DATASET2050

Cook, A.J.

Presented at Connectivity Workshop, EUROCONTROL, Brussels, 18 January 2017.

DATASET2050

A very brief overview, plus some thoughts on future mobility metrics

Dr Andrew Cook, Principal Research Fellow
University of Westminster, London

DATASET2050

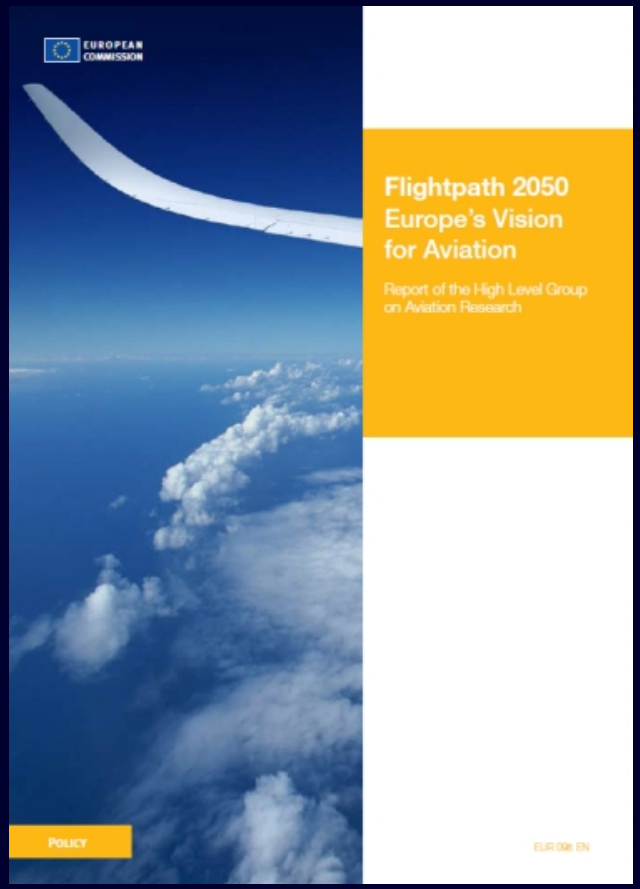
Data-driven approach for seamless, efficient European travel in 2050

EU Research & innovation programme
2014-17 (CSA); mobility for growth (topic)

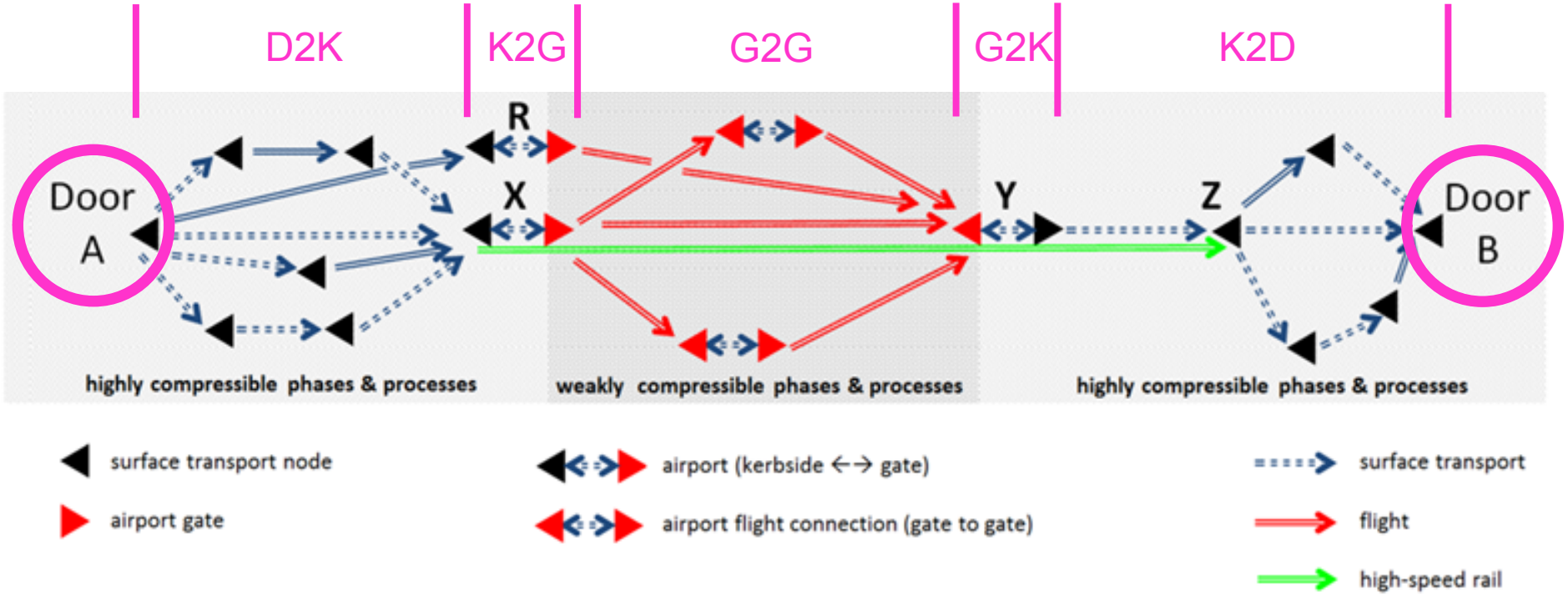
Innaxis, University of Westminster
Bauhaus Luftfahrt, EUROCONTROL

Topic: mobility for growth; pillar: societal challenges; work programme part: smart, green and integrated transport

