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DATASET 2050

Mobility metrics

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Contents

Performance management

"If you cannot measure it, you cannot manage it"

Lord Kelvin (attrib.)

To manage DATASET 2050 developments

- Measure these developments using metrics
- Produce indicators that show progress towards the goals
  - May be composed of combinations of metrics

Many dimensions to problem of attaining a goal

- Key Performance Areas (KPAs)

Performance management

Indicators show performance in each KPA

- Some are Key Performance Indicators (KPIs)
- Others are secondary indicators

Indicators vs. metrics

- A metric is a measurement
  - fuel used; money spent; time elapsed; minutes delay
- An indicator can be a metric or more complicated
  - Should enable progress towards goals to be measured
    - Percentage of intra-European journeys less than 4 hours door-to-door
  - Could also indicate harmful side-effects
    - Ratio of rich travellers to poor travellers vs. demographic

ICAO KPAs

11 KPAs for improvement of air traffic management (ATM)

Defined in 2005 and elaborated in 2009 for the ATM system

Access and equity	Capacity	Cost effectiveness
Efficiency	Environment	Flexibility
Interoperability	Participation and collaboration	
Predictability	Safety	Security

KPAs subdivided into Focus Areas

DATASET 2050 KPAs

Objectives for mobility & connectivity different from ATM

- ICAO nomenclature provides good basis
  - Some names and definitions of KPAs slightly modified or adapted
  - “Participation and collaboration” irrelevant to DATASET2050

DATASET 2050 KPAs subdivided into Mobility Focus Areas

- derived from the air transport goals
- Inspired by expected future transport properties
  - Most from "Meeting ‘societal’ & market needs“ - Flightpath 2050
  - Some derived from EC Aviation Strategy (2015)
    - describes several research areas for tackling challenges to growth in air transport

Dataset 2050 KPAs

Key Performance Area	Mobility Focus Areas
Access and equity	Affordability; Equity; Reach
Cost effectiveness	Beneficiary; Cost; Value for money
Efficiency	Duration; Comfort; Speed
Flexibility	Diversity of destinations; Multimodality; Resilience
Interoperability	Seamlessness
Predictability	Variability; Punctuality; Reliability
Safety	Safety
Security	Security
Sustainability	Environmental aspects; Social aspects
Capacity	Capacity

DATASET 2050 Indicators

DATASET 2050 has defined KPIs for each KPA

- Preferably taking most of the MFAs into account
  - Not always possible or important

Other (non-key) indicators defined

- Considered less important factors in mobility performance assessment
- May be called upon if necessary

DATASET 2050 KPIs

Key Performance Area	Key Performance Indicators
Access and equity	4-hour reach; Income access disparity; Disabled access
Capacity	Journeys within 4 hours; Delay elasticity with respect to throughput
Cost-effectiveness	Passenger distance per euro spent
Efficiency	Time efficiency performance
Flexibility	Distance diversity of destinations
Interoperability	Transition-journey ratio
Predictability	Likelihood of arriving more than 15 minutes late at destination
Safety	Number of deaths per million passenger journeys
Sustainability	Total Global Warming Potential of intra-European air travel

DATASET 2050 KPIs

KPA	KPI	Description
Access and equity	4-hour reach	How far can you get in 4 hours? $max(\forall j{:}dist(D2K_{ij})+(\forall k{:}dist(K2K_{jk})+max(dist(K_j2D))))$ From door I via airports j and k
	Income access disparity	How much more likely are the rich to travel than the poor? $journeys_h / journeys_l$ $journeys_h$ = private journeys by people in top 50% $journeys_l$ = private journeys by people in bottom 50% of population by income. Requires population surveys
	Disabled access	How does disability affect travel? Weighted ratio for people with disabilities against total population $\frac{N-n}{n} \times \frac{\sum_{i}^{n} journeys_i}{\sum_{j}^{(N-n)} journeys_j}$

