FTL Effectiveness

– How much lower risk? At what cost?

Tomas Klemets, Head of Scheduling Safety, Jeppesen

tomas.klemets@jeppesen.com

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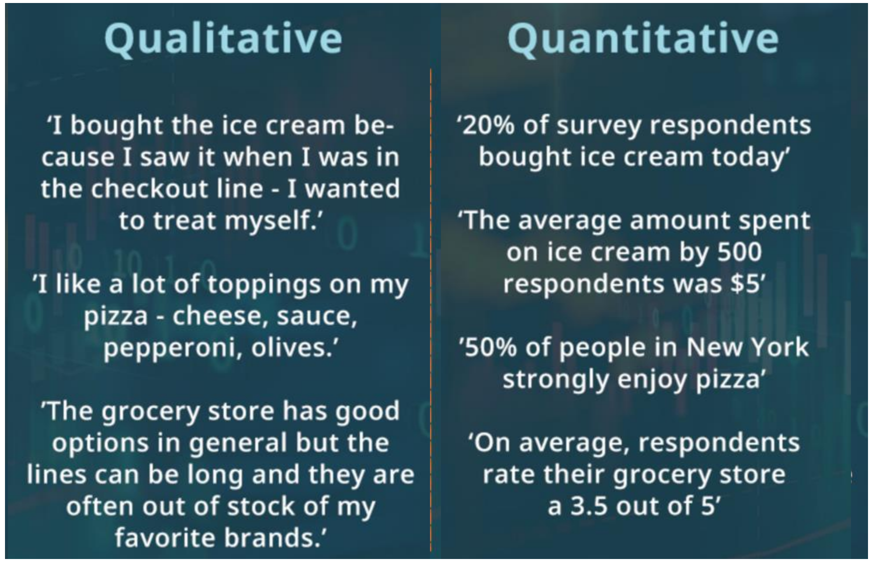
The problem…

- **FTLs are primarily there to limit fatigue risk**
- **FTLs spring from rules designed to limit physical (not cognitive) fatigue**
- **The FTL updates in ≈2010-2020 have been done mostly in a qualitative way:**
  - *“12 h of rest before a flight should be better than just 9 h” (…but we know rest may force crew out of bed)*
  - *“A shorter night duty should be more safe than a longer one” (…but more night duties, disrupting good sleep?)*
- **We lack a quantification of the effects of rules, on *overall* fatigue risk, when applied to (complex) crew management processes**



EASA
European Aviation Safety Agency

- *Phase 1 – published in March 2019. Found ‘an increased probability of high fatigue levels during nights and duty periods with late finishes, among both pilots and cabin crew’*
- *Phase 2 – ongoing. NLR/DLR/scientists. Collecting data to further quantify ‘FTL Effectiveness’. At all possible?*

The platform

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FTLs (4)

- FAR 117
- CAAC-R6
- EASA FTLs
- EASA Subpart Q

Periods (3 weeks)
(OAG)

- 6 May 2019
- 10 Oct 2019
- 3 May 2021

Fleets (≈400)

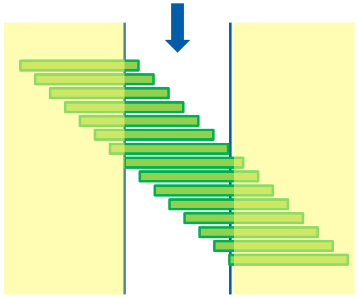
- All Boeing and Airbus fleets
- NB > 200 f/w
- WB > 100
- Pax only

Crew Plans to produce:

