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Performance measurement in a world of targets and trade-offs

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Performance measurement in a world of targets and trade-offs

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University of Westminster

Overview

- Performance measurement
 - some key challenges
 - SESAR 2020 Scientific Committee (TF3)
- KPAs, KPIs and metrics
- Targets and the future of the European ATM system
- Further exploration of trade-offs
- Questions for discussion

- Performance measurement
 - some key challenges
 - SESAR 2020 Scientific Committee (TF3)

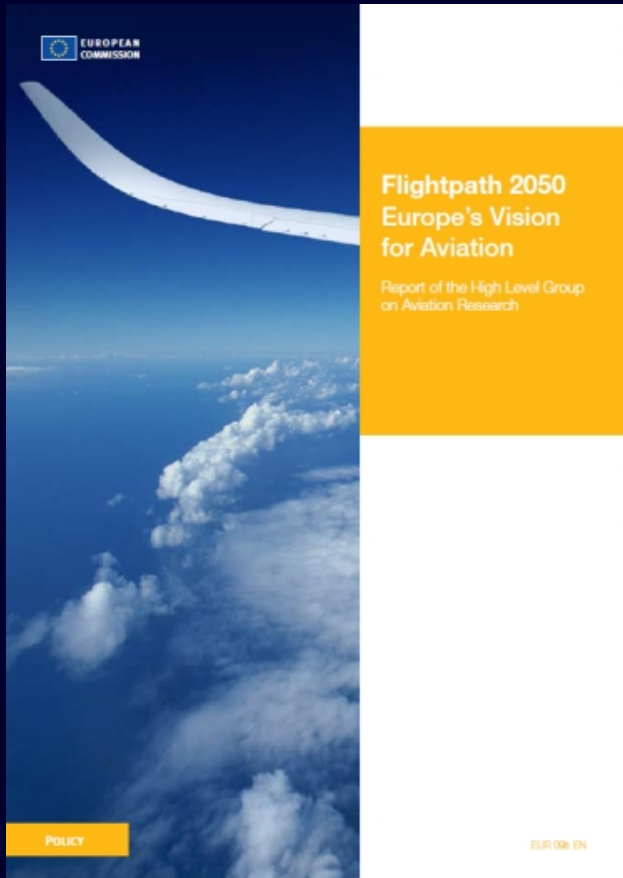
High-level summary of challenges

- Spatial scope
 - G2G -> D2D context; intermodality – disruptive change?
- Better stakeholder alignment
 - pax- & cost-centricity; Performance Scheme opportunities
- Trade-offs
 - perennial topic; inter- & intra-KPA; where next?
- Oversight v. insight
 - typically NW level; complementarity (classical & complexity)
- Standardisation v. adaptability
 - comparative validity v. context-sensitivity (pax, ANSPs; global)
- Data and modelling context

