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OF TECHNOLOGY

Real-Time Crowding Information: Results from a Stockholm Metro Pilot Study

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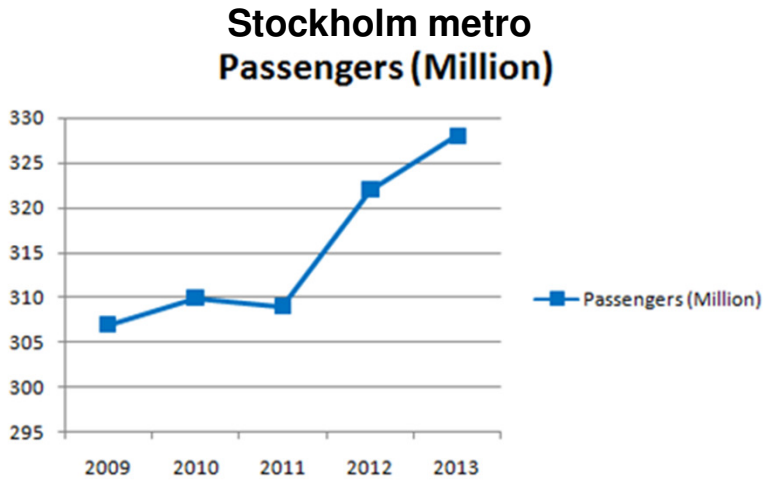
Background: Crowding

Increasing crowding in public transport is common problem worldwide

Many negative effects:

- Discomfort
- Risk of denied boarding
- Longer dwell times, delays, lower punctuality/regularity
- Public transport less attractive



Påstigande per år (miljoner)

Trafikslag	2013	2012	2011	2010	2009
Tunnelbana	328	322[1]	309	310	307
Pendeltåg	82	76	73	70	69
Lokalbanor	47	45	45	38	34
Buss	300	298	291	284	277
Summa	757	**741**[1]	**718**	**702**	**687**

Background: Crowding

Still, passengers are unevenly distributed among cars

Even in peak hours, with loads exceeding practical capacity, there are available seats (usually in middle cars)

2. Stockholm Metro Seat Utilization - Percent (%)					
	07.30-08.30	09.00-15.00	16.30-17.30	15.00-18.00	18.00-21.00
Green Line	70	35	55	55	35
Red Line	80	40	80	65	40
Blue Line	75	45	75	70	50
Sum	75	40	70	60	40

SL 2013

Potential to reduce crowding through better information

Pilot study:
Tekniska högskolan towards T-Centralen

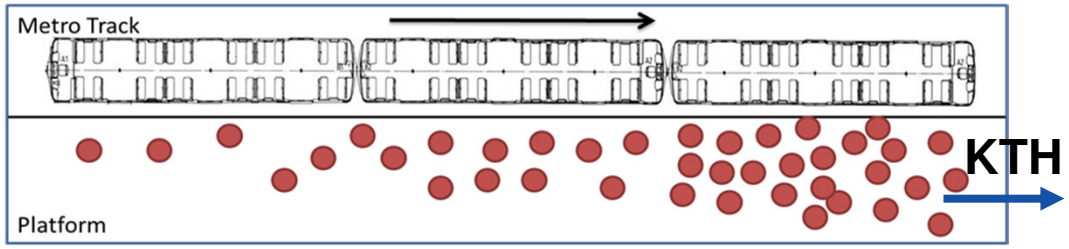
Two entrances, one towards KTH main entrance

During afternoon peak:

Many board at Tekniska högskolan and preceding station Universitetet

Few alight

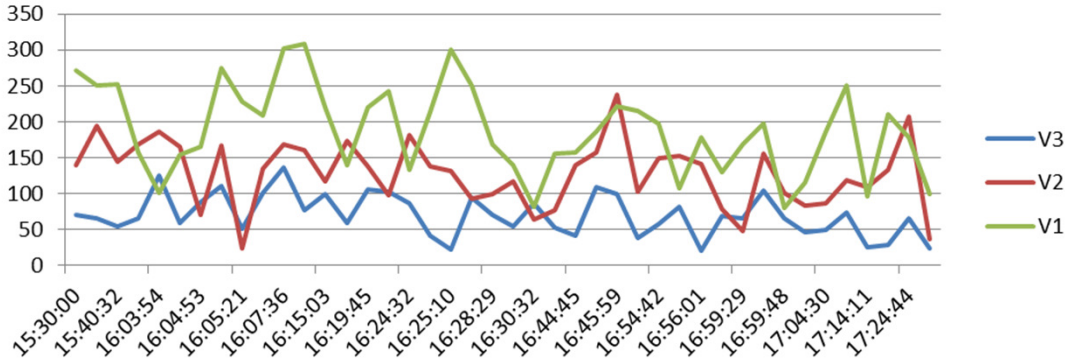
Skewed distribution on platform



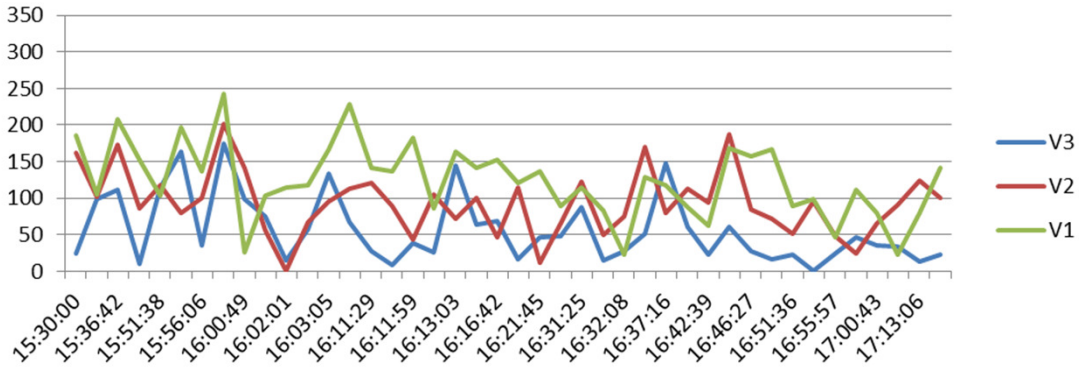
Before-period: May 2014

Passenger load data from air suspension measurements
(Assumption: Average person 76 kg + 2 kg luggage)