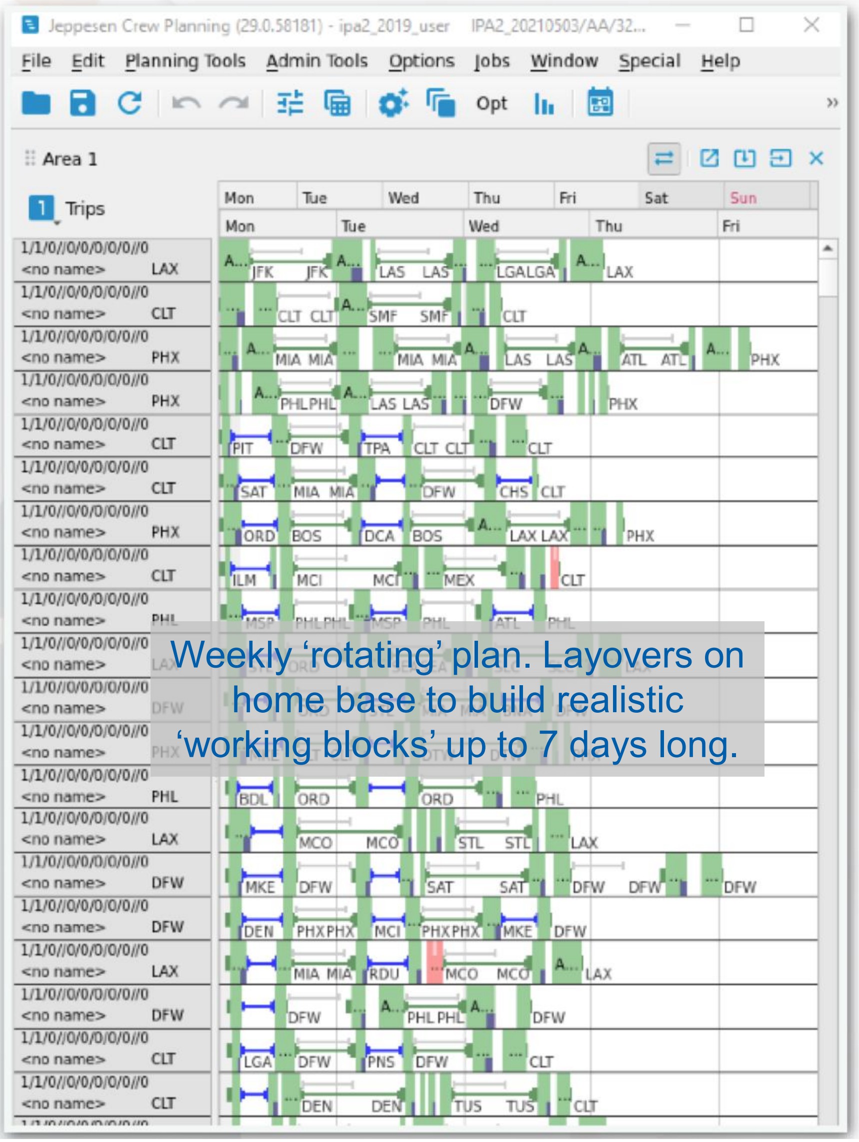
4 * 3 * 400 = **4800**

(8,900,000 flights planned *into context*, using >15k CPU hours…)

The week to measure!

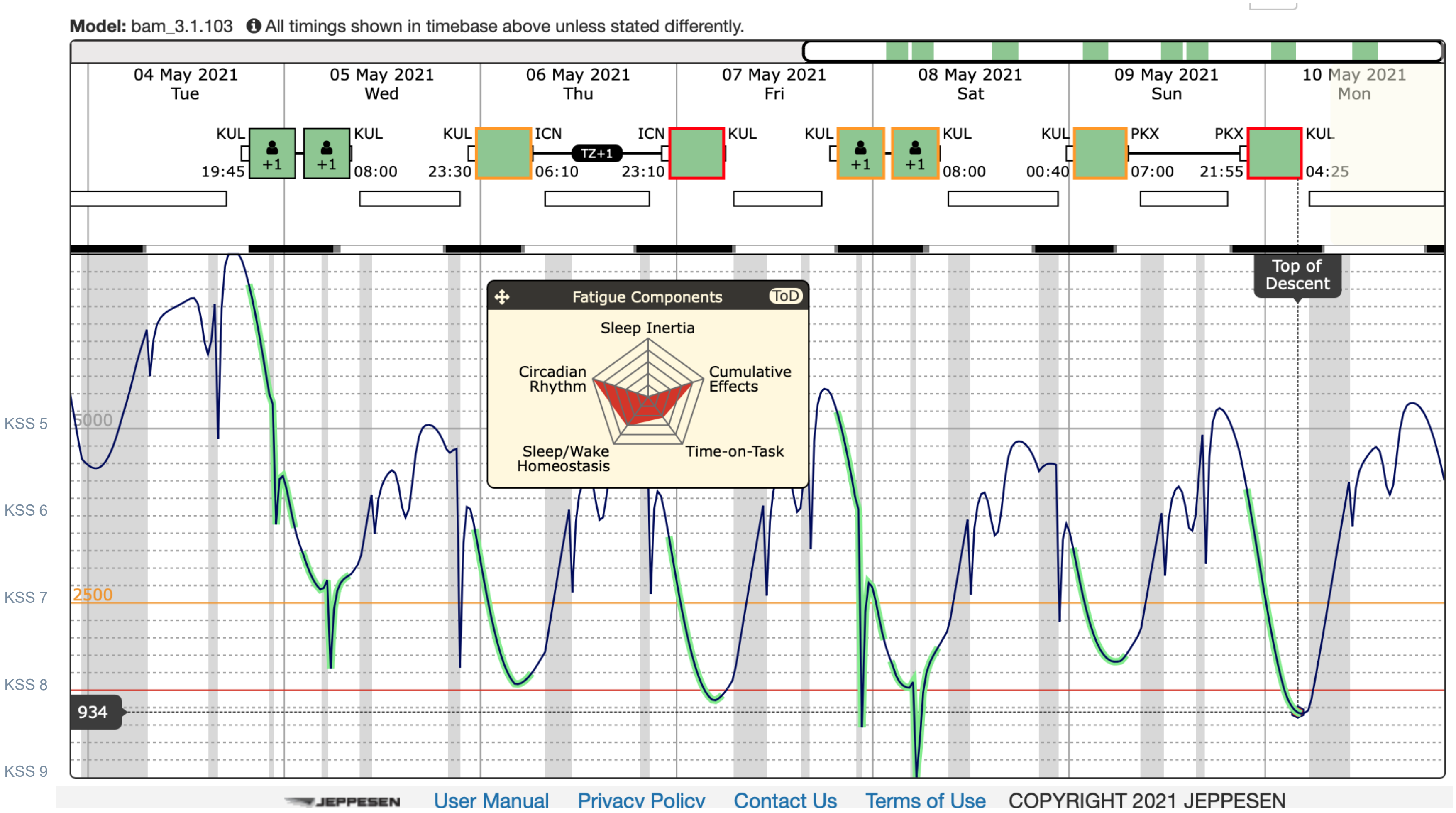


'Roll out' and load into a BI-solution



Weekly 'rotating' plan. Layovers on home base to build realistic 'working blocks' up to 7 days long.