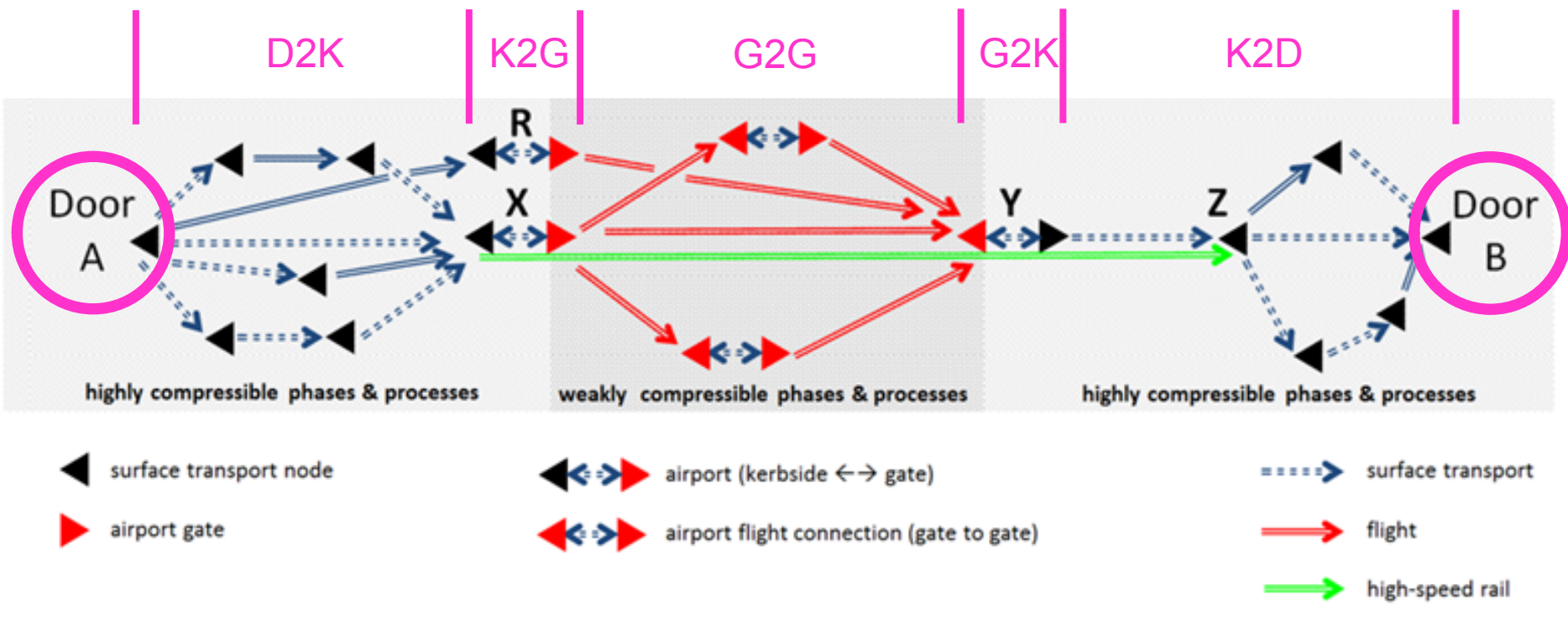
highly
dependent

&
support
evidence
-based
policy

Spatial 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-centric → pax-centric metrics
 - pax delay, driving costs & behaviour
 - 1.6 – 1.7 (US); 1.3 – 1.9 (Europe)
 - can't always detect changes with flight-centric metrics alone
- How measure progress without the right metrics? (Current G2G?)



- Where are the key compressibilities to move towards 4H D2D?
- What new metrics do we need? (DG MOVE Aviation Strategy for Europe)
 - several new, challenging trade-offs are immediately apparent!
- What are the potential (integration) impacts on ATM?
 - e.g. for Essential Operational Changes, such as UDPP
 - e.g. for ATM Technology Changes, such as A-CDM
- Pax need? Impact on supply, of social norms (EC: speed paradigm)

Spatial scope

- 01 access and equity
- 02 capacity
- 03 cost effectiveness
- 04 efficiency
- 05 environment
- 06 flexibility
- 07 interoperability
- 08 participation & collaboration
- 09 predictability
- 10 safety
- 11 security

wrt baselines (current, 2035, 2050)

- APT access/egress modes used
- with/without bags
- min. 'necessary' waits (e.g. gate)
- buffers (elective wait; pax / a/c)
- MCTs
- terminal / taxi configs
- available route / ~ GCD / FR
- ATFM



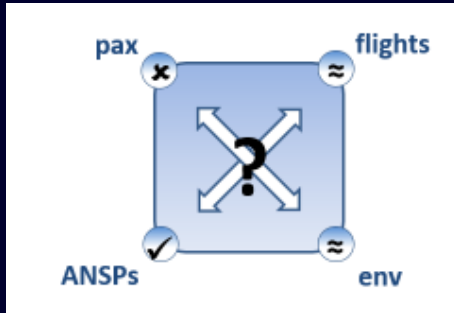
- phase c.f. transition
- 'unproductive' time

