ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

IVT
Institut für Verkehrsplanung und Transportsysteme
Institute for Transport Planning and Systems

Effects of on-board Ticket Sales on Public Transport Reliability

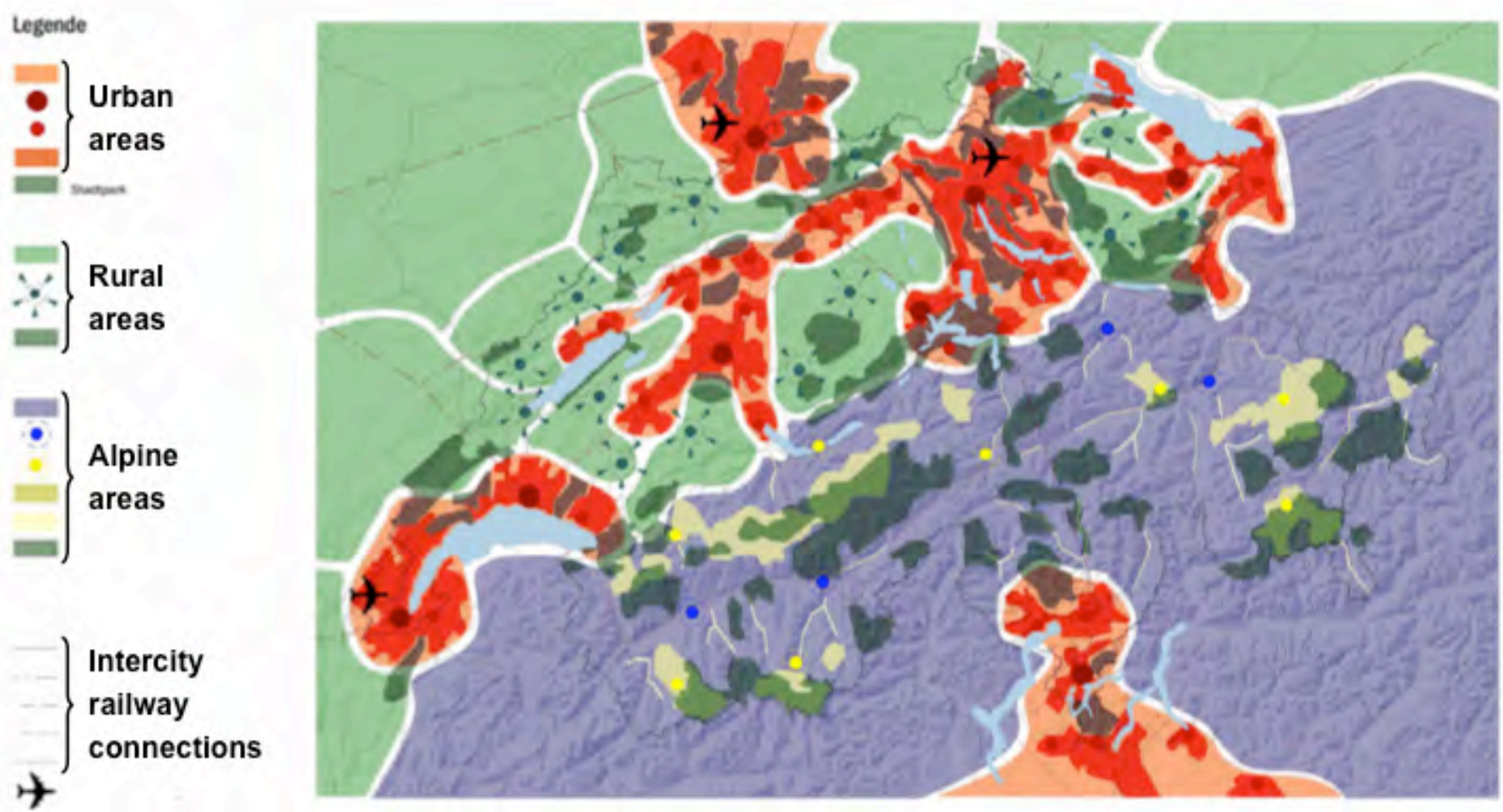
R. Dorbritz, M. Lüthi, Prof. Dr. U. Weidmann, A. Nash

TRB 88th Annual Meeting, 12th January 2009

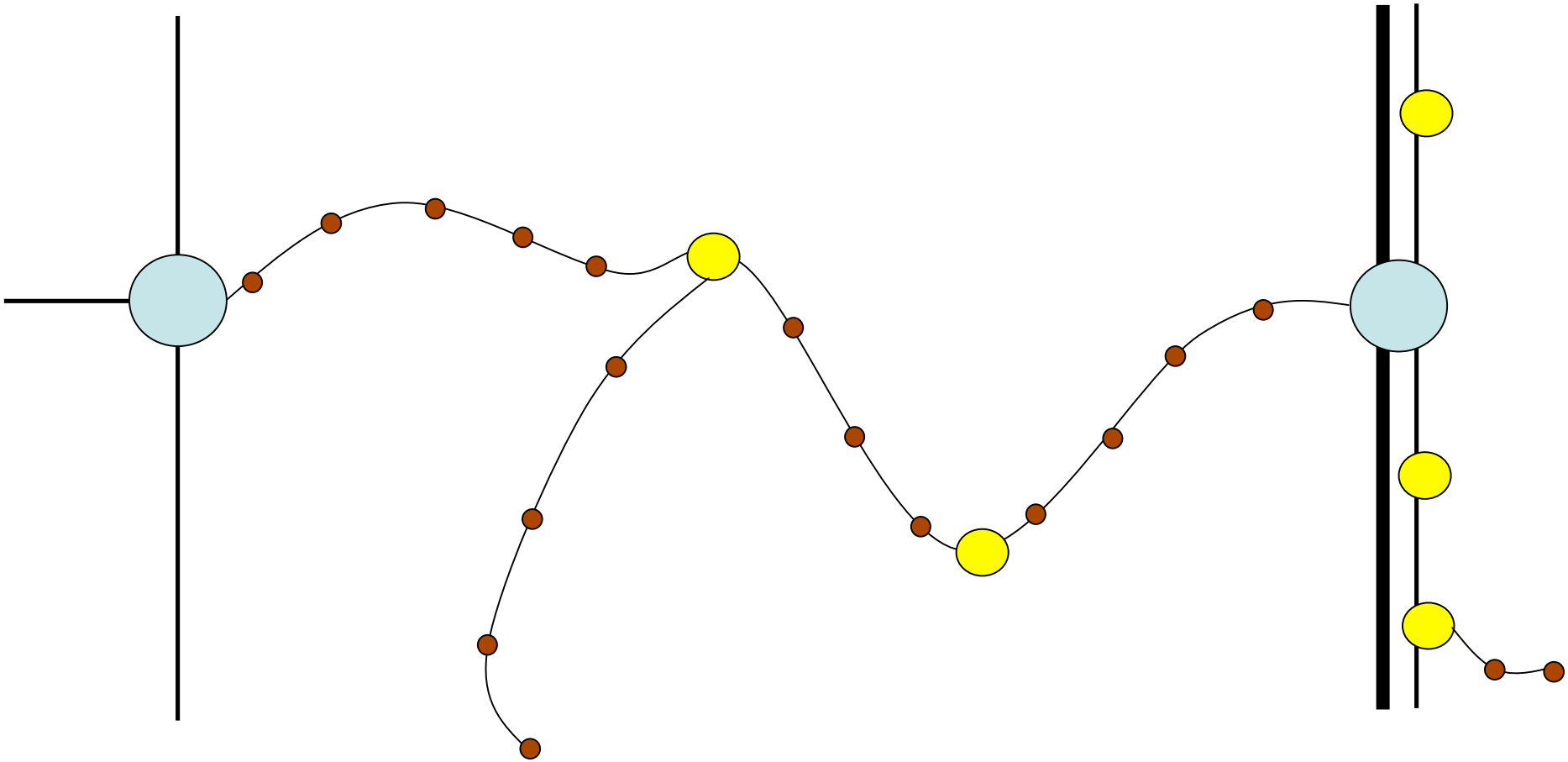
Introduction:

- 7.59 Mio inhabitants
- 41,000 km^2
- 5,312 km railways, 28’240 km total public transport
- 47 annual train rides per person and year
- 21.8% of all passenger kilometers are public transport
- 1,876 Mio passengers total with public transport in 2007 (542 Mio in Zurich area)

Introduction:



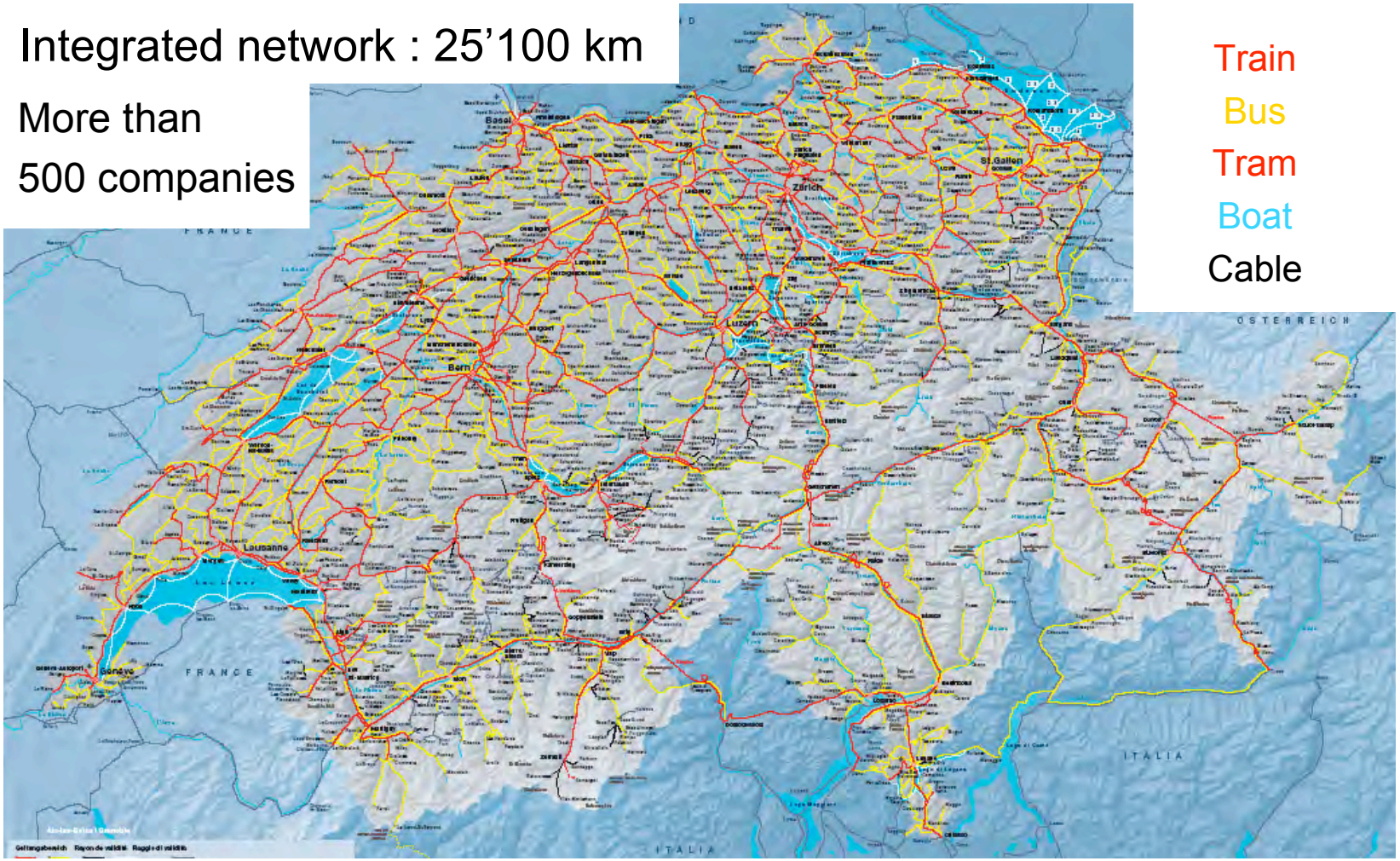
Introduction:



Introduction:

Integrated network : 25’100 km

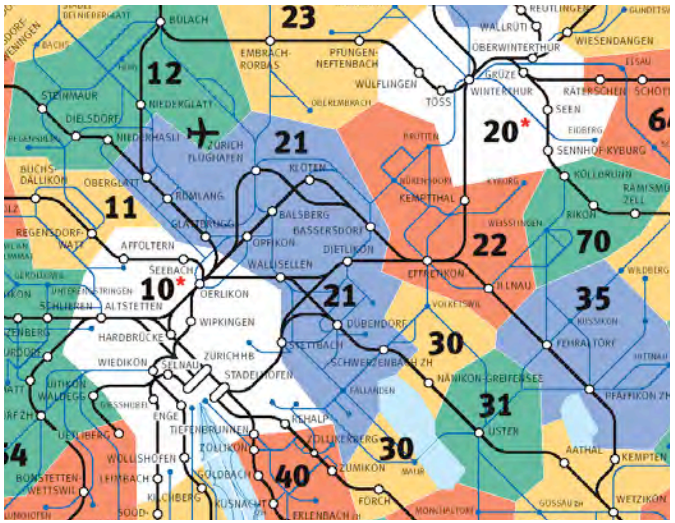
More than
500 companies



Introduction:

Half fare Card 2.2 Mio (28 % of pop.)
Half price on the whole network

General Pass 0.37 Mio (4.9 % of pop.)
free travel in the whole network



Fare communities

Within the zones, passengers can travel as often as they like during their ticket's period of validity. And they can choose the types of public transport that best meet your needs. Train, bus, tram, boat, funicular or cable car – the choice is free. And one ticket covers all of them.

Introduction:

Single ticket

		Adults		Children 6 - 16 / Half-Fare	
	Valid Hrs.	2nd class CHF	1st class CHF	2nd class CHF	1st class CHF
Local network	1/2	2.50	4.10	2.10	3.40
1-2 zones	1	4.00	6.60	2.80	4.60
3 zones	1	6.20	10.20	3.10	5.10
4 zones	2	8.00	13.20	4.00	6.60
5 zones	2	9.80	16.20	4.90	8.10
6 zones	2	11.60	19.20	5.80	9.60
7 zones	2	13.40	22.20	6.70	11.10
All zones	2	15.40	25.60	7.70	12.80
Short distance	1/2	2.50	4.10	2.10	3.40

Introduction:

Travelcards

- ZVV NetworkPass – the annual and monthly travelcard
- Z-Pass / Z-BonusPass – the travelcard for inter-region commuting