Need to broaden scope



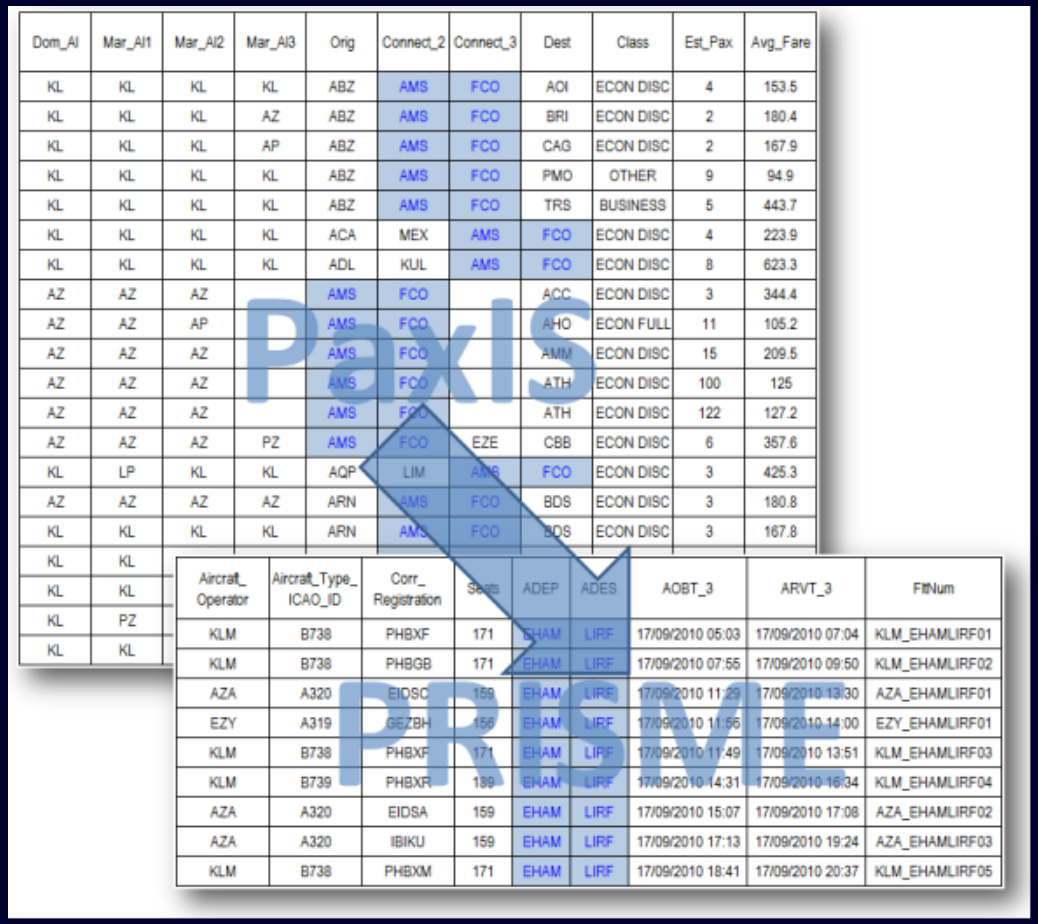
- Flightpath 2050 (ACARE, 2011)
  - "highly ambitious goals" (x5)
  - "90% of travellers within Europe are able to complete their journey, door-to-door within 4 hours"
- Flight- → pax-centric; G2G → D2D
  - pax delay, driving costs & behaviour
  - 1.6 – 1.7 (US); 1.3 – 1.9 (Europe)
  - DATASET2050: door-to-door pax mobility
  - current, ≈2035, ≈2050
- How measure progress without the right metrics? (Current G2G?)



Core model: ‘Mercury’

- Evaluates range of metrics (incl. cost resilience)
- Evaluates range of flight & pax prioritisation strategies
- Includes tactical costs to the airline (4 AO types)
- Assesses various types of disturbance and uncertainty
- Key data-related characteristics:
  - runs a busy day and month (September 2010 & 2014)
  - non-exceptional in terms of delays, strikes, weather
  - busiest 200 ECAC airports (e.g. 97% pax & 93% traffic, 2010)
  - 50 non-ECAC airports (based on pax flows in/out Europe)
  - extensive range and logic checks (e.g. speeds, registration seqs)
  - calibration (independent sources, e.g. network delays and LFs)
- Unique combination of PaxIS and PRISME data …

Core model: ‘Mercury’



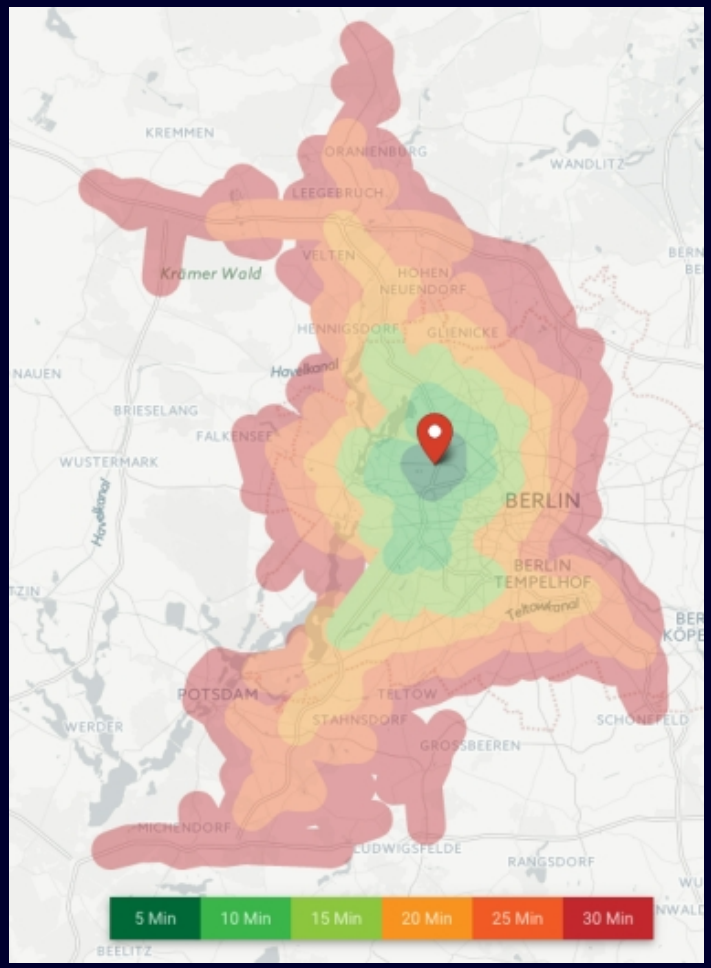
Dom_Al	Mar_Al1	Mar_Al2	Mar_Al3	Orig	Connect_2	Connect_3	Dest	Class	Est_Pax	Avg_Fare
KL	KL	KL	KL	ABZ	AMS	FCO	AOI	ECON DISC	4	153.5
KL	KL	KL	AZ	ABZ	AMS	FCO	BRI	ECON DISC	2	180.4
KL	KL	KL	AP	ABZ	AMS	FCO	CAG	ECON DISC	2	167.9
KL	KL	KL	KL	ABZ	AMS	FCO	PMO	OTHER	9	94.9
KL	KL	KL	KL	ABZ	AMS	FCO	TRS	BUSINESS	5	443.7
KL	KL	KL	KL	ACA	MEX	AMS	FCO	ECON DISC	4	223.9
KL	KL	KL	KL	ADL	KUL	AMS	FCO	ECON DISC	8	623.3
AZ	AZ	AZ		AMS	FCO		ACC	ECON DISC	3	344.4
AZ	AZ	AP		AMS	FCO		AHO	ECON FULL	11	105.2
AZ	AZ	AZ		AMS	FCO		AMM	ECON DISC	15	209.5
AZ	AZ	AZ		AMS	FCO		ATH	ECON DISC	100	125
AZ	AZ	AZ		AMS	FCO		ATH	ECON DISC	122	127.2
AZ	AZ	AZ	PZ	AMS	FCO	EZE	CBB	ECON DISC	6	357.6
KL	LP	KL	KL	AQP	LIM	AMS	FCO	ECON DISC	3	425.3
AZ	AZ	AZ	AZ	ARN	AMS	FCO	BDS	ECON DISC	3	180.8
KL	KL	KL	KL	ARN	AMS	FCO	BDS	ECON DISC	3	167.8
KL	KL									
KL	KL									
KL	PZ									
KL	KL									

