capacity utilization and higher costs for all parties

Analysis and management of uneven passenger distributions

- ➢ Rich public transport data
- ➢ Analyze passenger distribution based on actual data
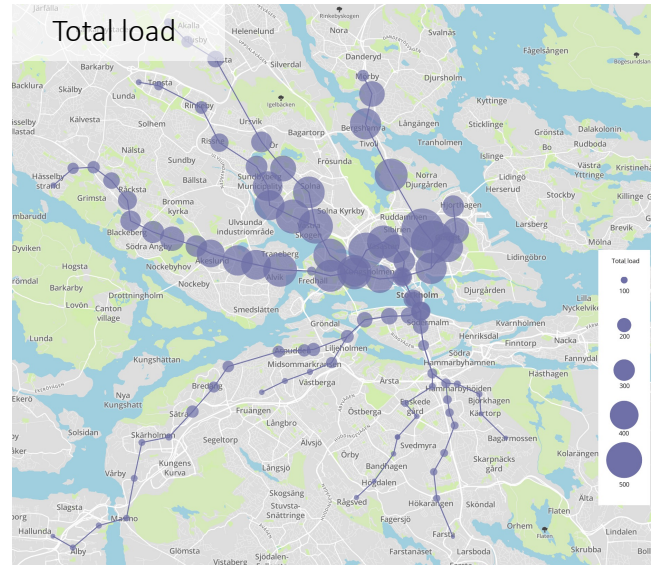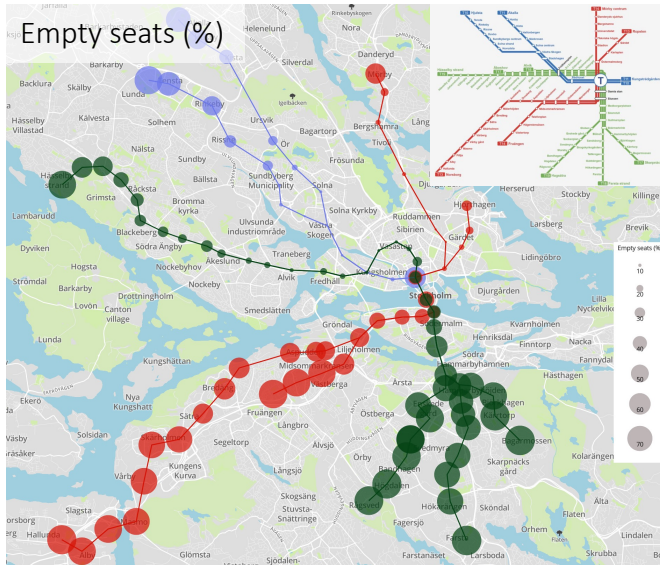- ➢ Enhance crowding management

- ➢ Direct passenger flows at gates, on platform or through information

- ➢ Model and evaluate passengers' access to train-car crowding information

Demand management

Source: Region Stockholm
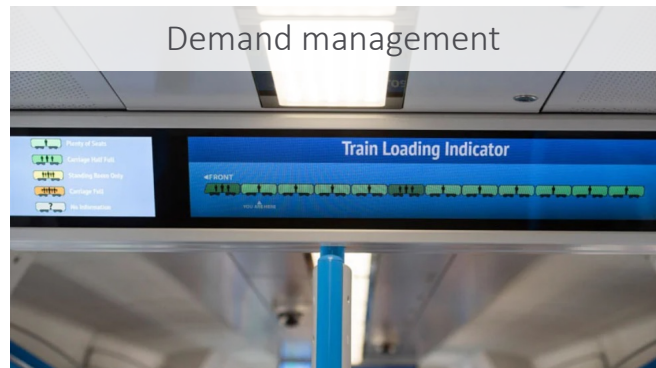
Studied area
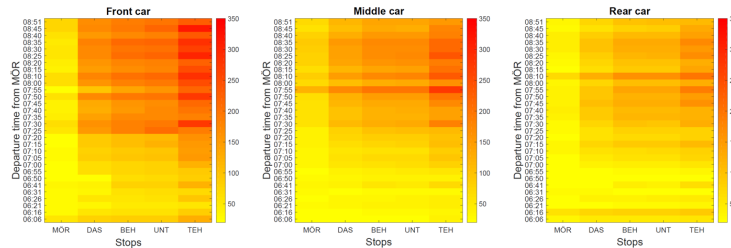## Stockholm metro network

Empty seats (%)