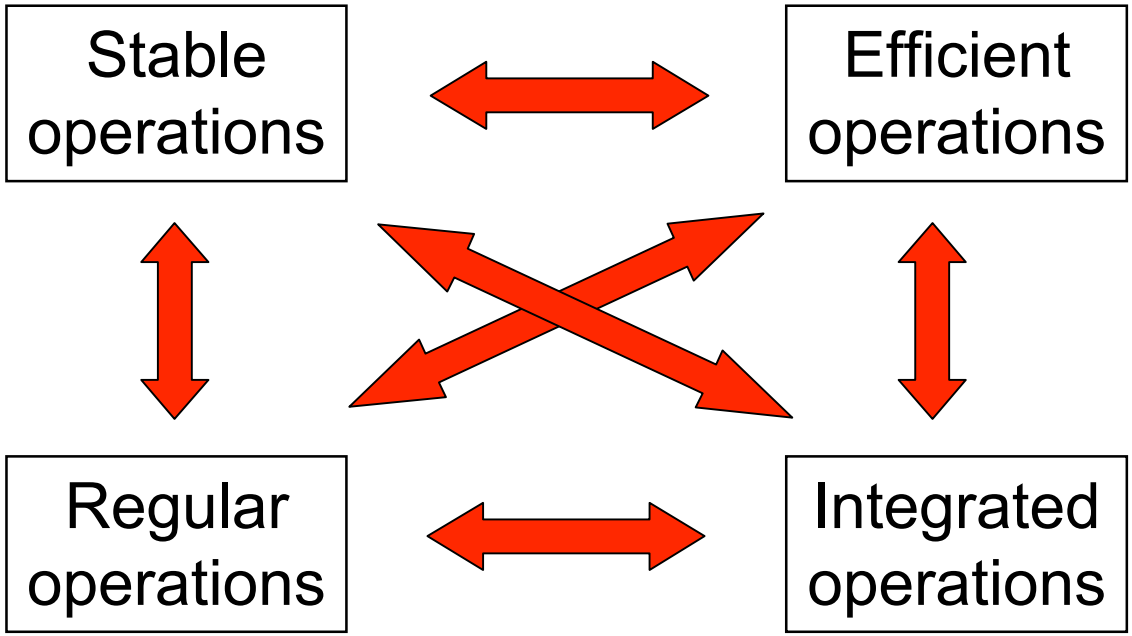
Occasional travel

- Multiple day pass and multiple-journey ticket: 6 days or trips of your choice on one card
- Single ticket, day pass: if you only make infrequent journeys
- Zone upgrade: for trips beyond the area of validity for your travelcard or ticket
- Class upgrade: pay extra to travel first class

Trips / leisure

- 9 o'clock pass: travel after 9 o'clock pays off!
- ZürichCARD / ZürichCARDPLUS: the ideal tickets for guests and tourists
- Albis day pass: your all-in ticket for the Uetliberg-Felsenegg-Albis region
- Self-service loading of bicycles: if you want to take your bike with you
- Group fare: for groups of 10 or more people
- ZVV night supplement: mandatory for all passengers on the nighttime network

Introduction:



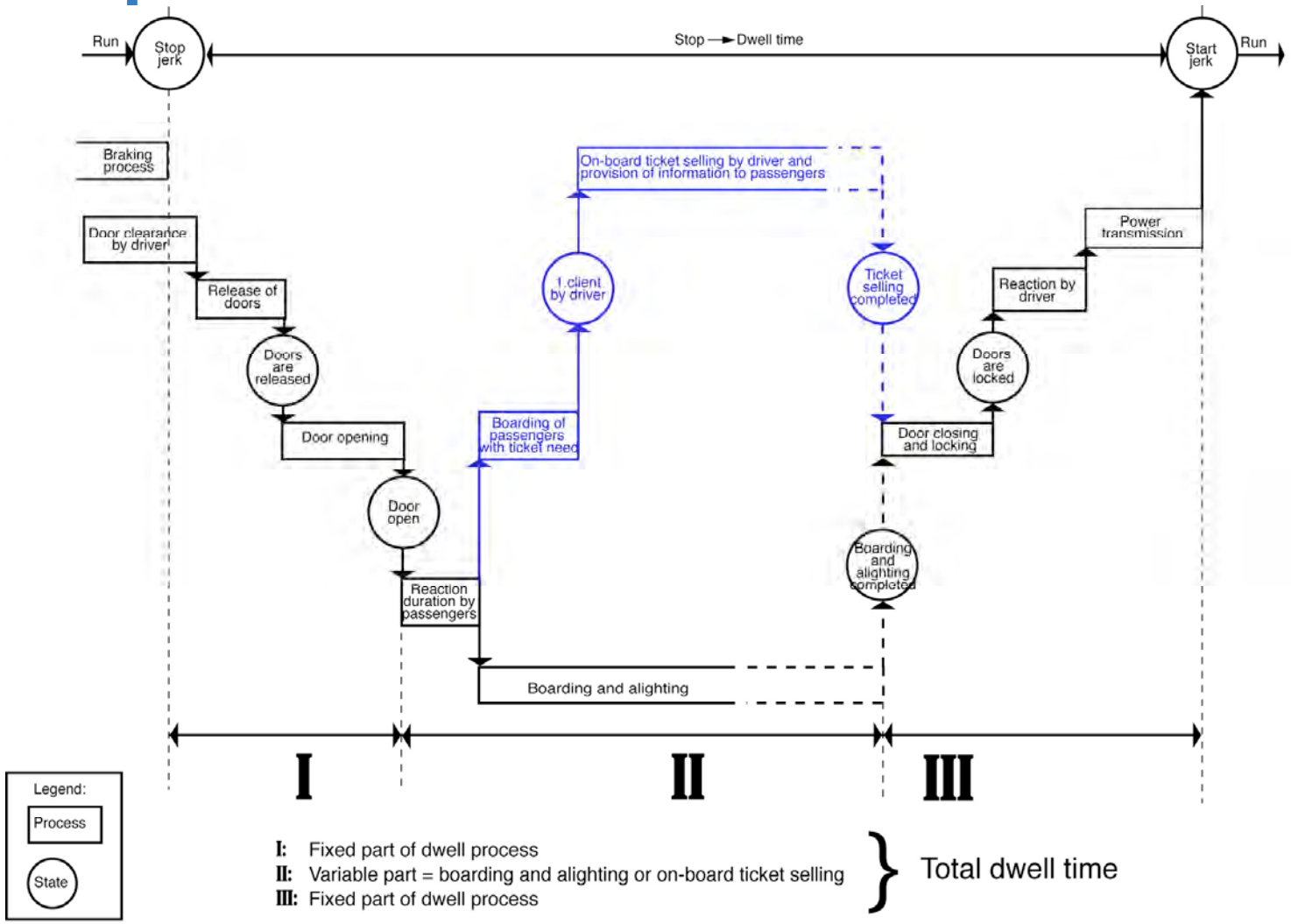
Introduction:

- Dwell process is underlying large variations and is one of the main reasons for delays.
- Results of research on boarding and alighting times is used for scheduling.
- On-board ticket selling by drivers has significant impacts on reliability and stability of bus lines.
- On-board ticket selling by drivers extends travel time significantly.
- Factors influencing on-board ticket selling duration are not known.