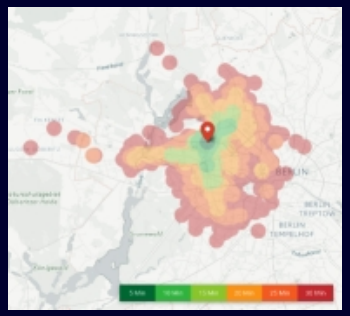
Aircraft_ Operator	Aircraft_Type_ ICAO_ID	Corr_ Registration	Seats	ADEP	ADES	AOBT_3	ARVT_3	FltNum
KLM	B738	PHBXF	171	EHAM	LIRF	17/09/2010 05:03	17/09/2010 07:04	KLM_EHAMLIRF01
KLM	B738	PHBGB	171	EHAM	LIRF	17/09/2010 07:55	17/09/2010 09:50	KLM_EHAMLIRF02
AZA	A320	EIDSC	159	EHAM	LIRF	17/09/2010 11:29	17/09/2010 13:30	AZA_EHAMLIRF01
EZY	A319	GEZBH	156	EHAM	LIRF	17/09/2010 11:56	17/09/2010 14:00	EZY_EHAMLIRF01
KLM	B738	PHBXF	171	EHAM	LIRF	17/09/2010 11:49	17/09/2010 13:51	KLM_EHAMLIRF03
KLM	B739	PHBXR	189	EHAM	LIRF	17/09/2010 14:31	17/09/2010 16:34	KLM_EHAMLIRF04
AZA	A320	EIDSA	159	EHAM	LIRF	17/09/2010 15:07	17/09/2010 17:08	AZA_EHAMLIRF02
AZA	A320	IBIKU	159	EHAM	LIRF	17/09/2010 17:13	17/09/2010 19:24	AZA_EHAMLIRF03
KLM	B738	PHBXM	171	EHAM	LIRF	17/09/2010 18:41	17/09/2010 20:37	KLM_EHAMLIRF05

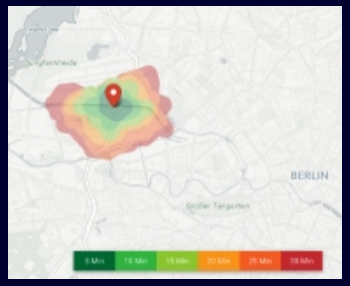
- aggregated PaxIS (IATA ticket) pax data allocated onto individual flights (PRISME traffic data, from EUROCONTROL)
- assignment algorithms respecting aircraft seat configurations and load factor targets
- full pax itineraries built respecting MCTs and published schedules
- 27k flights in scope
- 3.8 million pax
- >150k routings

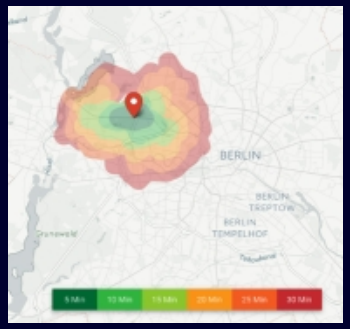
2014

Building a picture for 2050









- Access and egress
  - by mode
  - by time of day
  - OpenStreetMap; Google; other aps
  - websites (incl. airport access tools)
  - timetables (primary data)
  - market research
  - wider literature (journals, reports, accessibility plans)