Tekniska högskolan

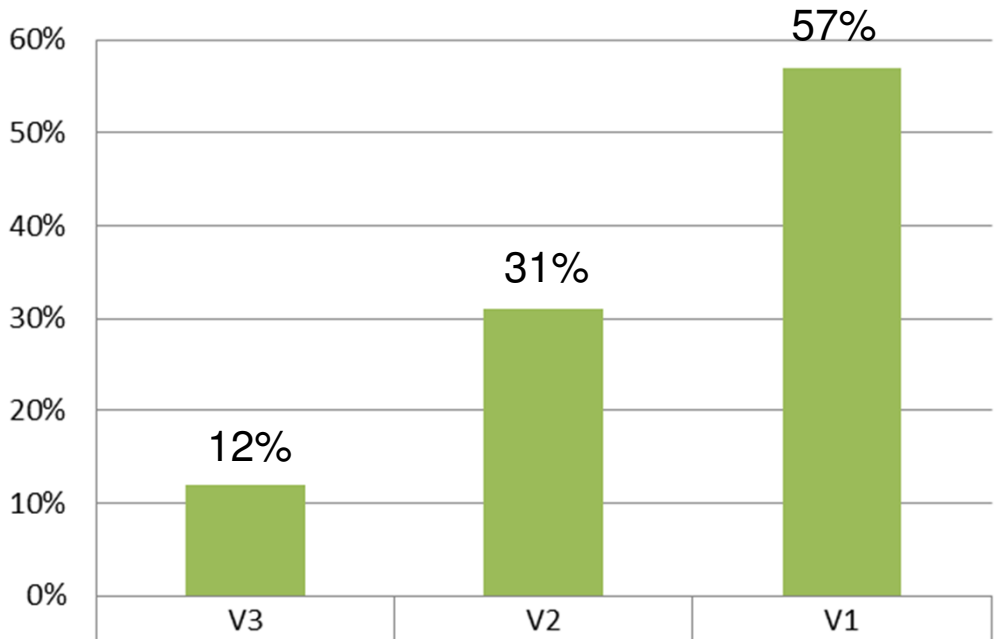


Universitetet



Before-period: May 2014

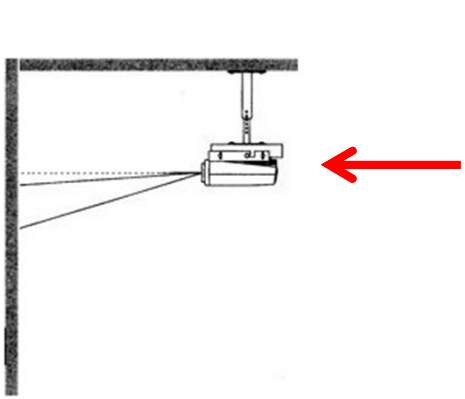
Difference in passenger load Tekniska högskolan – Universitetet shows skewed boarding distribution