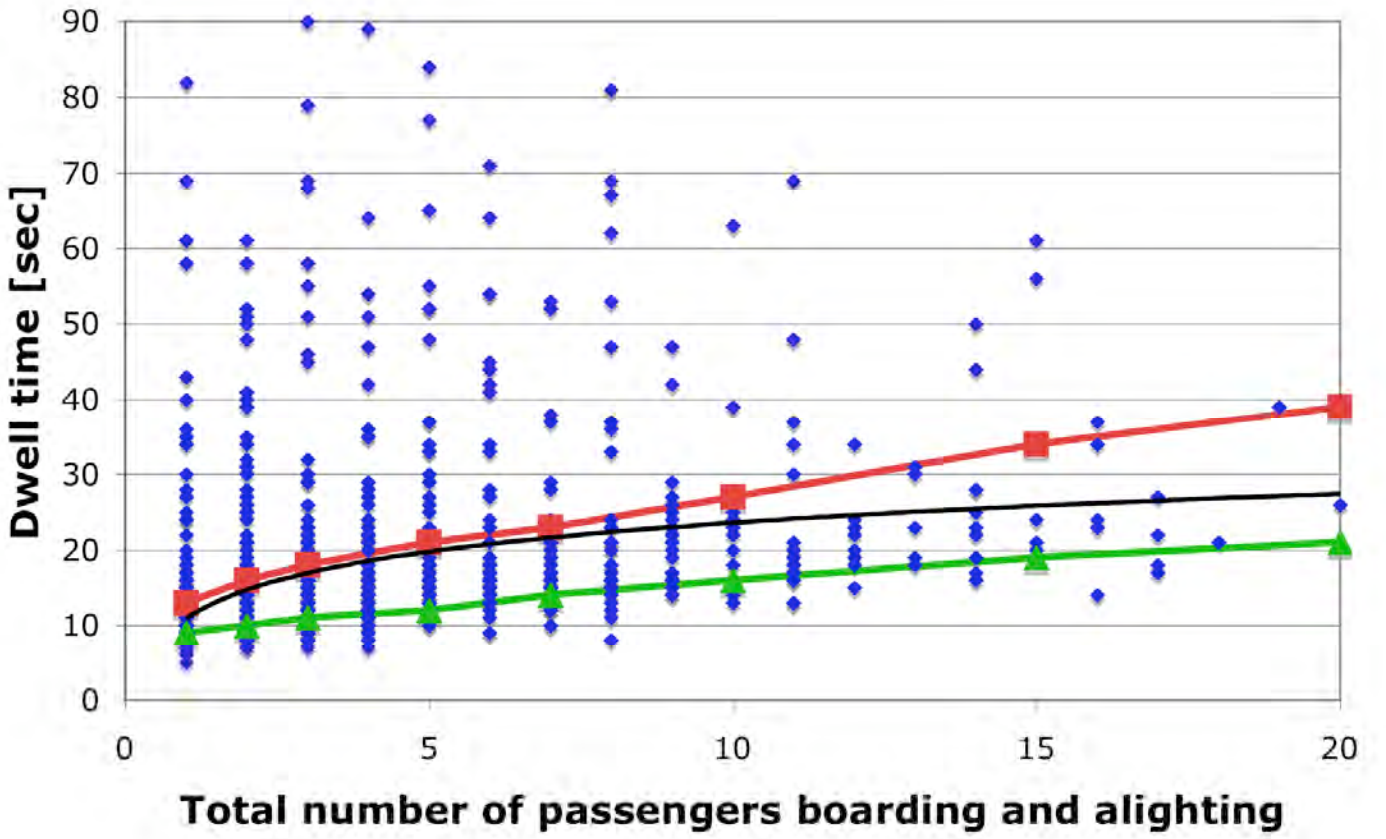
Research questions:

- Identify relevant processes and factors influencing durations of ticket selling through drivers on-board
- Quantify effects of on-board ticket selling through drivers
- Define application areas for on-board ticket selling by drivers
- In coordination with VBG and Postauto Zürich to evaluate usage of new ticketing strategies