Building a picture for 2050

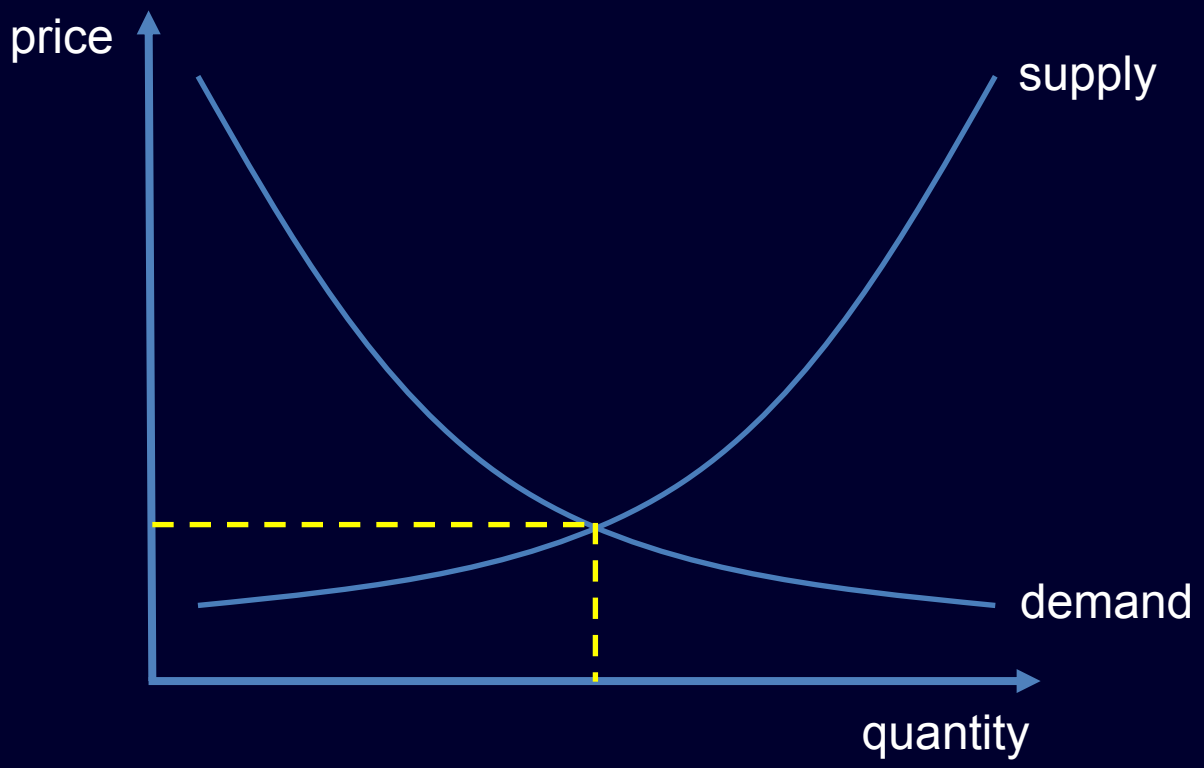
- Model framework: high-level factor groups
  - H1. Traffic / demand
  - H2. Market forces / technologies / supply
  - H3. Policy / regulation
- Is *disruptive* change required? – e.g. journey ownership, pax data management; regulatory?
- Need to consider future European pax archetypes/segments
  - data-driven, evidence-based (better availability for 2035)
  - multiple data sources & factors considered (e.g. ICT use, education)
  - 65+ group around 25% of population in 2035 ('Best Agers')
  - passengers may belong to more than group

High-level factor group		Model scenario 1: WEAK supporting changes	Model scenario 2: EXPECTED supporting changes	Model scenario 3: STRONG supporting changes
H1. Traffic / demand				
Door-to-kerb	**NET**	**LOW**	**LOW**	**MEDIUM**
...	Future traffic	Low	Low	Low
...	HSR substitution	Low	Medium	High
Kerb-to-gate	**NET [...]**	**LOW**	**MEDIUM**	**MEDIUM**
Gate-to-gate	**NET [...]**	**LOW**	**MEDIUM**	**MEDIUM**
H2. Market forces / technologies / supply				
Door-to-kerb	**NET [...]**	**LOW**	**MEDIUM**	**HIGH**
Kerb-to-gate	**NET**	**LOW**	**MEDIUM**	**MEDIUM**
...	Seamless ticketing	Low	Low	Medium
...	Self-service take-up	Low	Low	Medium
...	Baggage handling	Low	Medium	High
...	Security processes	Low	Medium	High
Gate-to-gate	**NET [...]**	**LOW**	**MEDIUM**	**MEDIUM**
H3. Policy / regulation				
Door-to-kerb	**NET [...]**	**LOW**	**MEDIUM**	**HIGH**
Kerb-to-gate	**NET [...]**	**MEDIUM**	**MEDIUM**	**HIGH**
Gate-to-gate	**NET [...]**	**LOW**	**MEDIUM**	**MEDIUM**

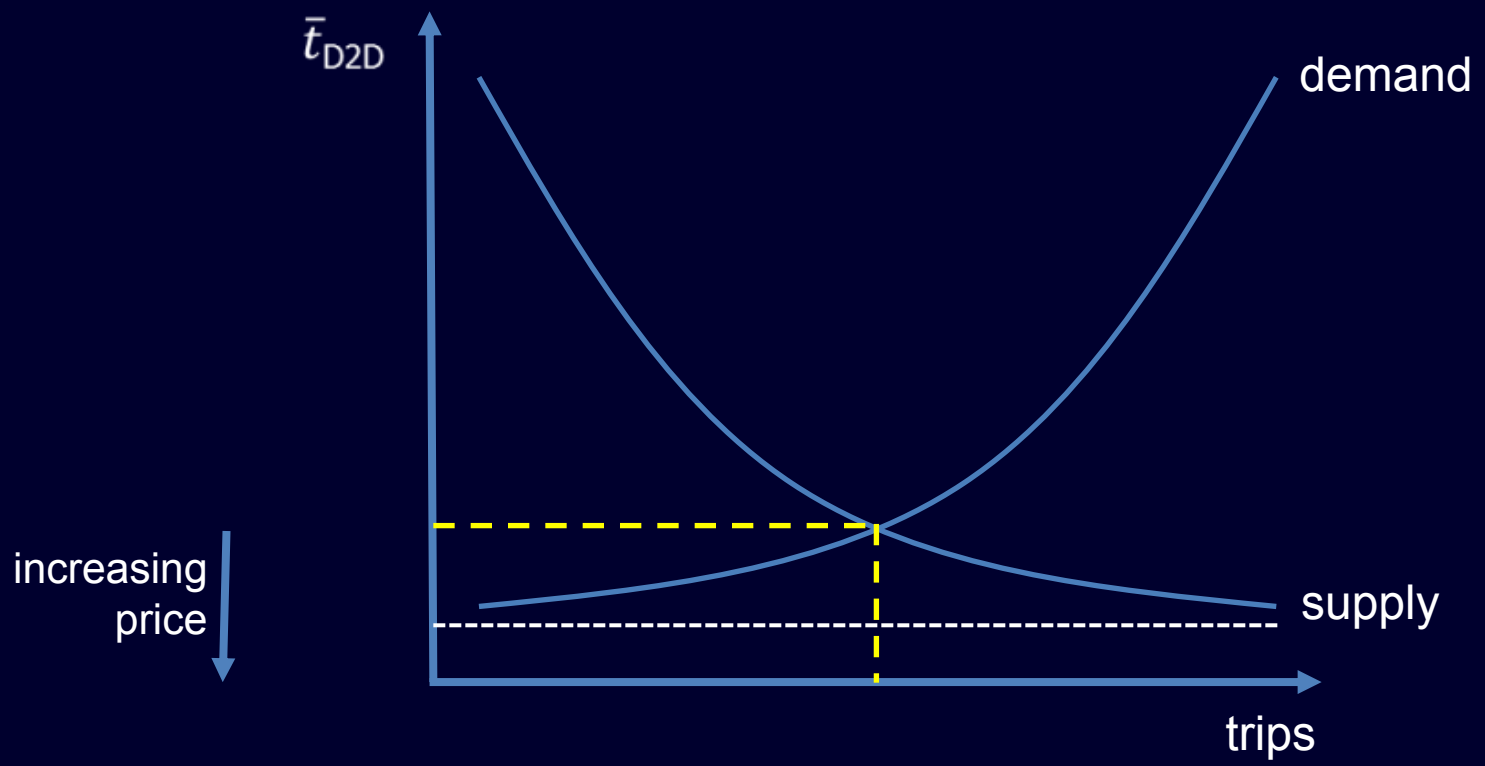
A global mobility metric?