Total load

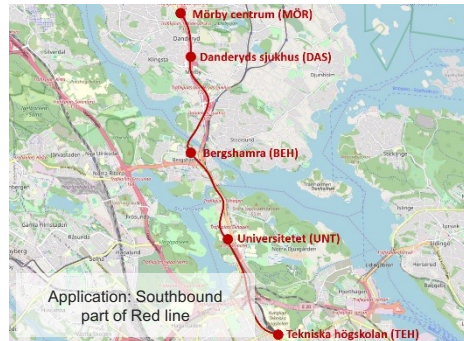> ➤ Inefficient capacity utilization even of heavily loaded trains

Determinants of crowding distribution
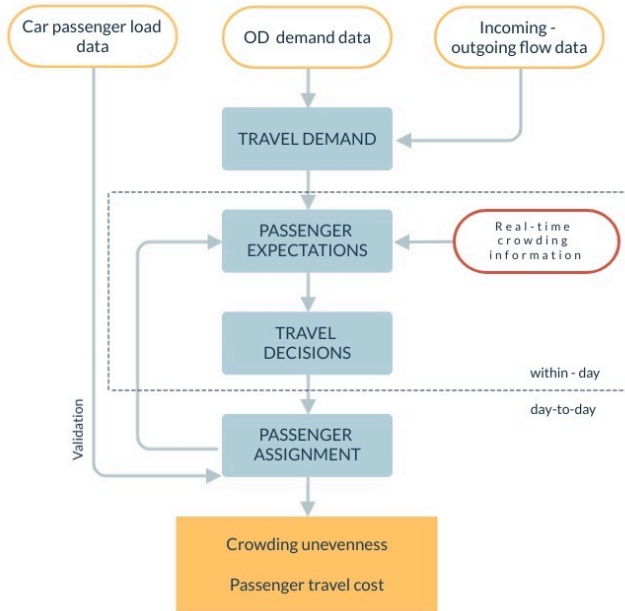
Determinants of crowding distribution

Application: Southbound part of Red line
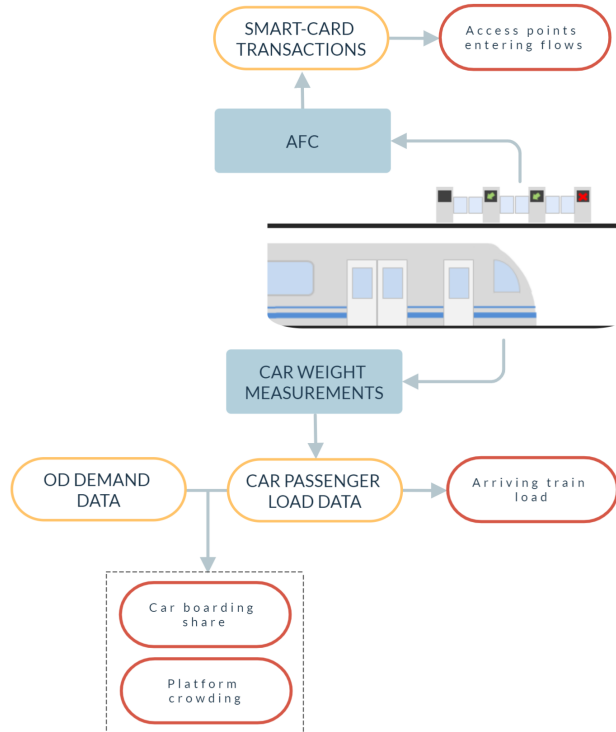
➢ Avoid **walking time** at the origin
➢ Avoid **on-board discomfort** and **platform discomfort** in crowded situations

Modeling train-car specific travel decisions

BusMezzo – an agent-based transit assignment model

Car passenger load data

OD demand data

Incoming - outgoing flow data

TRAVEL DEMAND

PASSENGER EXPECTATIONS

Real-time crowding information

TRAVEL DECISIONS

within - day

day-to-day

Validation

PASSENGER ASSIGNMENT

Crowding unevenness

Passenger travel cost

Car-specific path choices

> ➢ Passenger arrival at/destined to different station **entrances/exits**
> ➢ **Platform & car selection** (introducing compartments)
> ➢ Walking vs. in-vehicle crowding