Dwell process

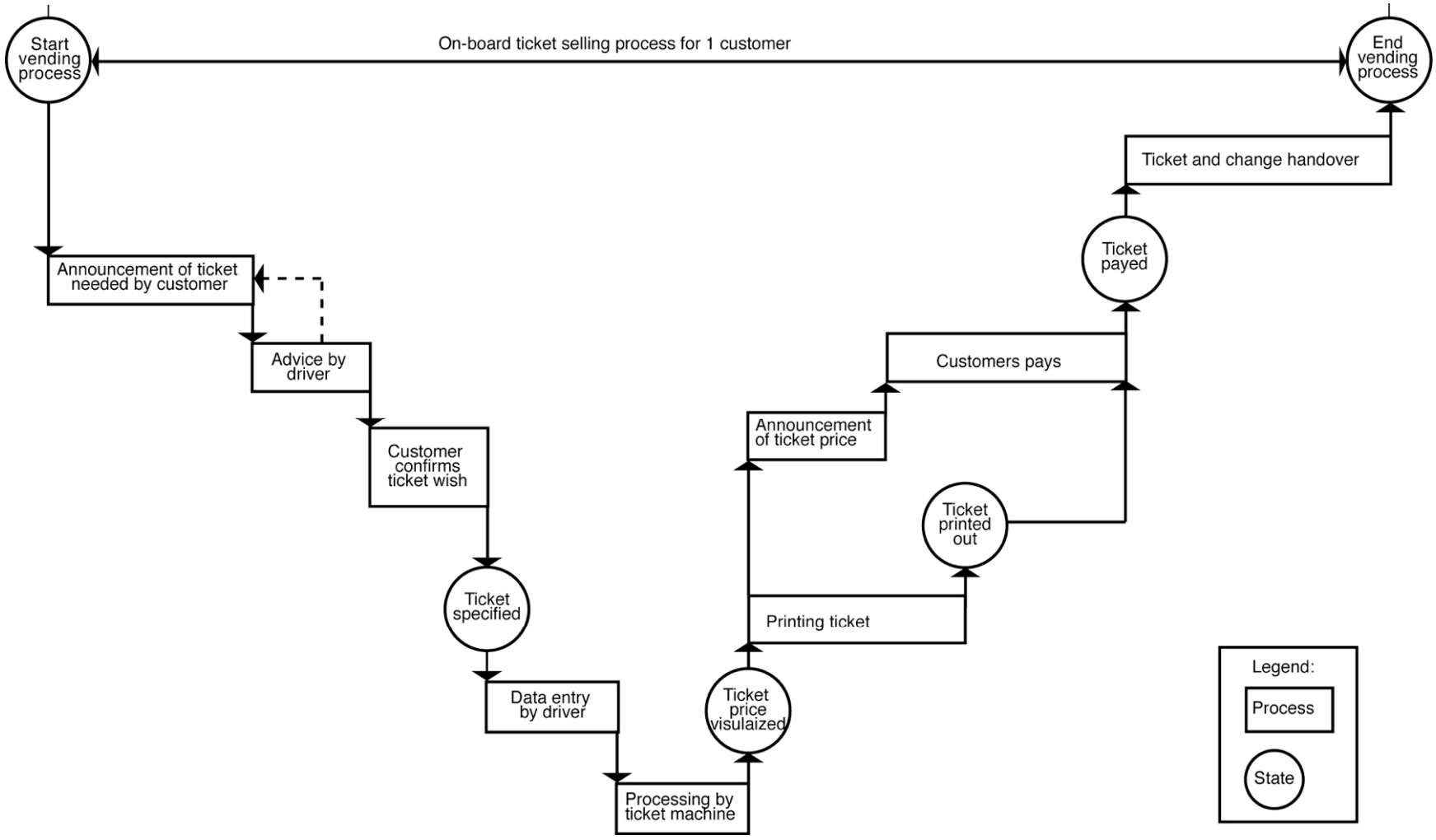


Dwell process

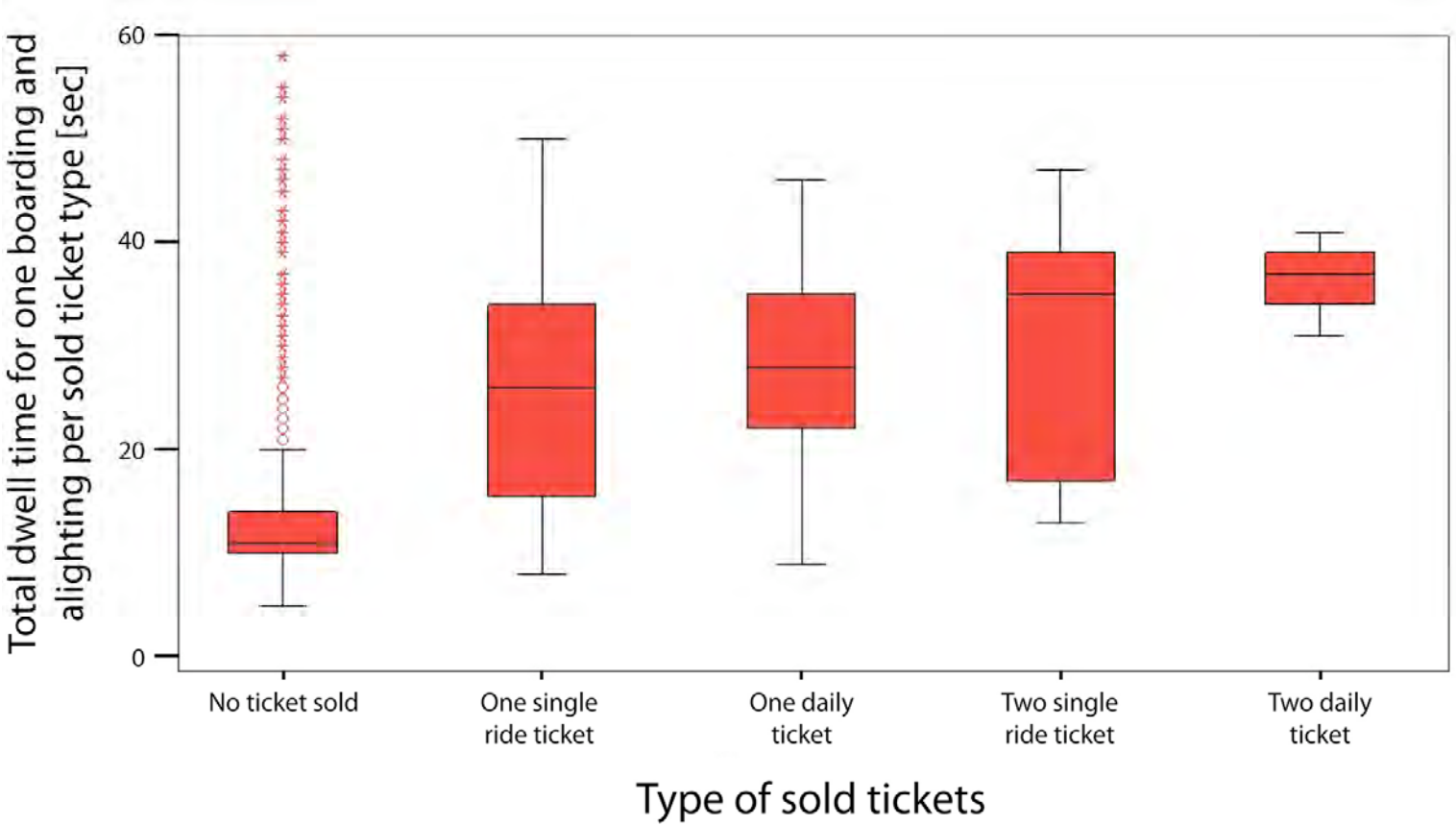


Relationship between total number of boarding and alighting passengers with dwell time (no tickets sold by driver). (Red line: 80 percentile, black: logarithmic regression, green: 20 percentile)

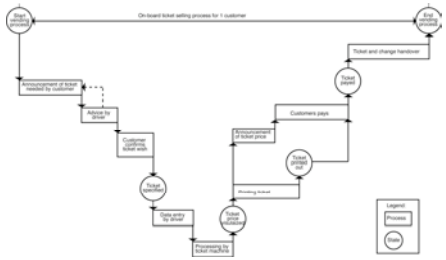
On-board ticket selling process



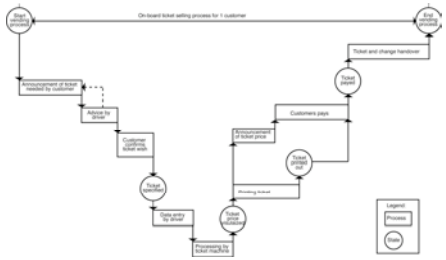
On-board ticket selling process
Measured data by VBG



On-board ticket selling process

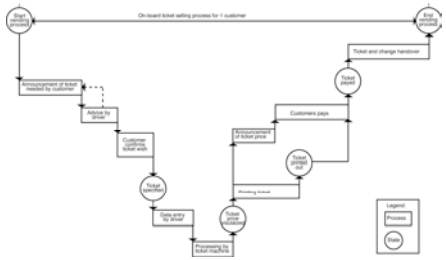


Sub process	Description	Influencing Factors (Factors in bold were considered in the experiment)
Boarding	Boarding the vehicle: Putting away the luggage; Going to the driver	**Customer: Different luggage;** Customers with limited mobility (e.g. disabled or pregnant people); Alighting passengers at front door; Passenger density in the vehicle; Weather; Door defects.
Consultation	Starting the consultation process; Consultation (questions and answers); Determining the appropriate ticket	**Character of bus driver and customer;** Knowledge of the line plan and tariff system; Speaking foreign languages (bus driver and customer); Fast consultation caused by other passengers waiting to buy tickets.
Data Entry	Printing the ticket; Finish the Consultation	**Ticket type; Knowledge and skills of the bus driver when entering the data;** Ticket sales machine failures (e.g. broken printer).
Payment	Saying the ticket price; Payment; Taking ticket and change from the bus driver	**Different payment scenarios; ticket price; skills of customer and bus driver;** Foreign customers not knowing the national currency; Fast payment caused by other passengers waiting to buy tickets.
Leaving the passenger entry area	Leaving the passenger entry area; Next customer starts consultation or bus departure	**Different customers; different luggage**; Customers with limited mobility; Departure time; Fast leaving of the entry area due to other customers.



On-board ticket selling process
Laboratory tests

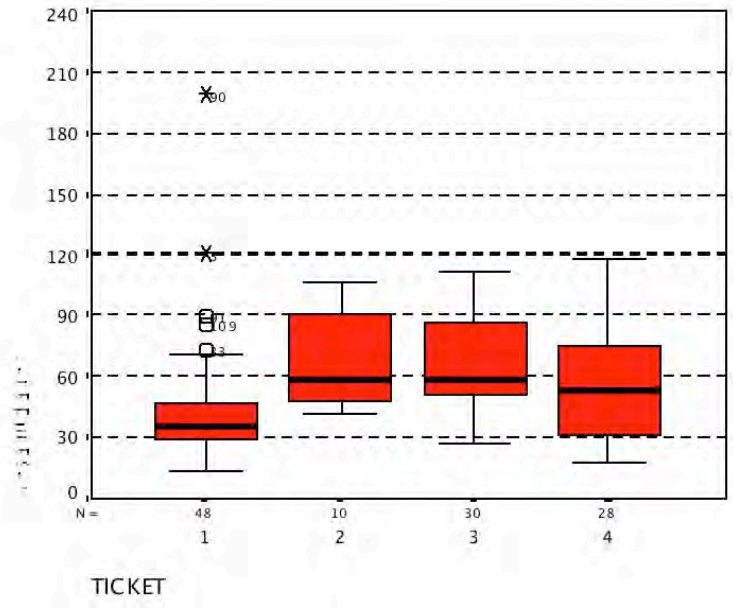
Ticket sales sub process	Mean Value [seconds]	Standard Deviation [seconds]
Boarding	5	3
Consultation	13	14
Data Entry	12	14
Payment	23	13
Leaving the passenger entry area	4	4
Total	55	29