Example of a pattern produced

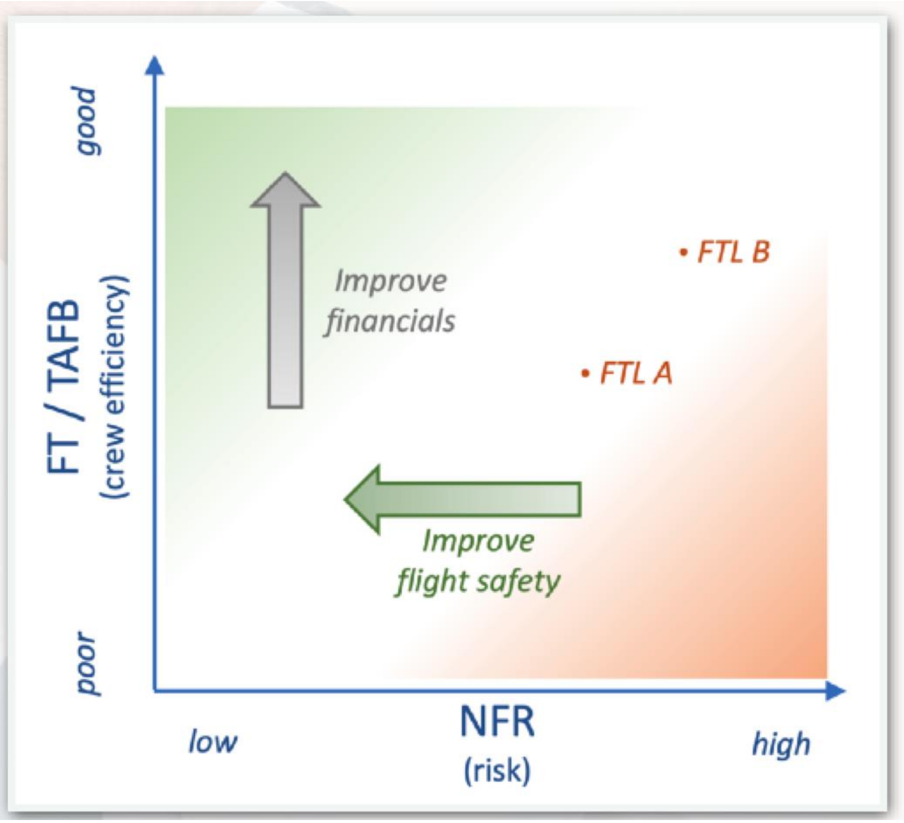


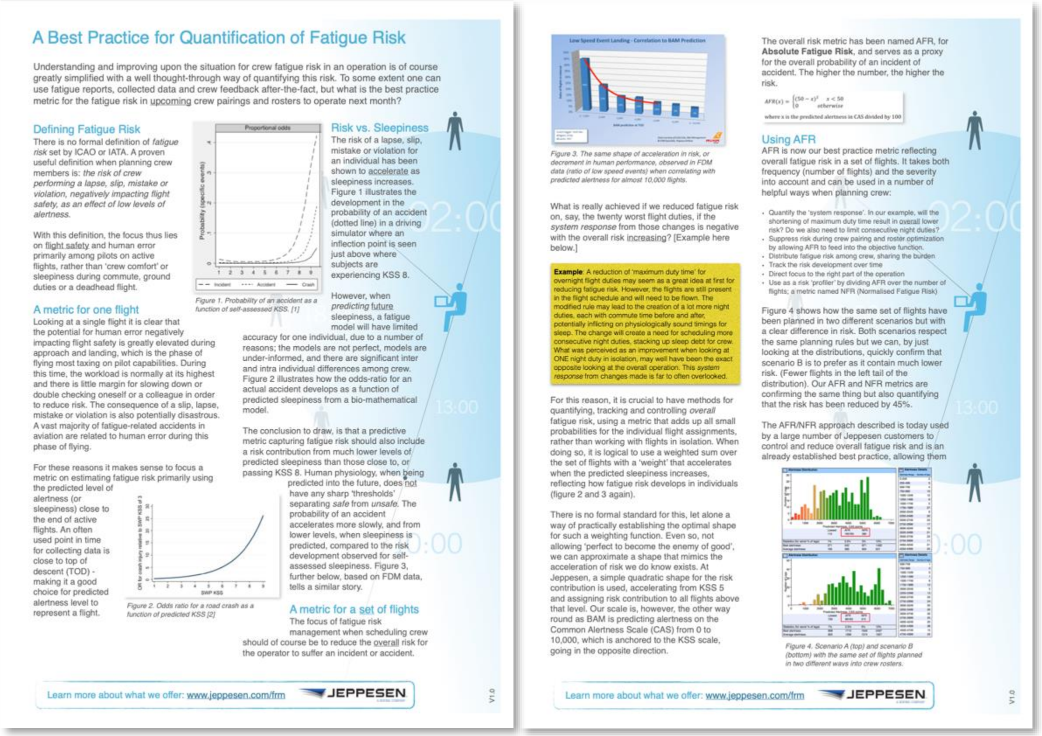
- MH 330
- Planned only using the EASA FTLs
- Six consecutive nights disrupted
- [**NOT** how they operate, but how they would be allowed to operate]

The metrics

FTL Effectiveness:

The ability of a regulatory flight and duty time ruleset to limit fatigue risk while allowing for crew efficiency.