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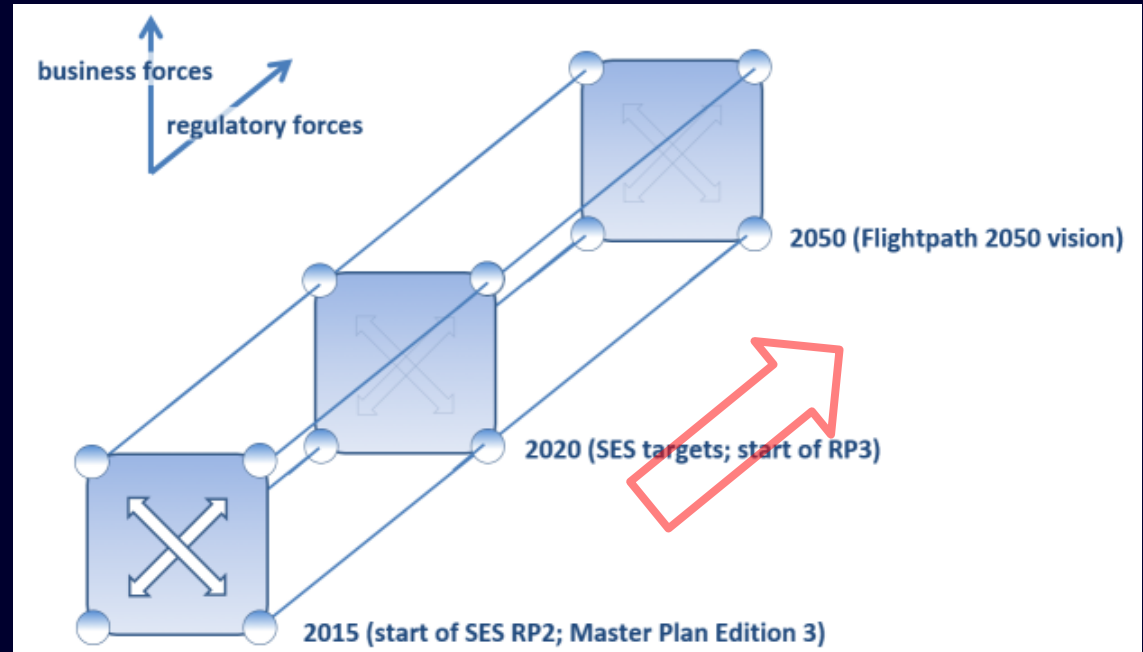
Better stakeholder alignment

- Pax-centricity
 - more mature metric development in US (data-enabled)
 - future alignment with demand and utilities (VoT)
 - Cost-centricity (detection c.f. flight-centric)
 - cost of delay supra-linear c.f. delay duration
 - cost of cancellation
 - cost of predictability (c.f. average delay)
 - (cost of) resilience
 - co-assessment with non-monetised metrics
 - Performance Scheme opportunities (re. RP3, i.e. 2020-4)
 - better mapping of targets with SESAR deployment (e.g. Common Projects)
 - wider stakeholder inclusion (e.g. AUs and airports)
- all relatively immature; trade-off implications

Trade-offs

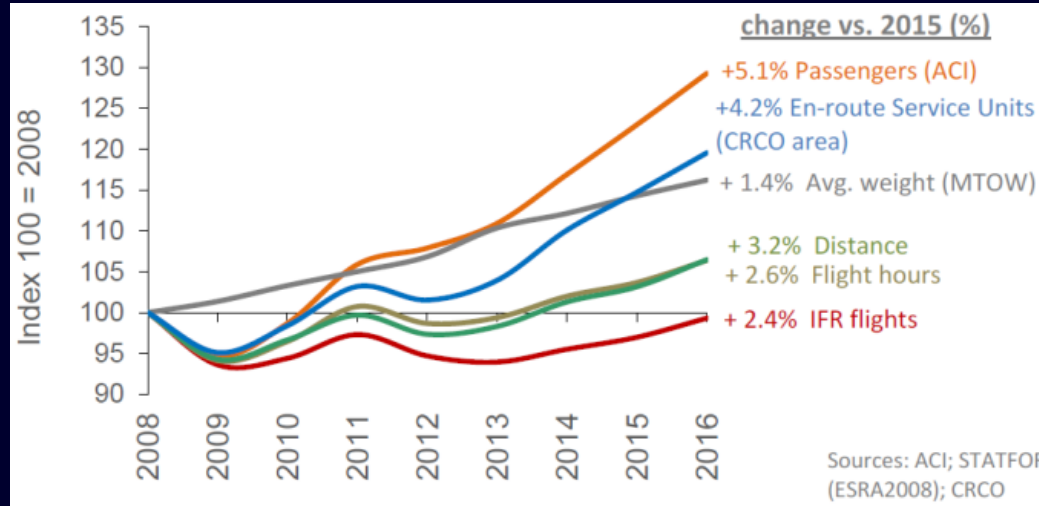


KPIs established for 2015
(all in SES PS, RP2)