Building on the 4H D2D vision

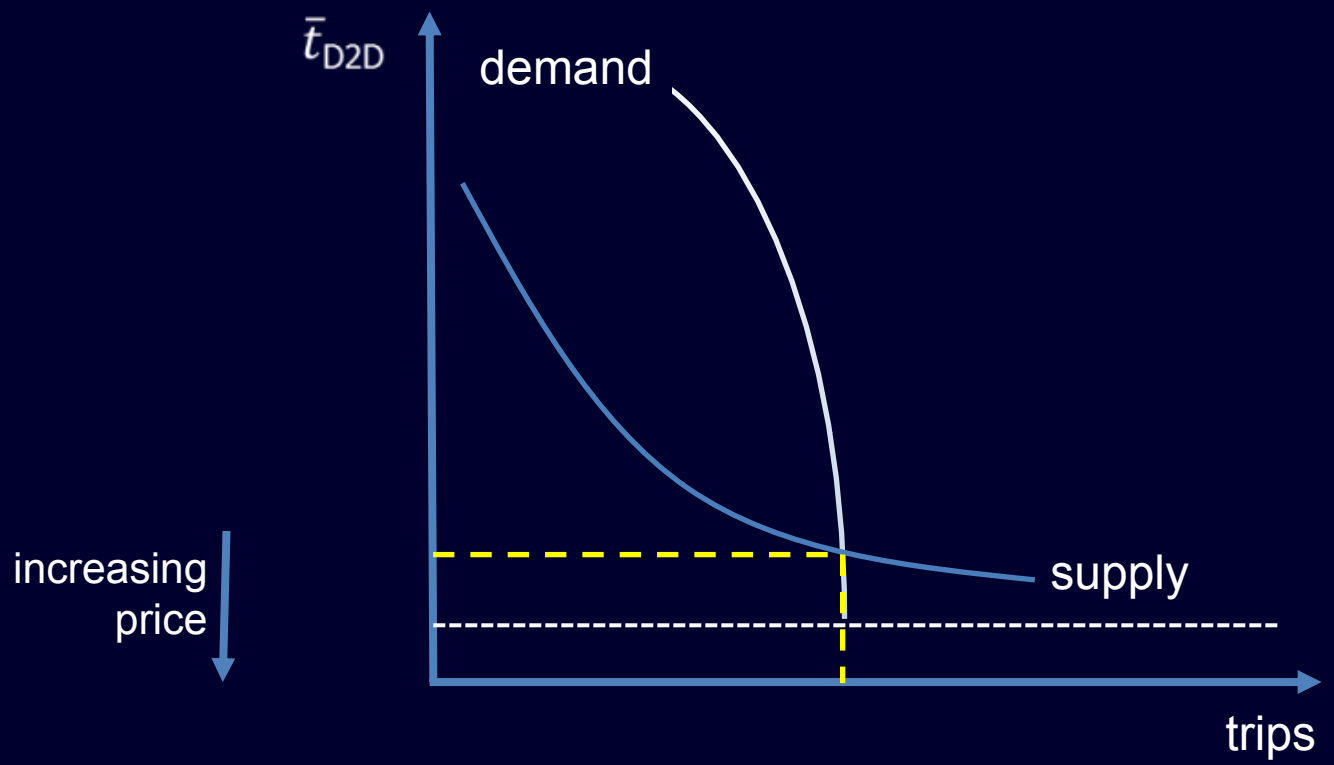
- ACARE goal gives us a good platform to consider:
  - the 90% – 10% distribution (predictability)
  - what travellers (will) want, changing social norms (equity)
  - traveller-trip types / market segments (equity)
  - transportation supply-side (trade-off)
  - demand-side & price effects: “faster and cheaper!” (trade-off)