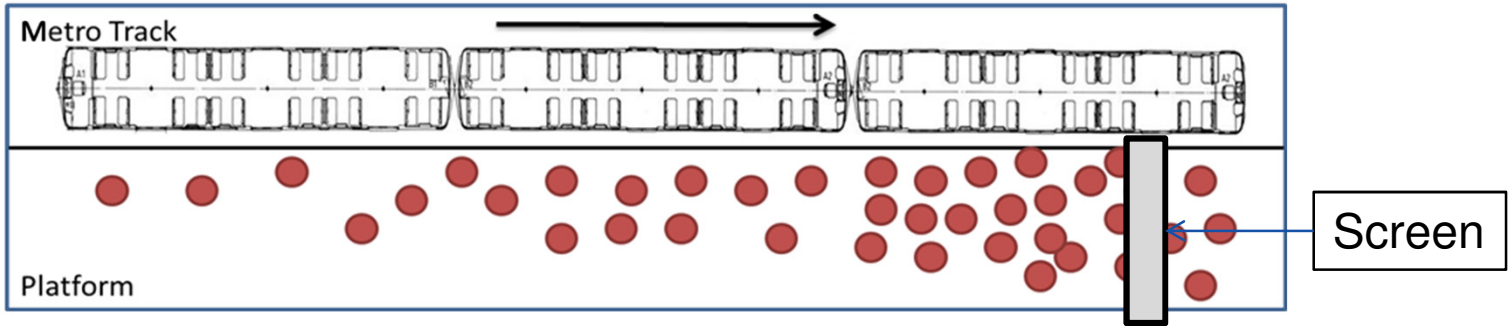


Technical installation

Projector and screen mounted in ceiling

Speaker providing vocal information

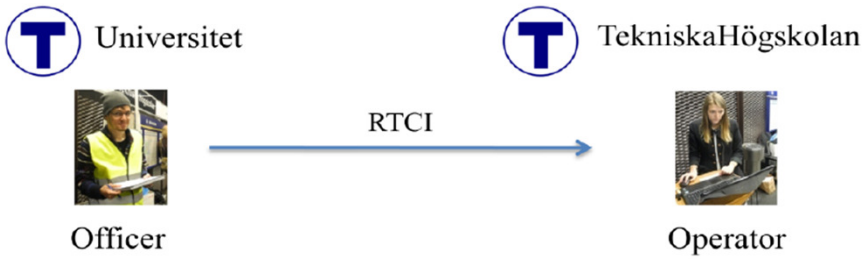




Crowding prediction method

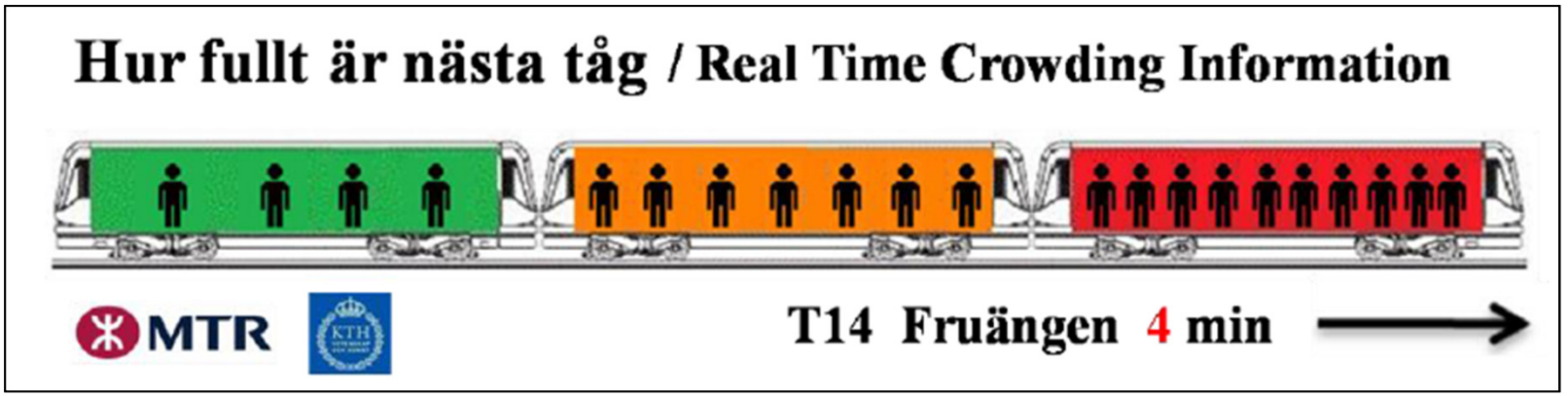
Before train departs Universitetet (> 2.5 min):
Historical average from air suspension weight measurements

After train departs Universitetet (< 2.5 min):
Observer at Universitet reports crowding to operator