- several projects, past and present (APACHE & Vista); CW ‘Challenges’
- various methods (e.g. influence diagrams, multi-criteria optimisation)
- demand for a multi-stakeholder tool

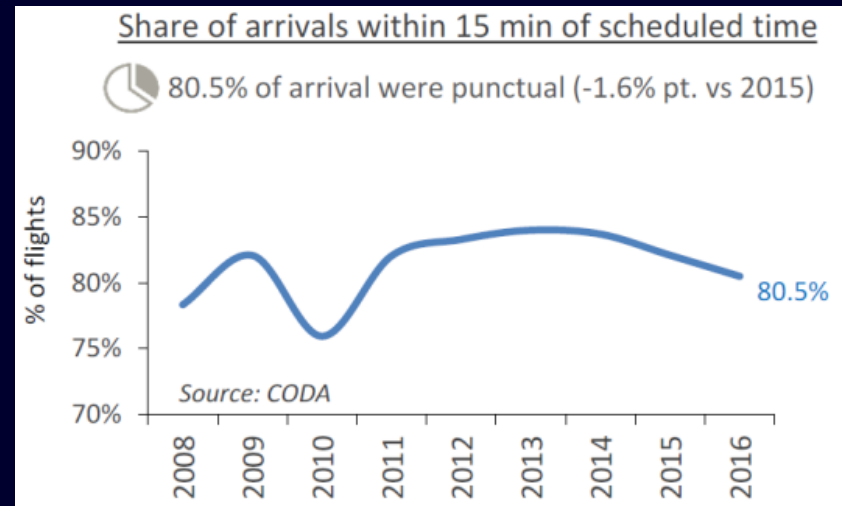
Trade-offs



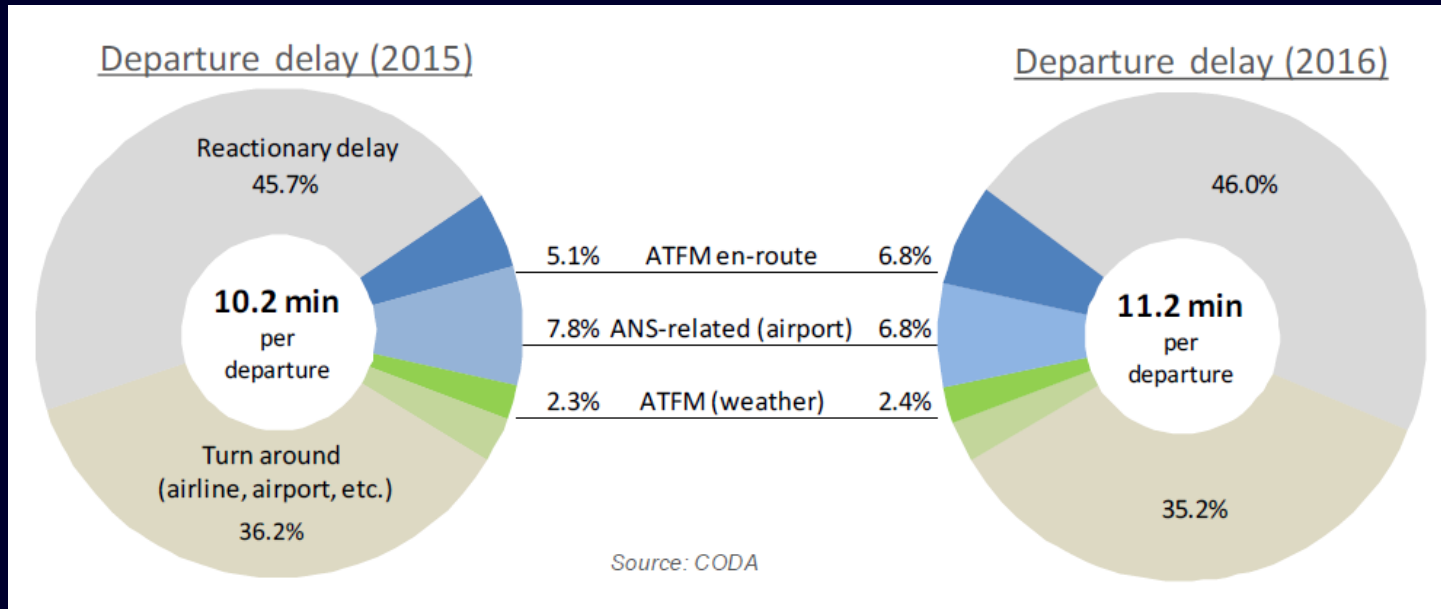
2016 traffic at pre-economic crisis level of 2008