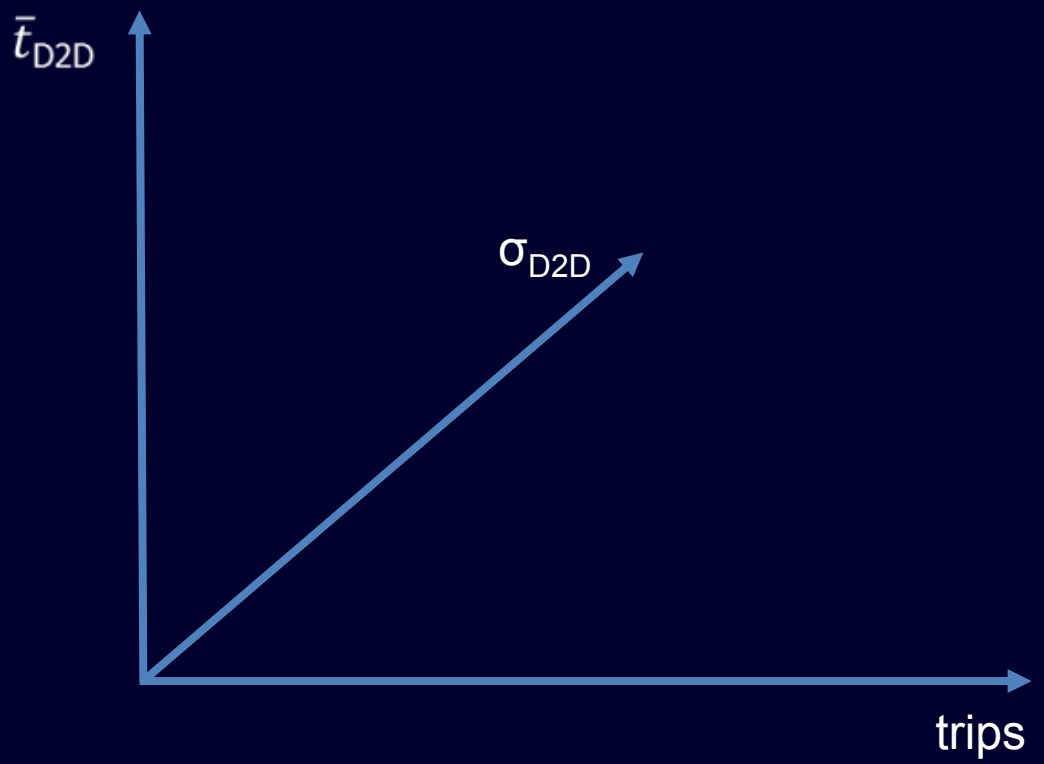


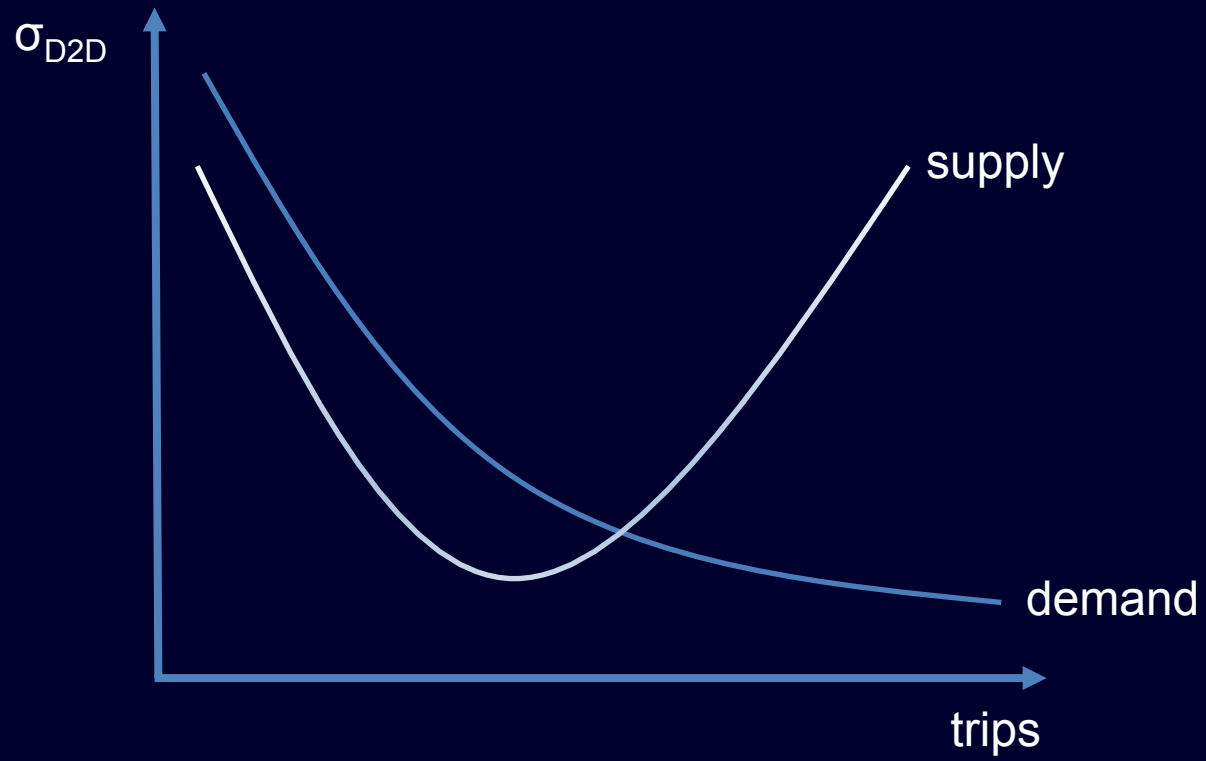
Price-driven market segment