Day-to-day **experience** and learning

Real-time **information** generation and provision
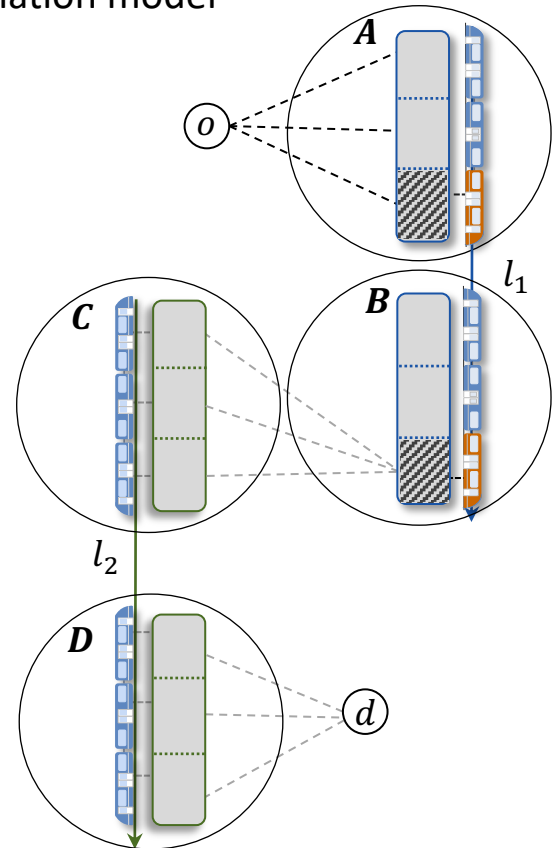
Modeling train-car specific travel decisions

BusMezzo – an agent-based simulation model

Platform section choice:
- Walking time to the platform section
- Expected future travel attributes
- Expected train car crowding (experience, information)

Car choice:
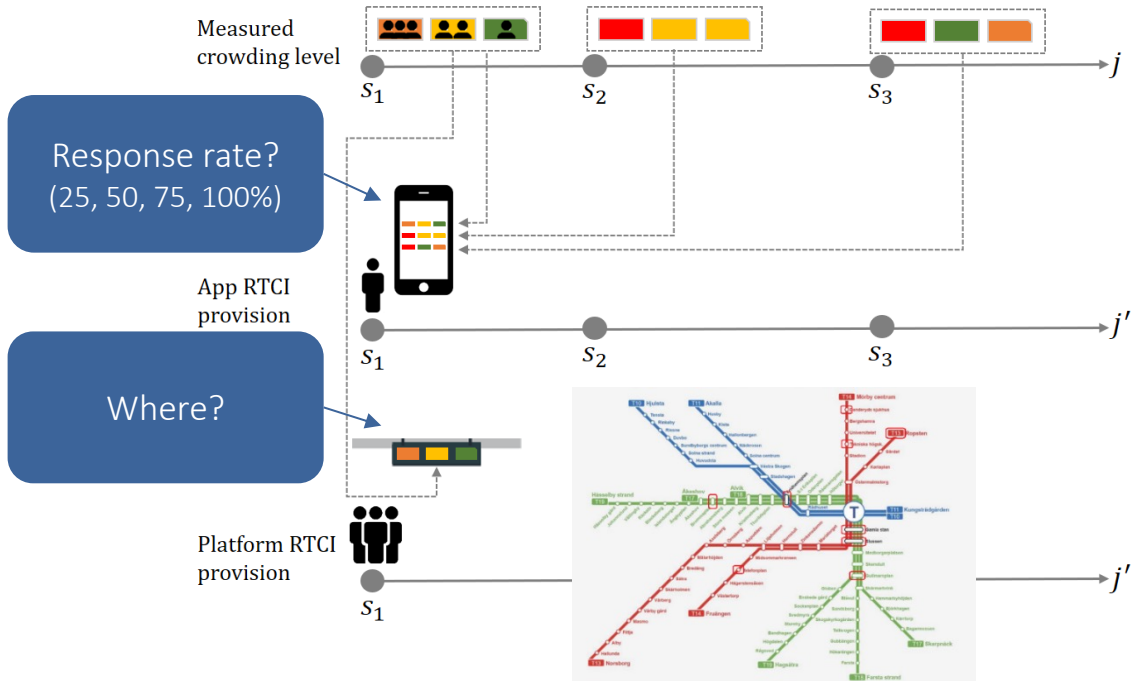- Selected platform section
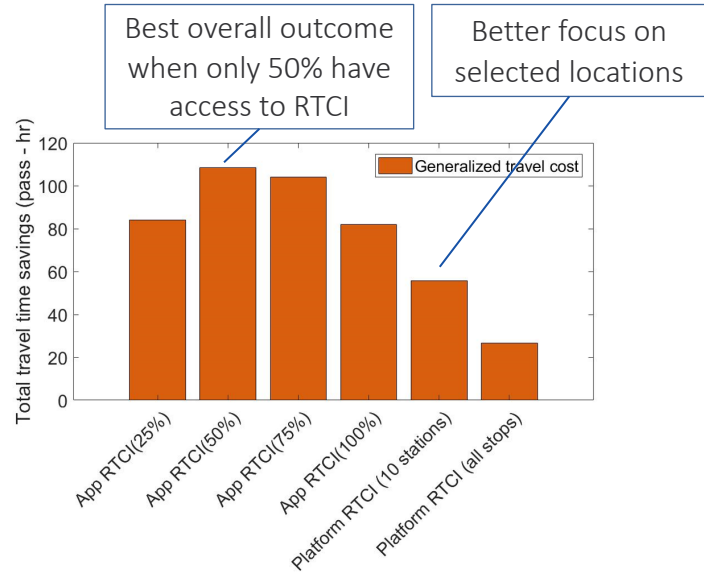- Car capacity