PRR 2016 (draft)

2016: third consecutive year that punctuality has fallen



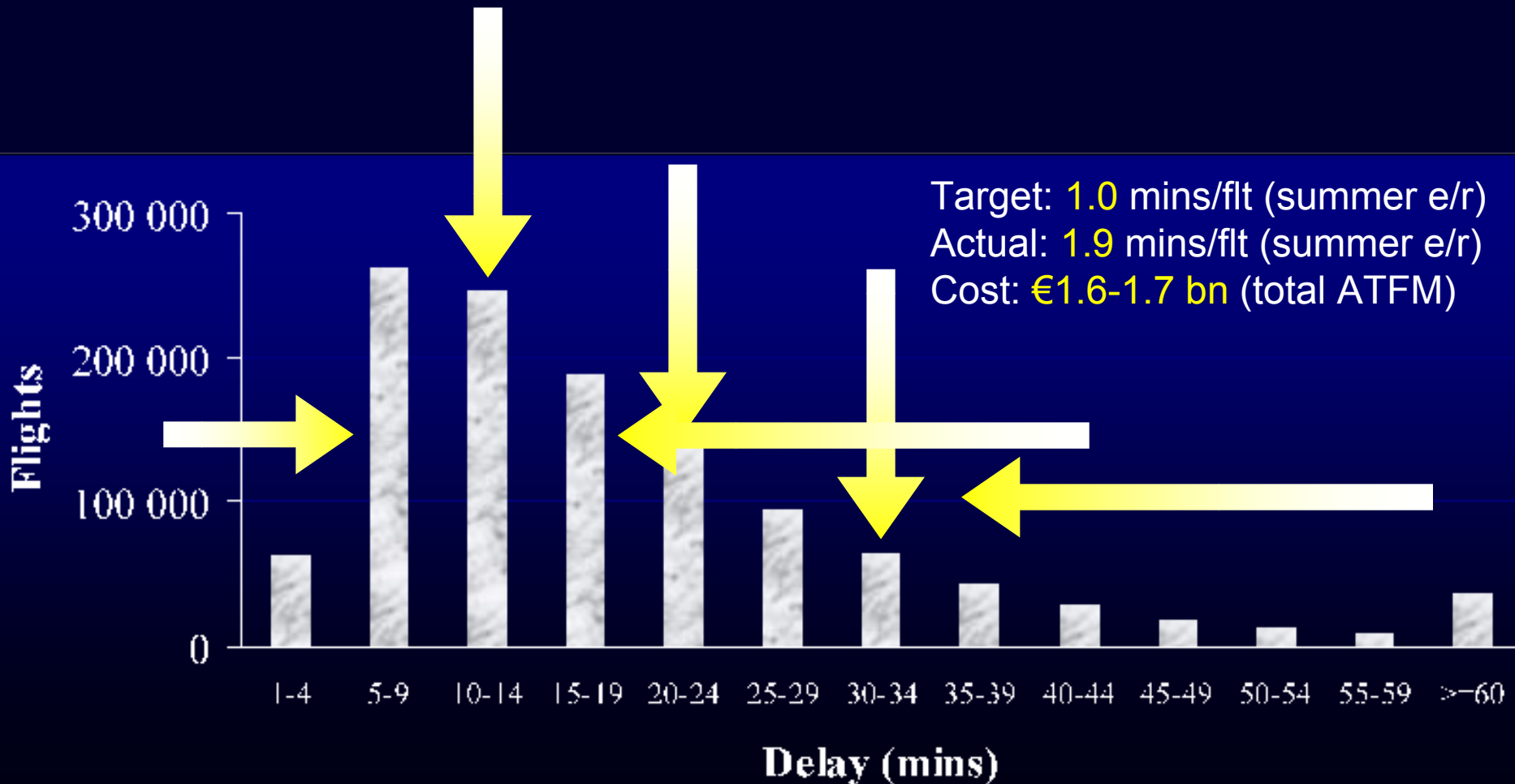
Trade-offs



PRR 2016 (draft)