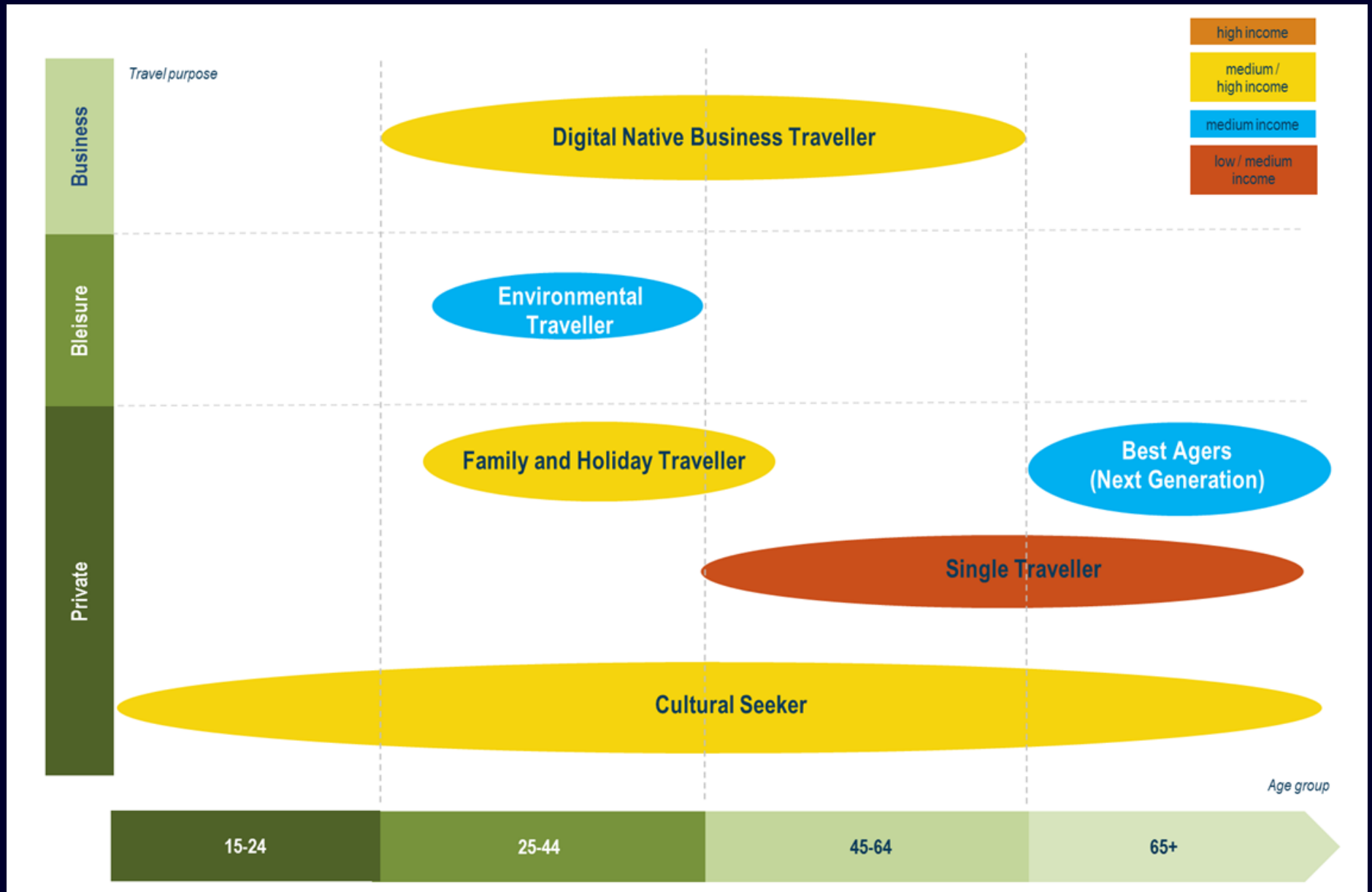


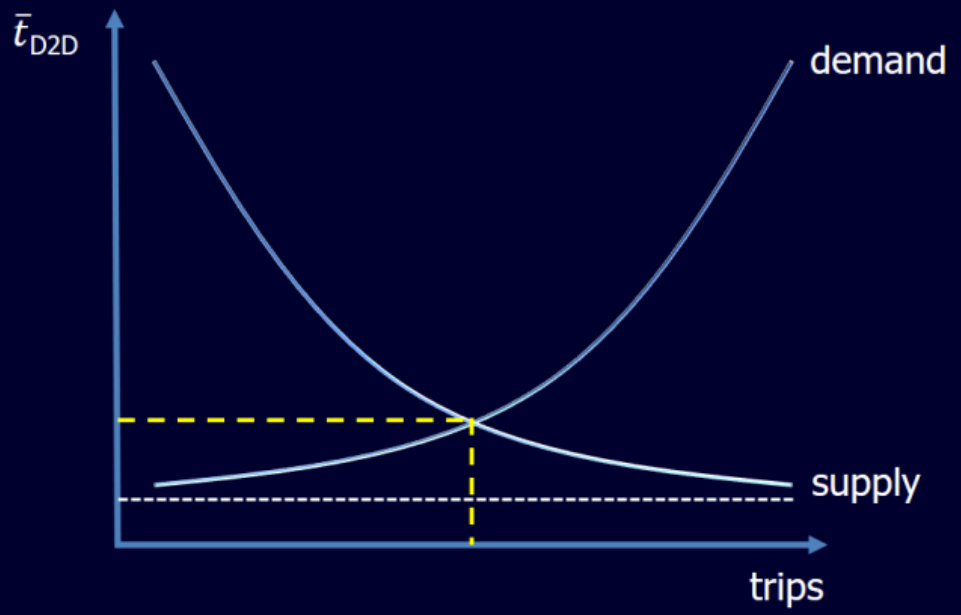
Time-driven market segment (high VoT)