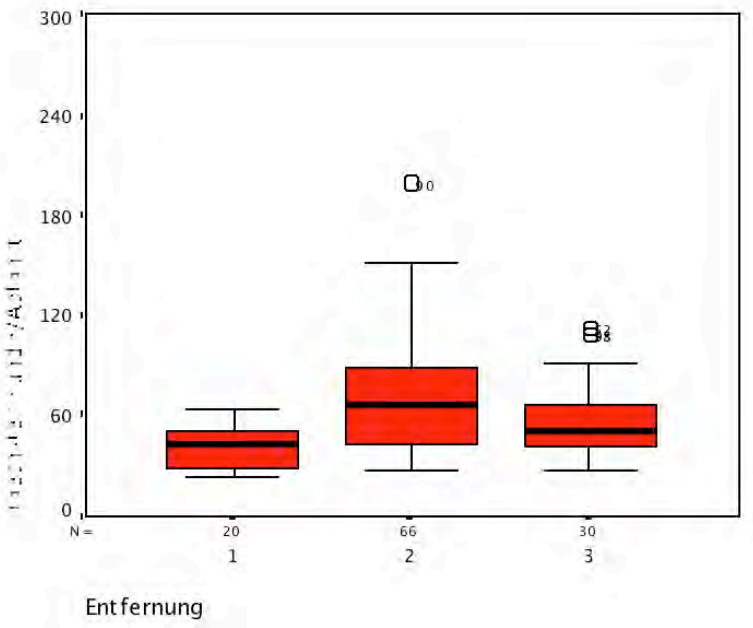
On-board ticket selling process
Laboratory tests

Ticket sales sub process	Mean Value [seconds]	Standard Deviation [seconds]
Boarding	5	3
Consultation	13	14
Data Entry	12	14
Payment	23	13
Leaving the passenger entry area	4	4
Total	55	29

On-board ticket selling process
Laboratory tests



Duration for different ticket types:
1: single ride
2: connecting ticket
3: multiple ride
4: daily ticket



Duration for different distances:
1: same zone
2: multiple zones
3: local trip

On-board ticket selling process
Laboratory tests

Payment Type	Exact Change	No high notes	High notes	Exact Change	No high notes	High notes
Cash available?	Customer has money ready			Customer searches for money		
Case	1	2	3	4	5	6
Mean Value [seconds]	14.6	17.4	29.9	22.5	18.4	30.0
Standard Deviation [s]	5.3	9.2	16.5	10.1	10.6	14.6

Conclusions and recommendations
Minimize impacts of onboard ticket sales

- Minimize the number of different ticket types offered for sale
- Add a surcharge to the price of tickets bought onboard the vehicle
- Set ticket prices to minimize the need for drivers to make change (e.g. by rounding)
- Require exact change (or at least refuse to accept high denomination notes)
- Provide better information at public transport stops on ticket cost and options for purchasing tickets in advance (this enables passengers to have correct fares ready and minimizes the amount of time spent discussing ticket options with the driver)

Conclusions and recommendations
Minimize amount of onboard ticket sales

- Ticket vending machines at stations (when machines are available eliminating onboard ticket sales should be considered)
- Ticket vending machines onboard vehicles (these have the disadvantage of allowing customers to buy a ticket only when they notice ticket inspectors, but the advantage of easily allowing operators to charge more for tickets purchased onboard – thereby encouraging the use of passes and tickets purchased in advance)
- Programs to encourage the purchase of monthly/yearly passes
- Increase the number of distributors selling advance tickets
- Make tickets available using new technologies (e.g. cell phone tickets)

Thank you

Contact:

Robert Dorbritz / Marco Lüthi / Prof. Dr. Ulrich Weidmann

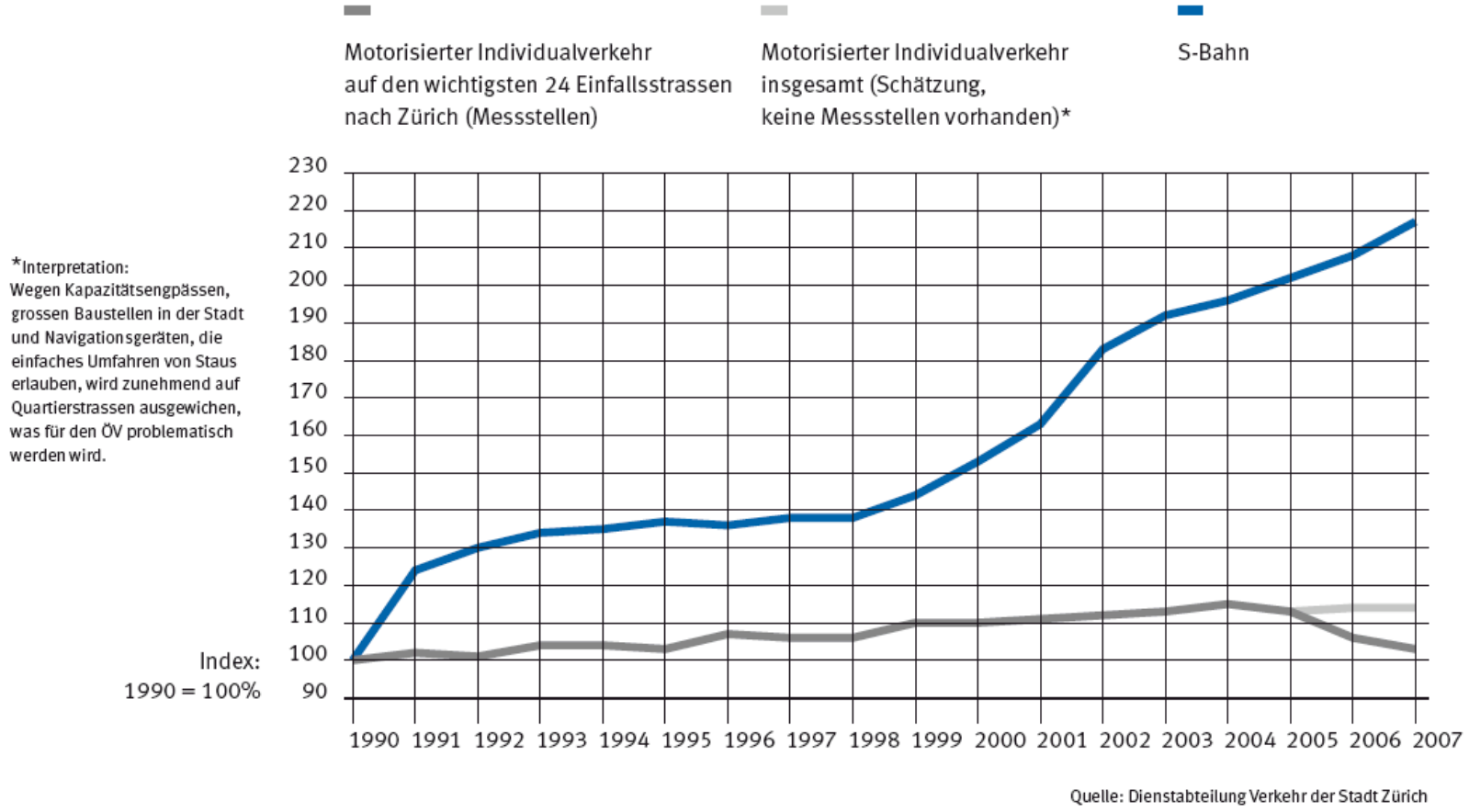
Institute for Transport Planning and Systems