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--- Results ---

EASA and European-based operators

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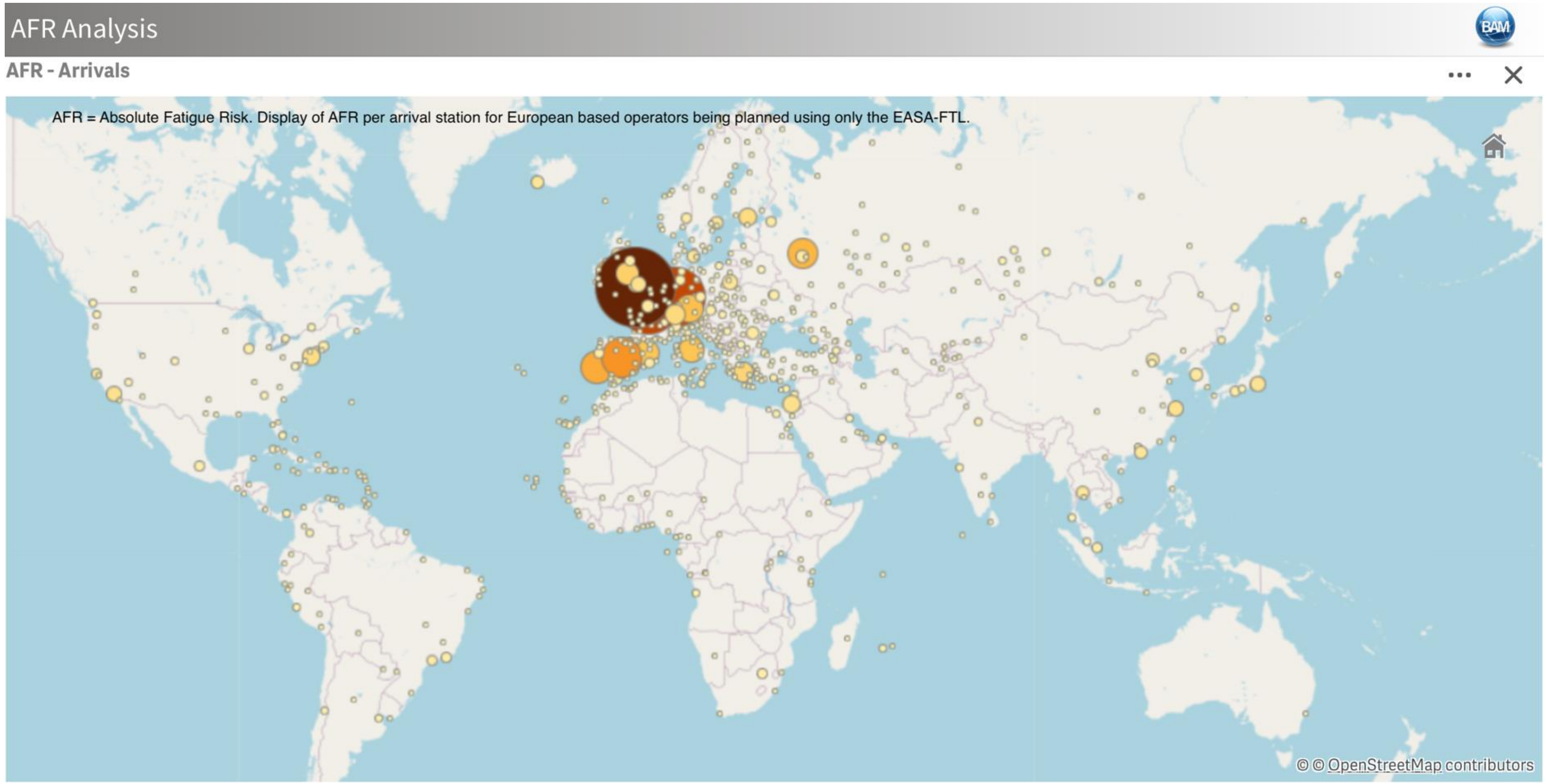

- European-based operators
- AFR: volume & severity, proxy for the probability
- Planned with current EASA FTLs only
- [**NOT** how they operate, but how they would be allowed to operate]

EASA and European-based operators

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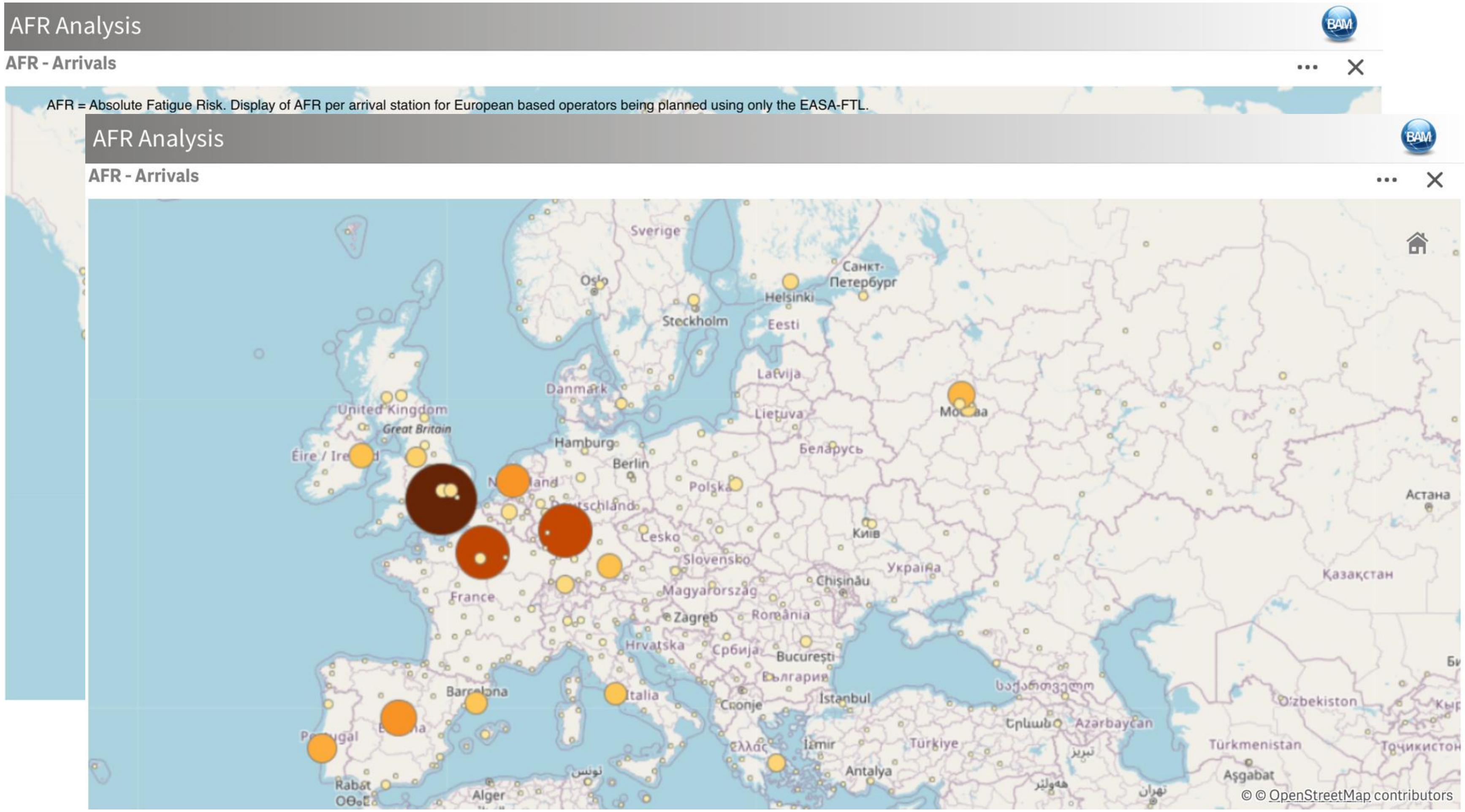