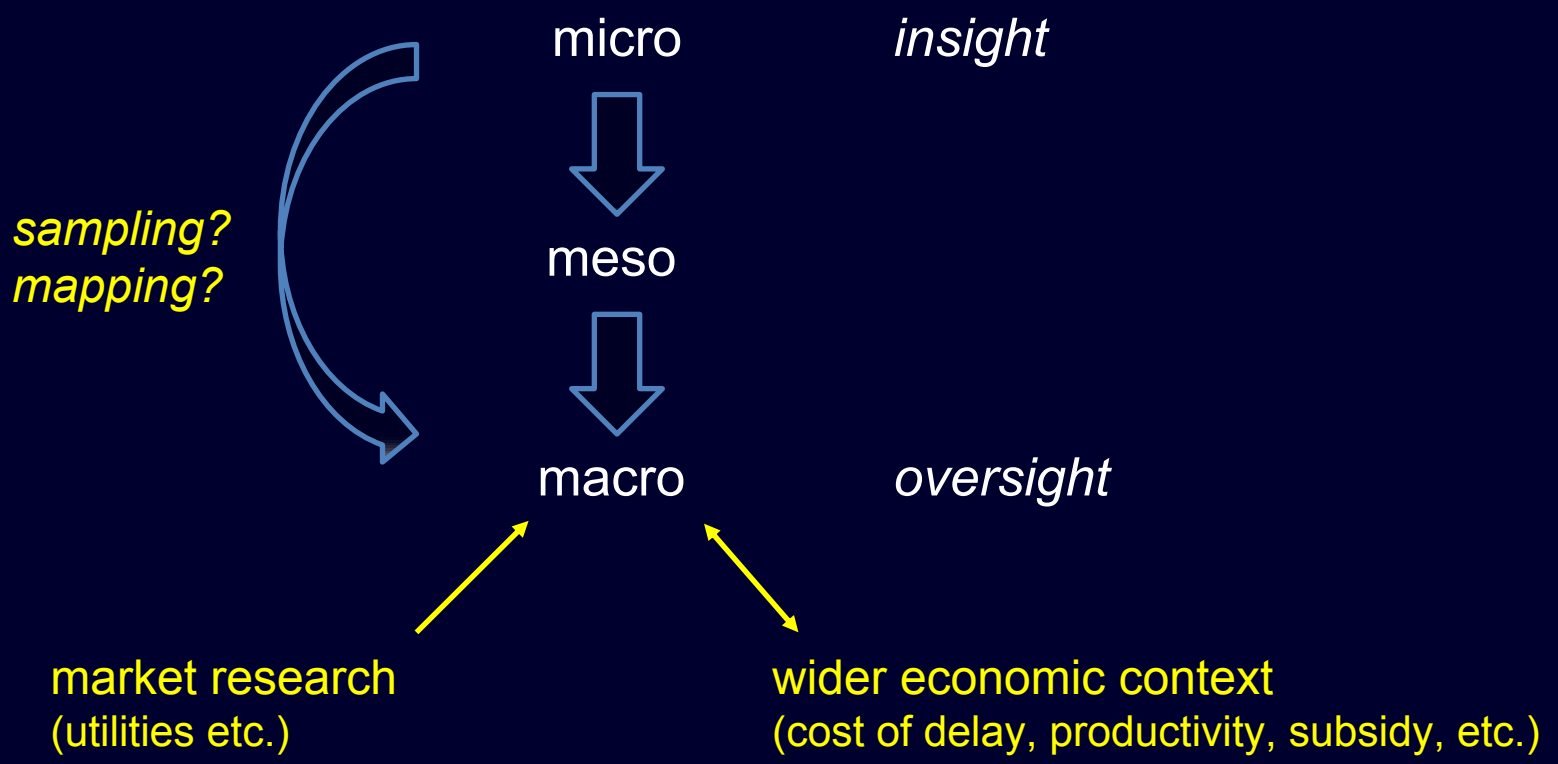
Segment:	1 (‘best agers’)
Value of time:	€50 / hour
Equilibrium D2D time:	5H

- Building up a metric for each segment
  - based on gain (+) or loss (-) to traveller, all relative to equilibrium
  - generalised cost = monetary + non-monetary (e.g. VoT)

				Metric calculation					
D2D time	Price (ticket)	Δ equilibrium time (gain/loss)		Δ price (ticket)	Δ VoT	Δ σ	Net	Trip %	
4H	€200	+1H		-€100	+€50	-€20	-€70	40	-28
5H	€100	0		0	0	0	0	30	0
6H	€50	-1H		+€50	-€50	-€10	-€10	30	-3
				Net result for segment					-€31

- Weighting by each segment's trips to give global metric
  - e.g. -€31 x n_1 + -€60 x n_2 + ... = **-€50 / trip** (or per pax, per km ...)
  - gives oversight, but little insight
  - neglects various VoT effects (e.g. productive time, waiting time ...)

Metric design landscape



Thank you, plus invitation …

- DATASET2050
  - participate at our next workshop
- CAMERA (new proposal, Advisory Board)
  - quantitative and qualitative evaluation of recent research activities and initiatives on mobility, identifying current and future gaps, and innovation bottlenecks – formulating policy recommendations
- PIVOT (new proposal, Advisory Board)
  - how will ICT applications (e.g. wifi) tend to reduce the perceived cost of travel time? Examining the potential shift away from the 'speed paradigm', plus transport project CBA impacts

cookaj@westminster.ac.uk

Stand-bys

Key trade-offs

Large spend	Small spend
90%	10% (shape & metrics)
Travel	Technology (+&-) & env.
Competition	Cooperation & responsibility
Airline profitability (LFs)	Network resilience
Airport profitability (non-aero)	Pax dwell times

Trip compression

- Two largest effects (??)

- Access times
  - driven by technology (travel supply) & regulation
- Dwell (buffer) times
  - driven by airport policy (revenue) & regulation (?)

passenger attitudes

- Policy implications

Conclusions

- Early mobility modelling has established the need for passenger-centric and cost-centric metrics
- Capabilities and plans regarding the most developed European model ('Mercury') have been outlined; this model is laying foundations for further development
- There is still a lot to be done, in particular to:
  - build a full, mature, intermodal European mobility model
  - develop new mobility metrics for the future (RP3 and beyond)
  - move closer towards data-driven policies (e.g. pax-resilient networks)
  - integrate such models and metrics with SESAR (e.g. UDPP, A-CDM)
  - use these to help (e.g.) airlines to develop better strategies
  - examine performance of particular airlines, routes, airports (c.f. network)
  - integrate such models with industry tools (tactical and strategic)

Positive global metric example

				Metric calculation					
D2D time	Price (ticket)	Δ equilibrium time (gain/loss)		Δ price (ticket)	Δ VoT	Δ σ	Net	Trip %	
4H	€110	+1H		-€10	+€50	-€20	+€20	40	+8
5H	€100	0		0	0	0	0	30	0
6H	€50	-1H		+€50	-€50	-€10	-€10	30	-3
				Net result for segment					+€5

- 4H ticket is cheaper
- net result is positive

Zero global metric example

				Metric calculation					
D2D time	Price (ticket)	Δ equilibrium time (gain/loss)		Δ price (ticket)	Δ VoT	Δ σ	Net	Trip %	
4H	€110	+1H		-€10	+€50	-€20	+€20	40	+8
5H	€100	0		0	0	0	0	20	0
6H	€60	-1H		+€40	-€50	-€10	-€20	40	-8
				Net result for segment					€0

- 6H ticket is not quite as cheap; trip %s are symmetrical
- net result is zero