Modeling crowding information

RTCI level	Car capacity utilization		Crowding factor
●○○○	$<= 80\%$ seated capacity		1.0
●●○○	$>80\%$ seated capacity	$<= 100\%$ seated capacity	1.3
●●●○	$>100\%$ seated capacity	$<= 50\%$ total capacity	1.5
●●●●	$>50\%$ total capacity		1.8

➢ Predict RTCI for each trip segment based on the measured car crowding level of the *most recent train run*.

➢ Each passenger utilizes the RTCI, as an *in-vehicle time multiplier* of a given trip segment, in the decision making process.

Measured crowding level

s_1 s_2 s_3 j

Response rate?
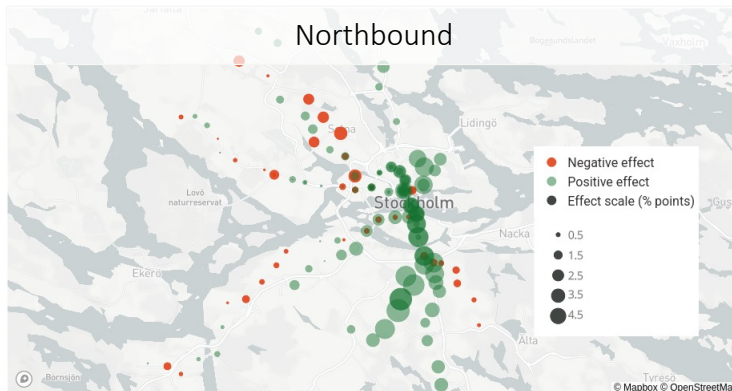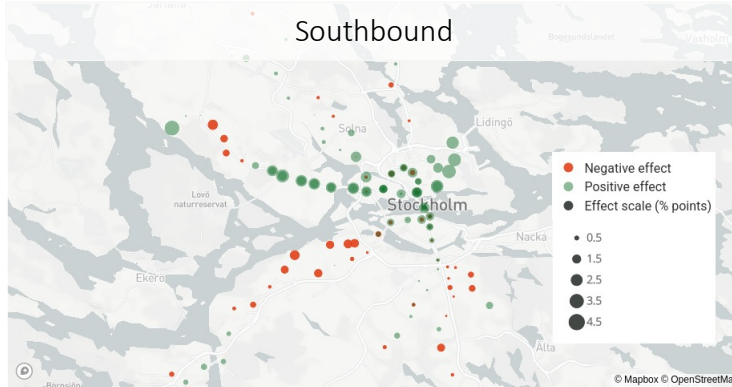(25, 50, 75, 100%)

App RTCI provision

s_1 s_2 s_3 j'

Where?

Platform RTCI provision

s_1 j'

The role of information

The role of information

Southbound

Northbound

- ➢ Lower crowding unevenness upon departure from the most heavily loaded stops (upstream of the city center).

- ➢ In anticipation of crowded conditions passengers choose to board less crowded train cars → a better train capacity utilization.

- ➢ Some global route choice effects along crowded corridors.

Summary

➢ Trade-offs between walking and waiting to board a less crowded train car.

➢ Experienced passengers board less crowded train cars in crowding conditions → improved vehicle capacity utilization and travel cost.

➢ Best overall outcome of RTCI when only 50% comply to the information.

Contributions

Authorities and Planners

➢ Frameworks to support the planning of attractive and sustainable public transport systems with respect to crowding unevenness effects

➢ Insights on whether, where and how a management strategy should be implemented

Operators

➢ Benefit from smaller fleet size required due to improved capacity utilization

Users

➢ Benefit from lower experienced discomfort at the cost of increased walking or waiting

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