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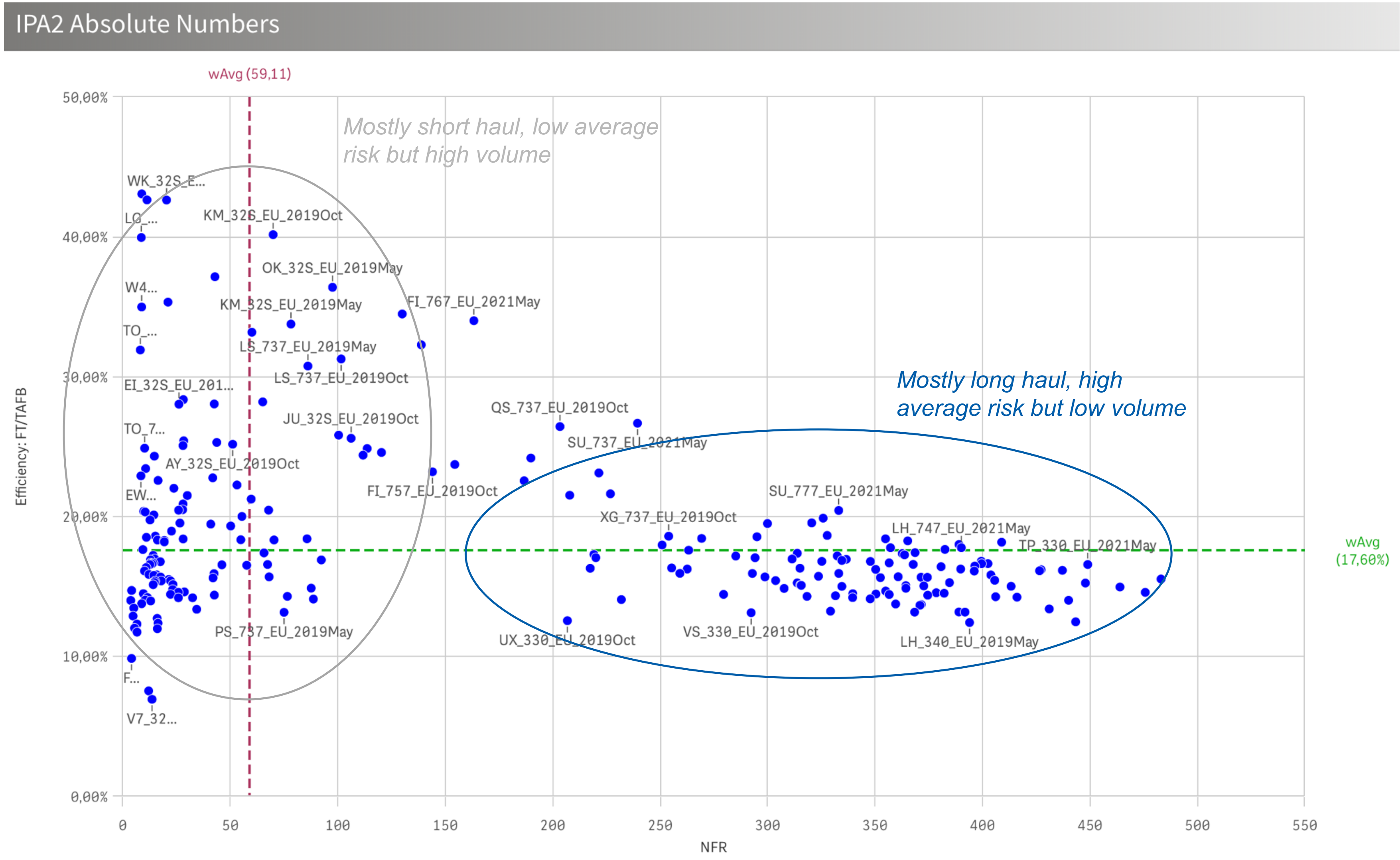
EASA FTLs, NFR per fleet