Increase in en-route ATFM delays (20.9% increase 2016 re. 2015)
 Average delay = **0.86** mins/flt; RP2 target = **0.50** (2015-19)
 Capacity/staffing issues remain by far the main driver

Trade-offs



ATFM slots, actual distribution, 2008. (NB. 88% IFR flights no ATFM delay; 92% in 2016.)

Trade-offs

Cost μ σ ≥ 60 mins

2008 (actual) 100 100 100 0.36

Simple halving 50 50 72 0.18

Push to left 51 74 68 0.00

Centralise 33 60 53 0.07

(All values are percentages. First three columns, relative.)

Trade-offs

Cost μ σ ≥ 60 mins

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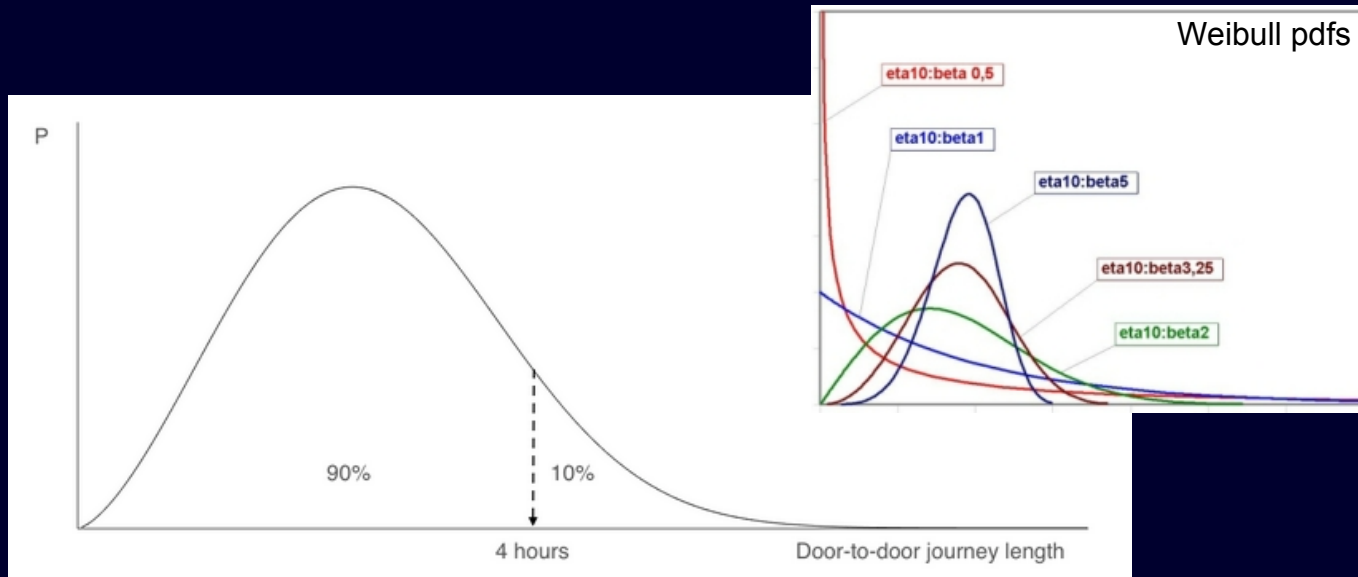
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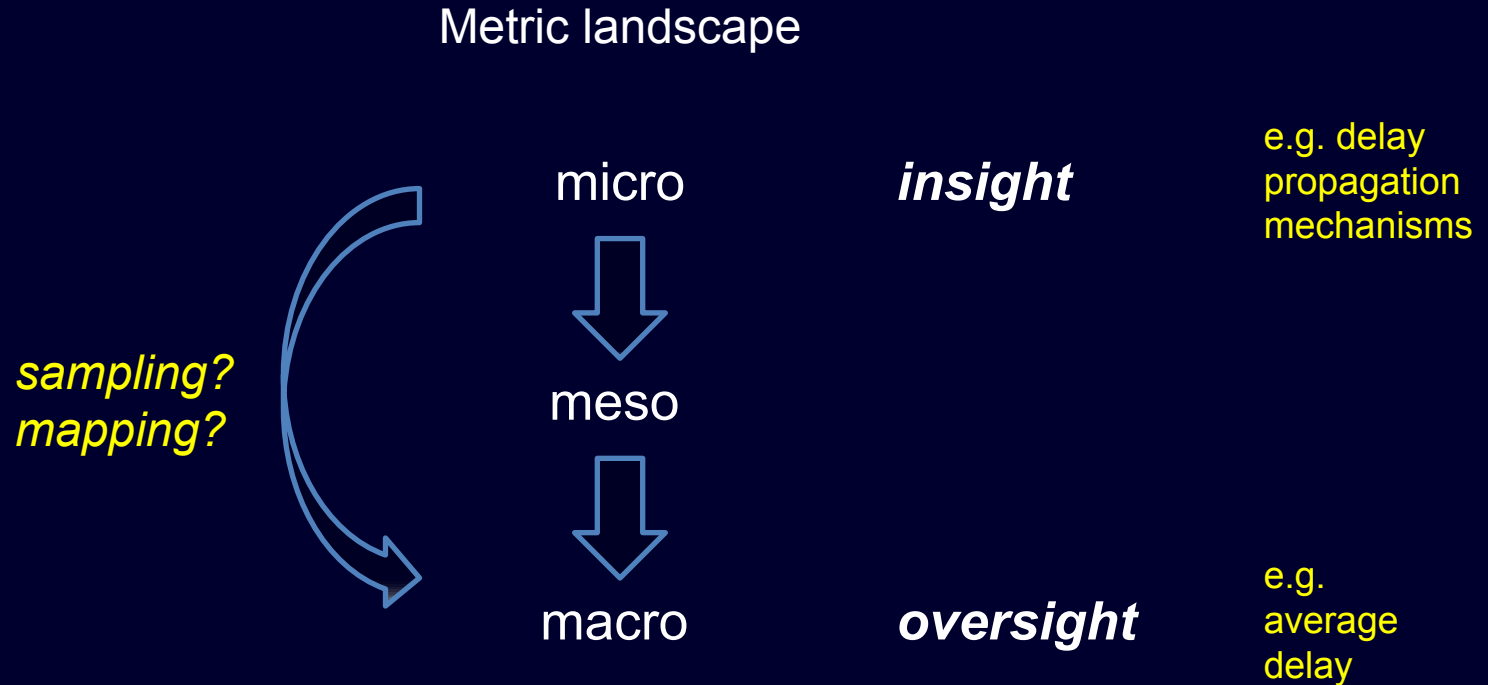
(All values are percentages. First three columns, relative.)

Trade-offs



- Many different 90% 4H D2D curves exist, depending on:
 - policy / regulation
 - technology (c.f. ATFM / UDPP mechanisms)
 - intermodality
 - etc.

Oversight v. insight



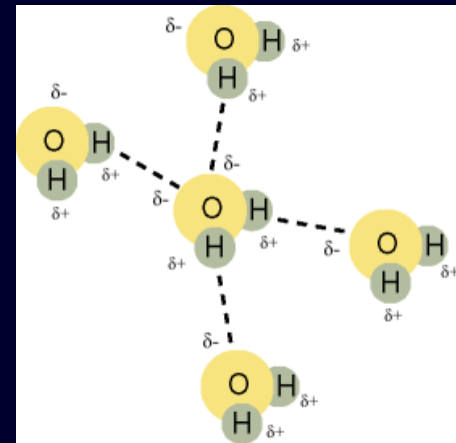
Future requirements, improved contexts:

- market research (utilities etc.)
- wider economics (cost of delay, supply-demand, subsidy, etc.)