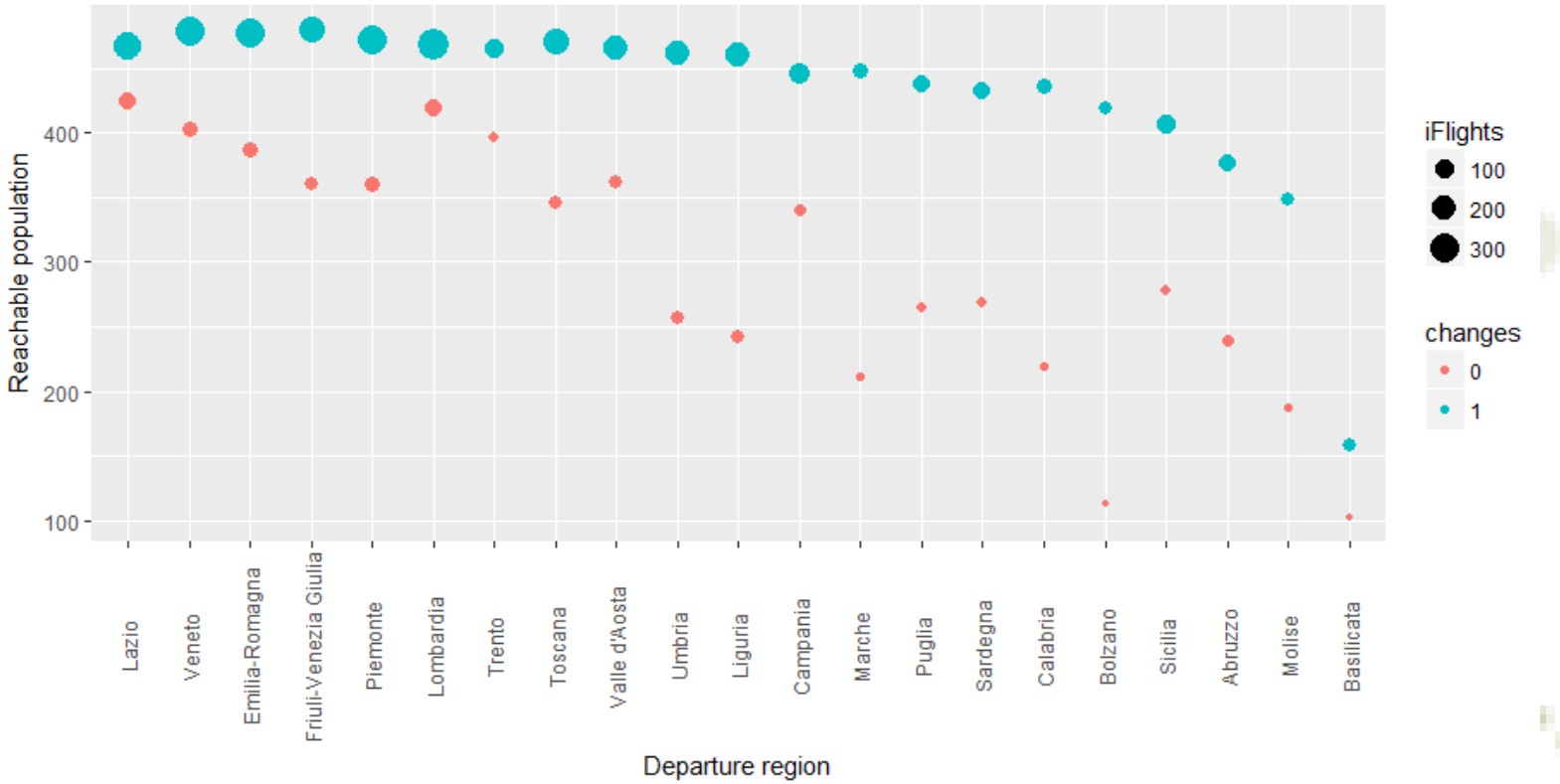
DATASET 2050 KPIs

KPA	KPI	Description
Capacity	Journeys within 4 hours	Simple percentage
	Delay elasticity with respect to throughput	How much delay do extra passengers create? $k_\delta = \frac{\Delta\delta}{\Delta N}$ The ratio of the variation of delay to the variation of throughput

DATASET 2050 KPIs

KPA	KPI	Description
Cost-effectiveness	Passenger distance per euro spent	$\frac{1}{n}\sum\frac{distance}{cost}$ Total for all journeys
Efficiency	Time efficiency performance	$Efficiency = \frac{best}{actual}$ No. of journeys for which efficiency > 0.8
Flexibility	Distance diversity of destinations	How widespread are the possible destinations? $\delta_O = \sum_i \left(\lvert\overline{OD_i}\rvert \sum_j \frac{\lvert\overline{D_iD_j}\rvert}{\lvert\overline{OD_j}\rvert} \right) \Big/ \sum_j \lvert\overline{OD_j}\rvert$

Example: Italian airports



- One-change journeys make the larger contribution
- But how many can be done in 4 hours?

DATASET 2050 KPIs

KPA	KPI	Description
Inter-operability	Transition-journey ratio	How much time is spent between connections? $\frac{transitiontime}{totaltime}$
Predictability	Likelihood of arriving more than 15 minutes late at destination	(Probability of getting to gate) x (Reliability of airlines) x (Probability of being late at destination)
Safety	Number of deaths per million passenger journeys	$\frac{\sum_{j=1}^{N}(1-\prod_{i=1}^{n_j}(1-m_{ij}d_{ij}))}{N} \times 1,000,000$ m_{ij} is fatality rate of ith leg of journey j d_{ij} is distance travelled in that leg
Sustainability	Total Global Warming Potential of intra-European air travel	$\sum_i \sum_j \sum_p v_{jp} GWP_{Jp}$ for each pollutant p for each leg j of transport mode J in journey i, where v_{jp} is the volume of pollutant p produced during leg j

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Other indicators

Key Performance Area	Other indicators
Access and equity	Low-income access; Medium-income access; High-income access; Carless access; Affordability; Unaffordability
Cost-effectiveness	Passenger distance per euro airline cost
Efficiency	Pax time efficiency; Average time efficiency
Flexibility	Cultural diversity of destinations; Cultural diversity performance; Mean time to fix
Interoperability	Total time spent in transitions during a journey; Number of phases required to complete a journey; Average of time spent per transition
Predictability	Variability on intra-European flights; Variability on airport public transport; Punctuality of intra-European flights; Punctuality of airport public transport; Reliability of intra-European flights; Reliability of airport public transport; Likelihood of missing a flight
Security	Number of cyber-security events
Sustainability	CO2 per passenger km; NOx per passenger km; Global Warming Potential per km of air journeys; Global Warming Potential of intra-European air travel
Capacity	Total journeys; Journeys under 6 hours; Journeys over 6 hours

Conclusions

A full range of KPIs has been defined for DATASET 2050

- Covering all Key Performance Areas
- Other indicators proposed

Any suggestions for others?