Risk of a fatigue-related incident/accident:

47/53%

Short haul/long haul

Shift in Efficiency and Risk

Subpart Q → EASA FTLs

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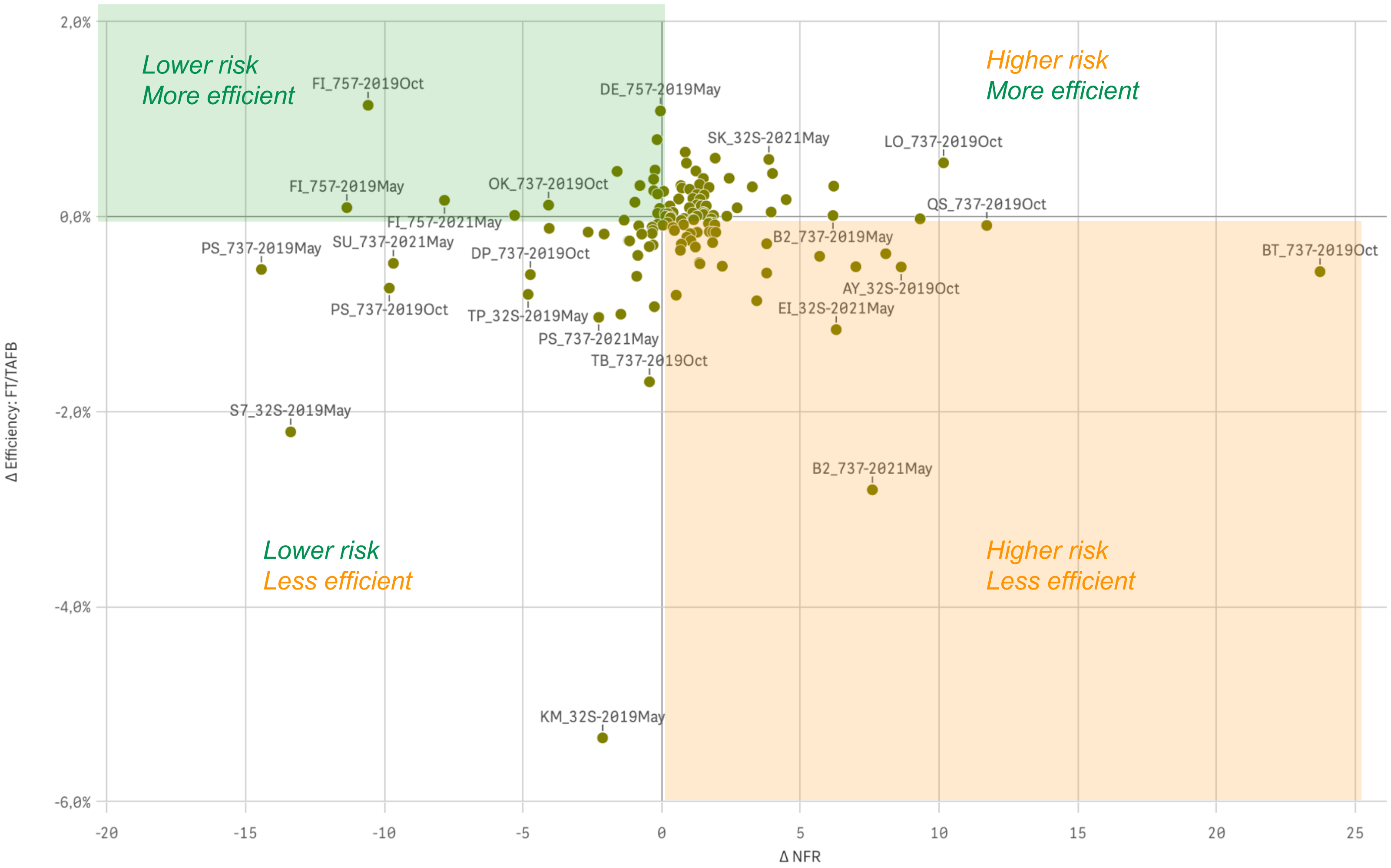


Short-haul (Europe)