Visual crowding information

Three crowding levels:
green < 150 pax orange ∈ (150,250) red > 250



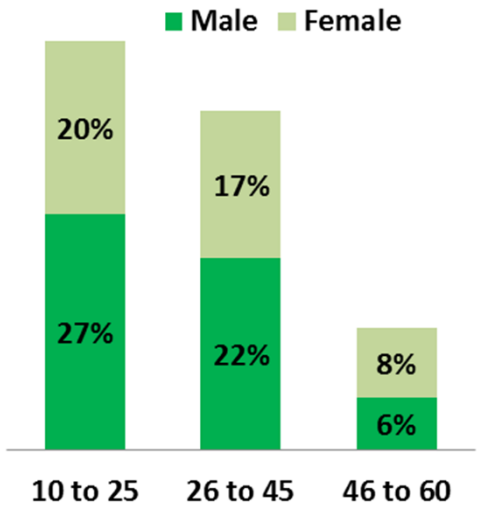
Evaluation

Real-time crowding information tested during afternoon peak six days in May 2015

Sometimes screen+speaker, sometimes screen only

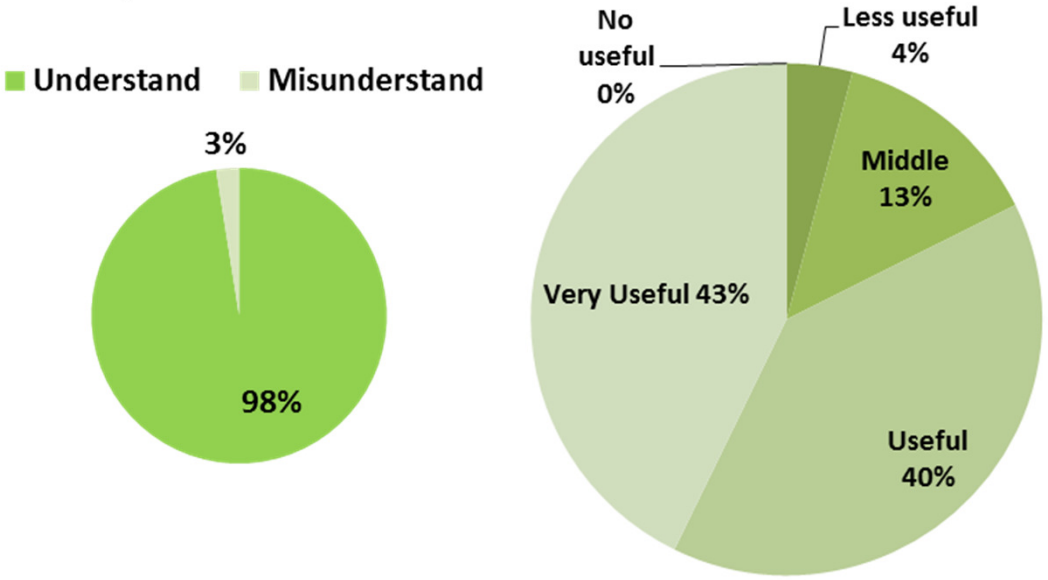
Evaluation based on

- Interviews with 118 waiting passengers
- Video analysis
- Passenger load data from weight measurements