Oversight v. insight

Complexity science

- Multidisciplinary; system of systems – usually a network
 - multiple components, non-linear dynamics
 - system properties cannot be predicted as a sum of the parts
 - non-analytical models, e.g. agent-based
 - usually need to take uncertainty into account
- Emergent behaviour, e.g. delay propagation
- ATM = complex socio-technical system
- How can complexity science contribute?
 - user-defined nodes/links in topological networks
 - existing metrics such as centralities (causality)
 - existing methods such as community detection, percolation theory and network vulnerability (analysis and treatment of nodes)



(JS Mill, 1872)

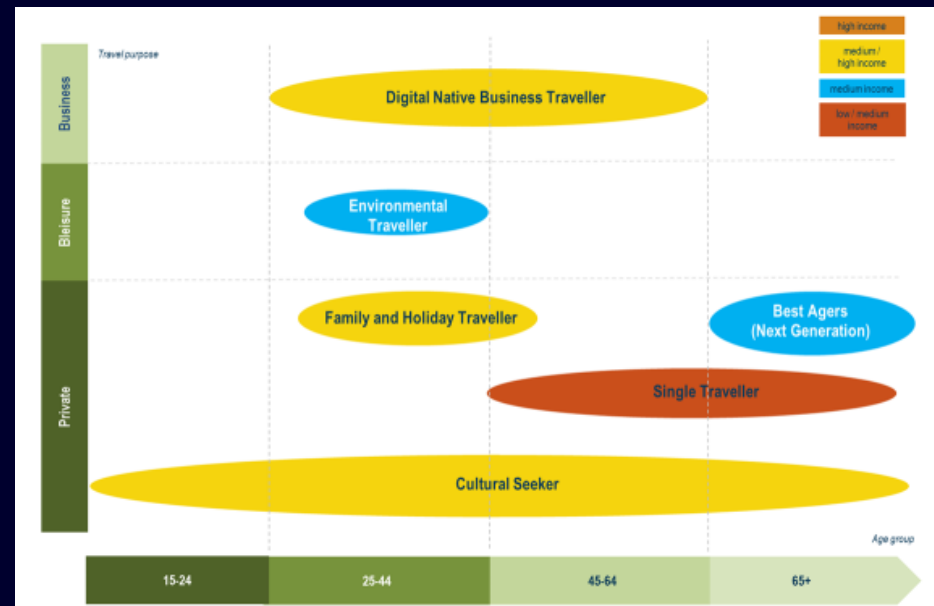
Standardisation v. adaptability

3.3.1 En-route ATFM delays

Please note that software release 20.0 of the Network Manager on 04 April 2016 introduced a change to improve the accuracy of the ATFM delay calculation for operational purposes which resulted in an estimated overall reduction of 11.8% of delay compared to the old methodology. More information on the change is available online at www.ansperformance.eu.

PRR 2016 (draft)

- Cost of delay (reg^N)
- Passenger demand (speed paradigm) and utility
- [...]
- Global comparisons



Data and modelling context

- Data
 - literature demonstrates many sampling and data constraints
 - how much of a network is 'enough'? (non-saturation of metrics)
 - top 34 airports (Europe & US) => $\approx 2\%$ error (thus care)
 - similar issues with data cleaning
 - accessibility in Europe improving (but: manuals, awareness, confidentiality)
 - big data: diversity / open architectures, integrity – dynamic metrics?
 - originally-filed flight plans (IFPS archives)
- Standardisation and comparability
 - EU-US harmonised KPI reporting, in coordination with ICAO
 - collaborations between China and US, China and EUROCONTROL
 - ATFM delay established as a proven leading indicator
 - standard (clean) datasets, c.f. other disciplines

S2020 Scientific Committee (TF3)

- Performance measurement in European air transport
 - key challenges and potential solutions
- Objectives
 - establishing key definitions
 - summarise state of the art, including European regulatory context
 - compare and contrast different indicators used (e.g. across stakeholders; across international schemes) and review critically
 - summarise current and recent research initiatives
 - identify key emerging challenges and key-trade-off analysis methods
 - propose initial solutions to (some of) emerging challenges (later!)
- Potential collaborations
 - PRU, ICAO, ART members (?)