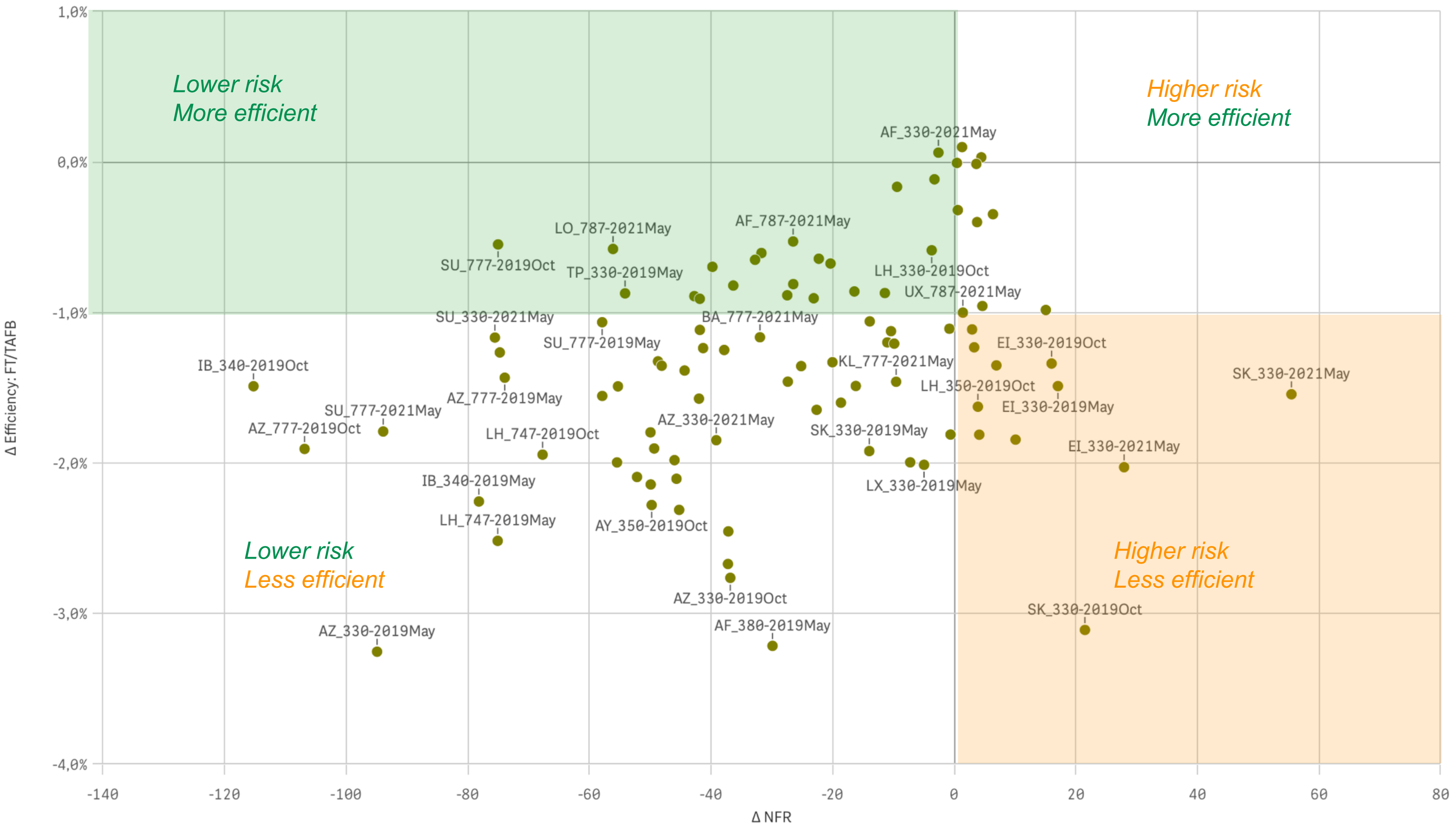
Subpart Q → EASA FTLs

NFR: 29.82 → 30.77 (+3.2%)

FT/TAFB: 17.70% → 17.60% (0.6%)

Elasticity? (small push using BAM, Subpart Q, 2019Oct)

	AF320	LH320	KLM737	Sun Express737
Ref NFR	20	26	10	242
NFR w/ penalty	11 (-45%)	17 (-34%)	5 (-50%)	223 (-7.9%)
[FT/TAFB change]	-0.25%	-1.2%	-0.13%	-1.2%
NFR w/ award	25 (+25%)	33 (+27%)	16 (+60%)	249 (+2.9%)



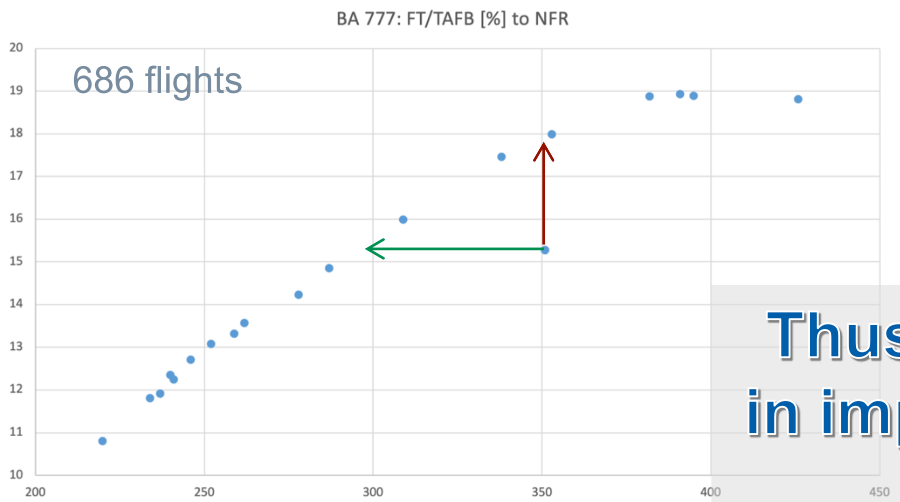
Long-haul (Europe)

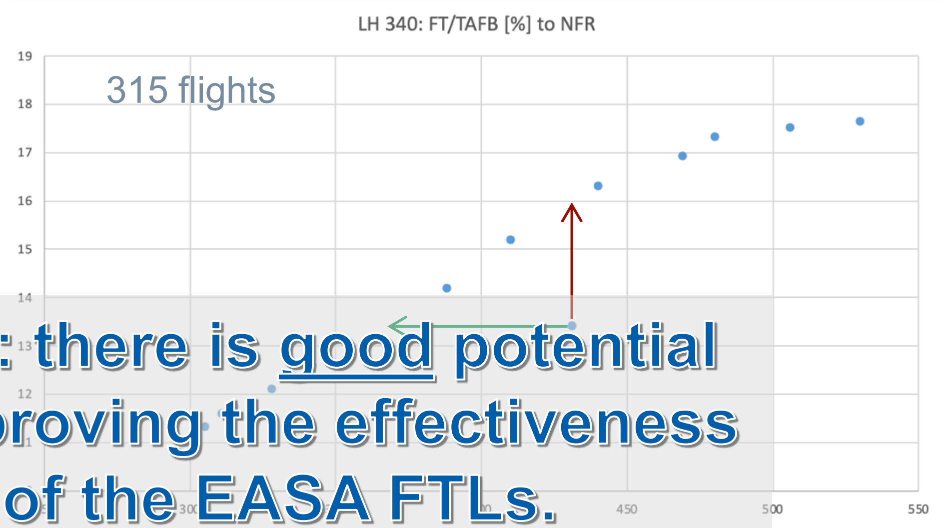
Subpart Q → EASA FTLs

NFR: 380.2 → 350.4 (-7.8%)