Interview results

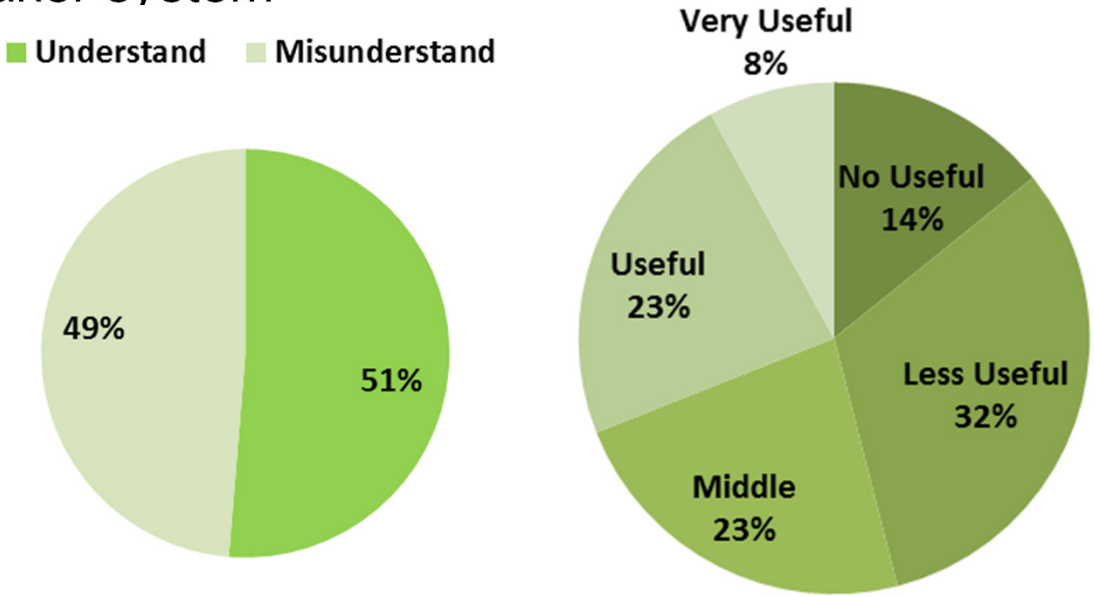
Projection system



No significant difference between age groups

Interview results

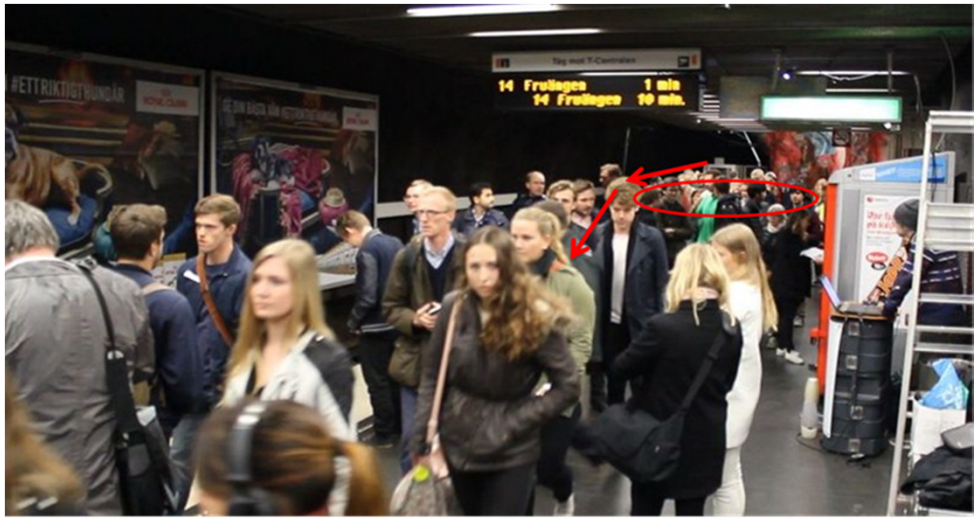
Speaker system



No significant difference between age groups

Video analysis results

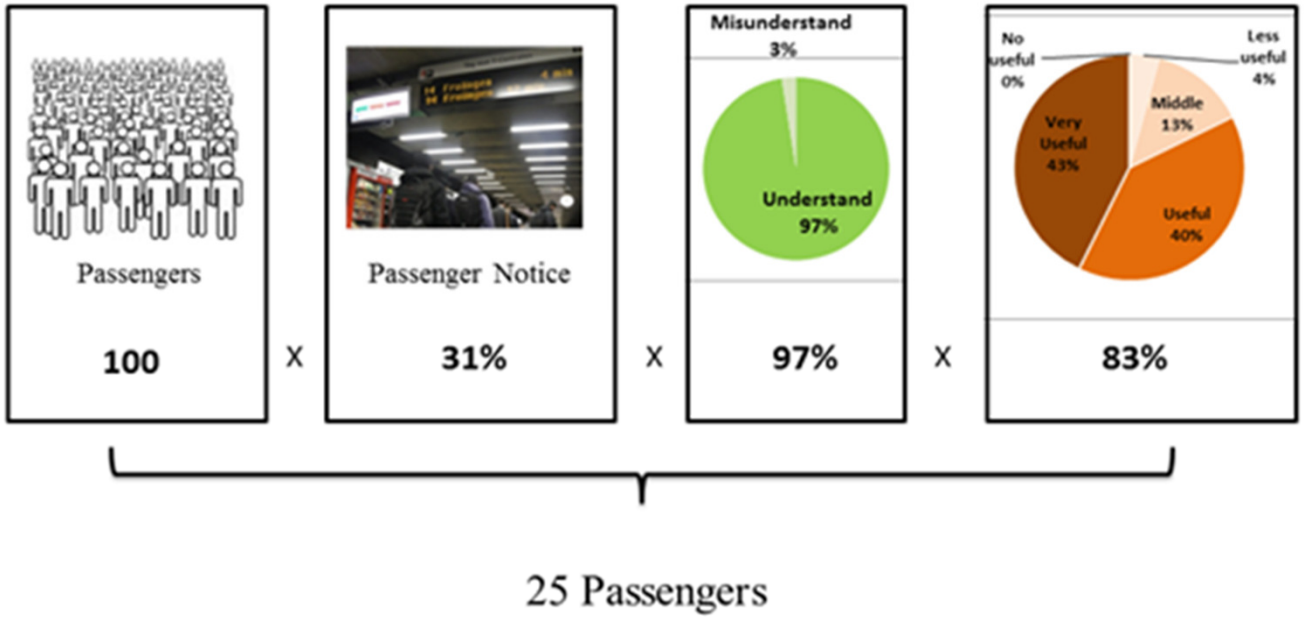
Behavior of 3000 passengers analyzed
Evidence of noticing screen (looking up, pointing)