ETH Zürich

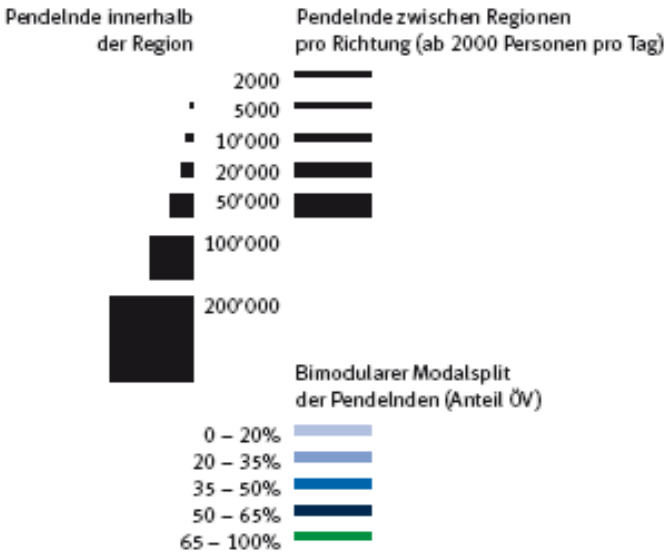
Switzerland

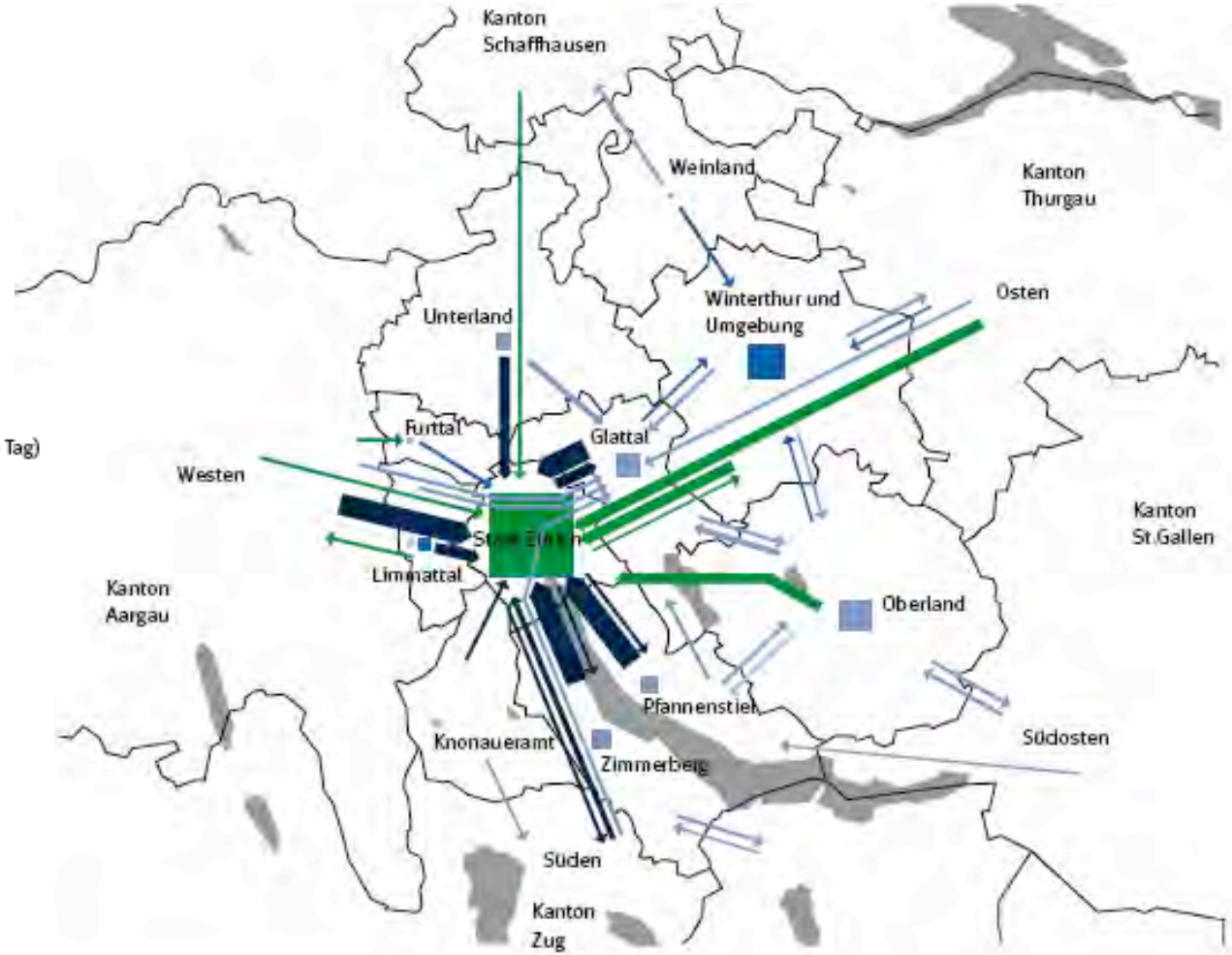
Dorbritz@ivt.baug.ethz.ch or Luethi@ivt.baug.ethz.ch

Zurich: Market share



Zurich: Market share





Pendelnde (Arbeit und Ausbildung) im Jahr 2000
(Velo, zu Fuss, MIV und ÖV)

ZVV Infrastructure

Verkehrsnetz/Infrastruktur

	Anzahl	Bemerkung
Verkehrsunternehmen	49	8 MVU, 10 Verkehrsunternehmen, 31 Transportbeauftragte
Personal (Stellenprozente)	3'649	inkl. Transportbeauftragte (ohne SBB)
Linien	370	davon 28 S-Bahn-Linien, 6 S-Bahn-Nachtnetzlinien, 13 Tramlinien, 7 Schiffsverbindungen, 4 Bergbahnen; der Rest sind Buslinien, 39 davon Nachtnetzbuslinien
Netzlänge (inkl. Nachtnetzlinien)	3'906 km	davon 709 km Nachtnetz-Netzlänge
Haltestellen	2'615	davon 204 Haltestellen in ausserkantonalem Tarifgebiet
Fahrzeuge*	2'043	735 Pneufahrzeuge, 1'275 Schienenfahrzeuge, 25 Schiffe, 8 Bergbahnen
Bediente Verkaufsstellen (stationäre)	221	davon 4 in ausserkantonalem Tarifgebiet
Ticketautomaten	ca. 1'516	zusätzlich Verkauf durch den Chauffeur in den meisten Regionalbussen

* Bei Schienenfahrzeugen wird die tatsächliche Anzahl Wagen und nicht Kompositionen gezählt.

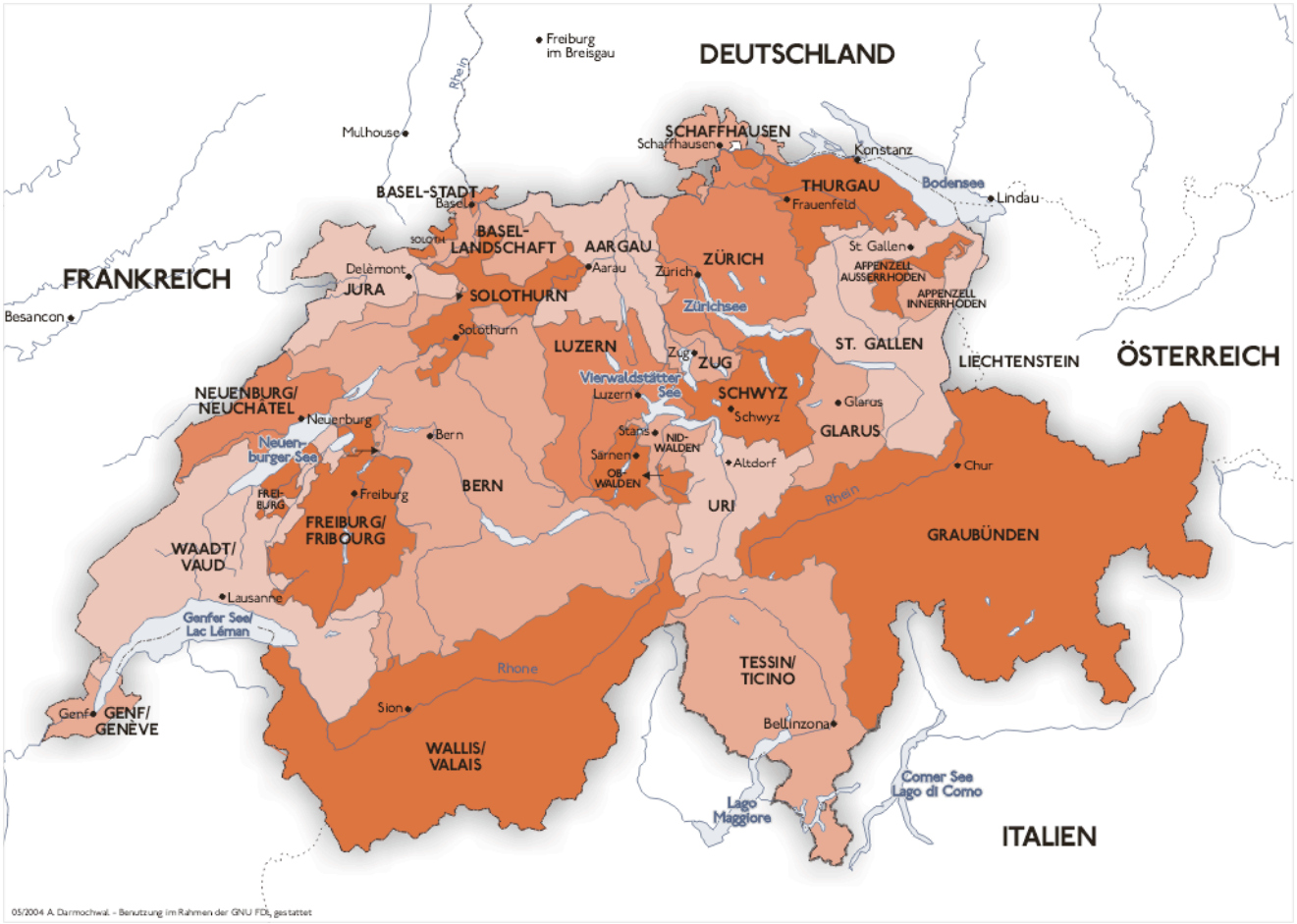
ZVV S-Bahn passengers

S-Bahn: Fahrgastzahlen

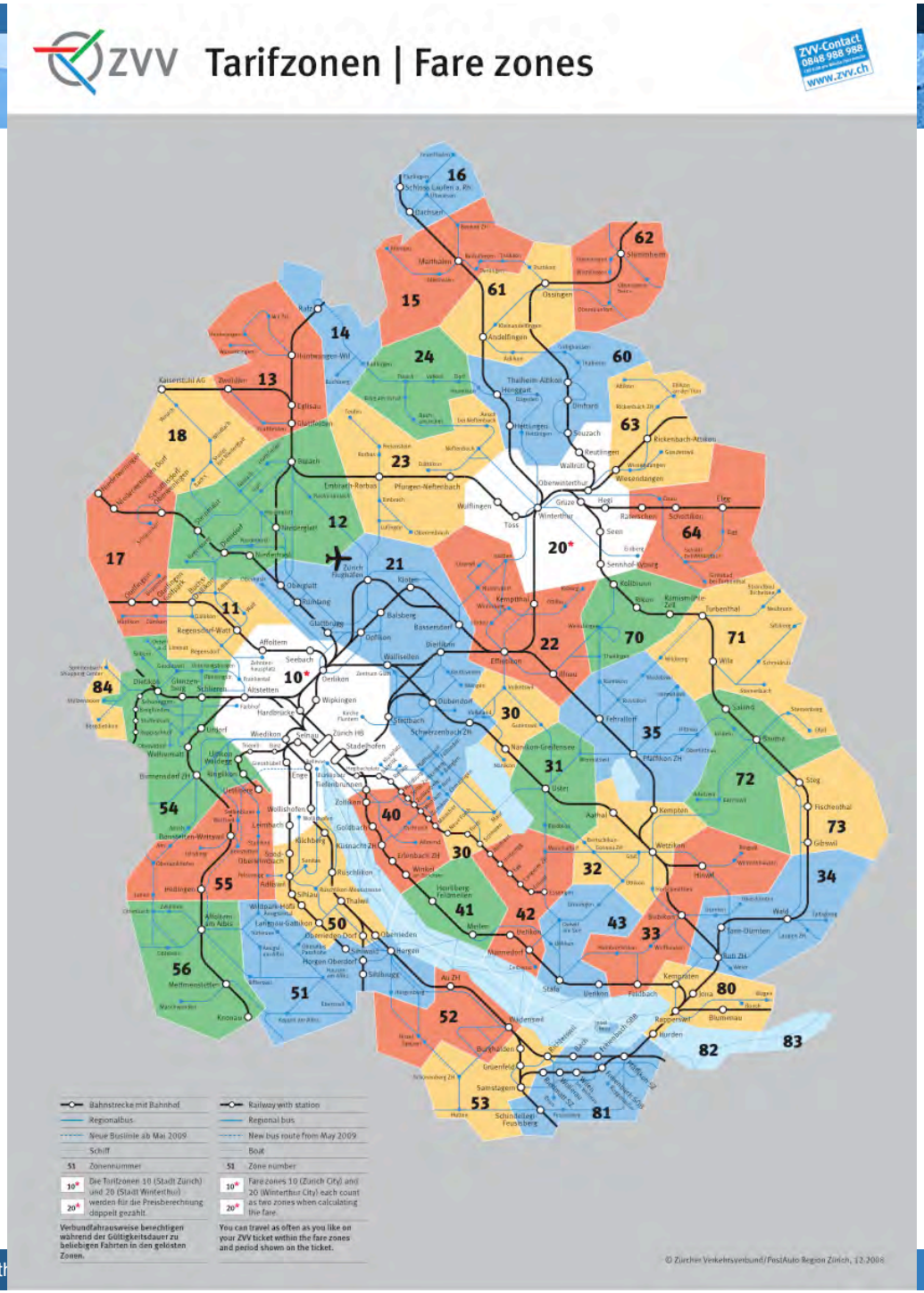
Tagesfrequenzen pro Werktag an der Stadtgrenze Zürich, Durchschnitt pro Fahrplanjahr (Ausnahme Forchbahn = Novemberwerte)

Linie	00/01	01/02	2003	2004	2005	2006	2007
Flughafen	7'138	7'114	7'539	7'972	9'175	10'091	11'891
Forchbahn-Pfannenstiel	8'514	8'514	8'514	8'514	8'514	8'770	9'178
Furttal	8'006	9'438	9'798	9'779	10'297	10'715	11'286
Glattal/Oberland	46'078	53'225	56'684	58'867	60'653	61'681	66'565
Knonaueramt	13'394	14'543	15'502	15'720	15'814	15'949	17'179
Limmattal	23'708	27'985	28'175	28'744	29'624	31'123	33'161
Linkes Seeufer (ohne IC/EC)	22'044	25'499	26'715	26'117	25'642	27'587	29'026
Rechtes Seeufer	22'412	25'042	26'545	27'536	28'093	28'913	29'970
SZU-Zimmerberg/Uetliberg	22'593	23'634	24'622	24'810	26'158	27'203	30'262
Unterland	16'220	18'074	20'138	20'977	21'783	22'169	23'236
Zürich–Winterthur (inkl. IC/EC)	67'540	76'178	79'451	81'534	84'032	88'725	93'899
Total	**257'647**	**289'246**	**303'683**	**310'570**	**319'785**	**332'926**	**355'653**

Switzerland:



ZVV:
Fare zones



ZVV
Bus operators:

VBG Citaro 530 standard bus