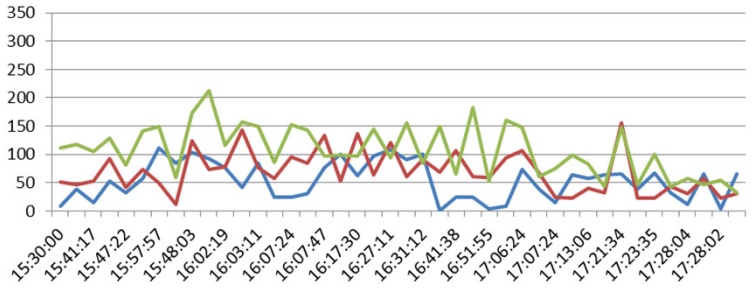
Without speaker: 28% noticed screen
With speaker: 33% noticed screen

Penetration rate

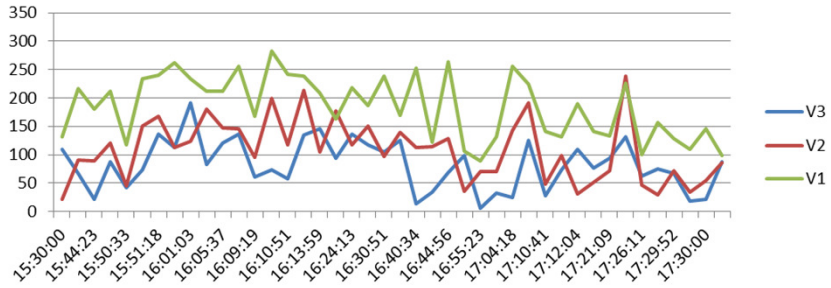
Estimated around 25% consulted real-time crowding information



Passenger load analysis

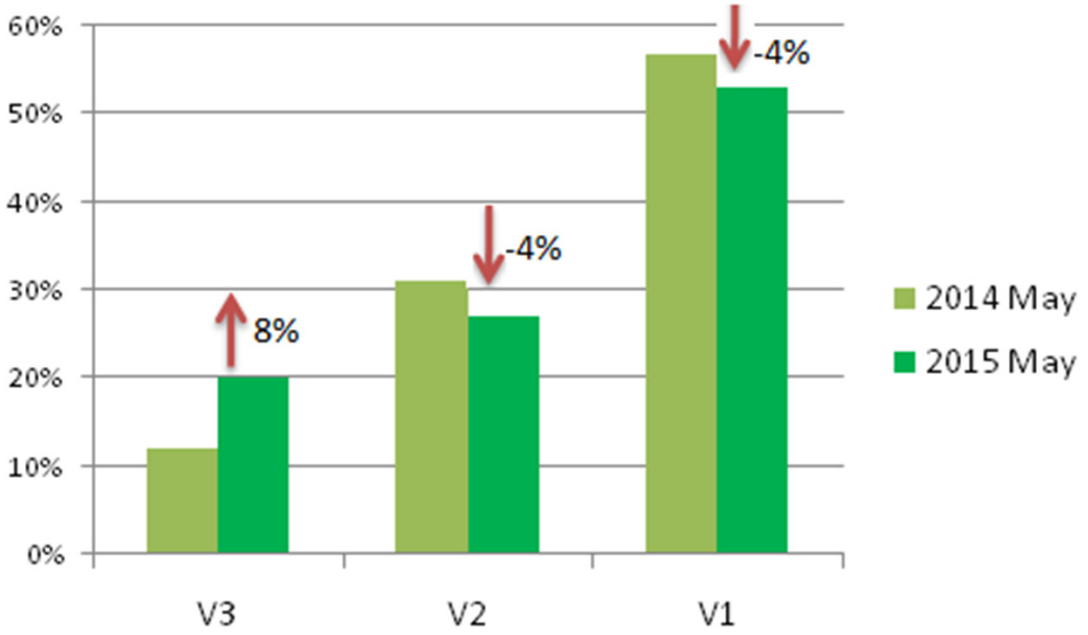


Universitetet



Tekniska högskolan

Shift towards more uniform boarding distribution



Conclusion

Pilot study shows real-time information has potential to even out passenger loads and reduce crowding

Ongoing work

- Technical solution for real-time crowding measurement

Further work needed

- Scale up to multiple stations
- Improve crowding prediction