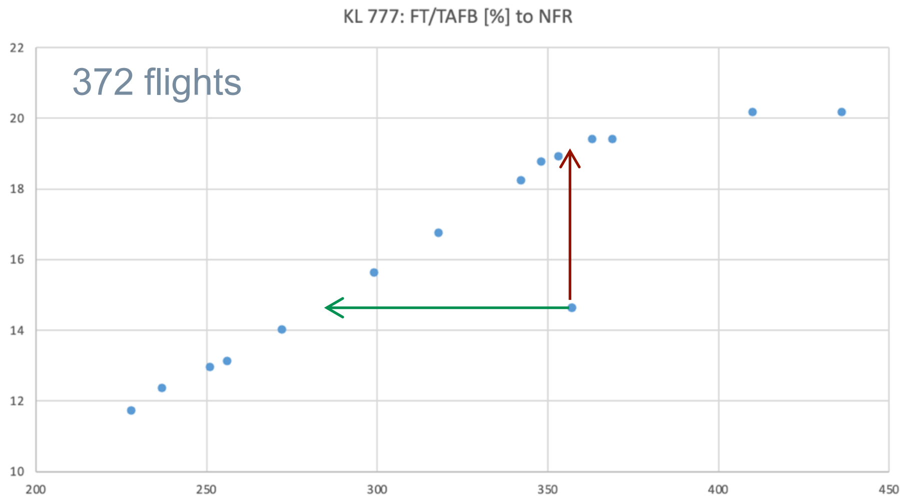
FT/TAFB: 17.30% → 16.10% (-7%)

Elasticity in long haul – it's there!





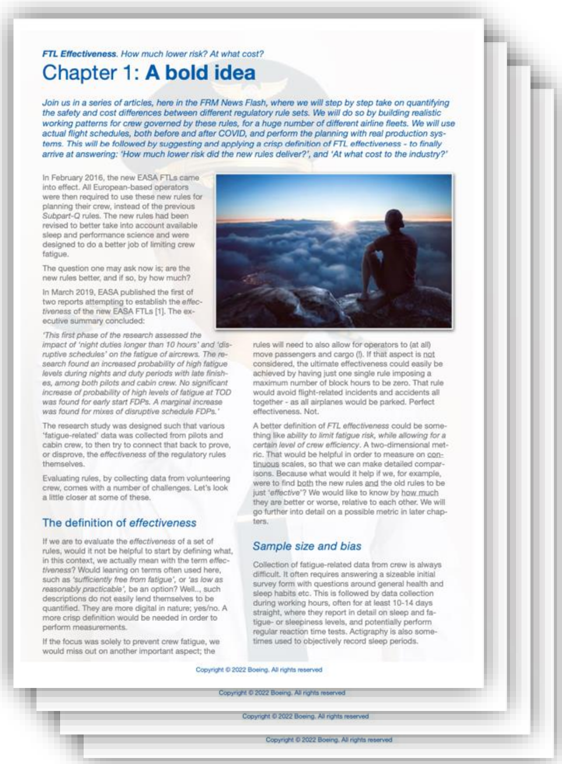
Thus: there is good potential in improving the effectiveness of the EASA FTLs.



- Weighted, remaining, potential in EASA FTL on these three fleets:
  - -16,1% fatigue risk, OR
    +18,0 % crew efficiency !!!
- …to be compared with the overall change with Subpart Q → EASA FTL:
  - -7.8 % risk
    -7.0 % crew efficiency
- *[Note: The 16 & 18% are for only one (1) mechanism. Then there is acclimatisation, minimum rest…]*

Discussion. Next steps?

- **Hold here for a moment. Is anyone (at all) interested?**
- **Then:**
  - What are the rules to praise/blame?
  - What can be learnt from FAR and CAAC?
  - Add CAP 371, CAO, CAR… and learn also from them?
  - Add more planning periods?
  - Measure with one more fatigue model?
  - Add also Embraer fleets?
  - *What-if* analysis to reformulate and improve the rules – on a few selected problems.
  - *Pressure-test* the rules? Direct the optimizer to produce the worst legal patterns allowed…



***FTL Effectiveness**. How much lower risk? At what cost?*

Chapter 1: **A bold idea**

Join us in a series of articles, here in the FRM News Flash, where we will step by step take on quantifying the safety and cost differences between different regulatory rule sets. We will do so by building realistic working patterns for crew governed by these rules, for a huge number of different airline fleets. We will use actual flight schedules, both before and after COVID, and perform the planning with real production systems. This will be followed by suggesting and applying a crisp definition of FTL effectiveness - to finally arrive at answering: 'How much lower risk did the new rules deliver?', and 'At what cost to the industry?'

In February 2016, the new EASA FTLs came into effect. All European-based operators were then required to use these new rules for planning their crew, instead of the previous *Subpart-Q* rules. The new rules had been revised to better take into account available sleep and performance science and were designed to do a better job of limiting crew fatigue.

The question one may ask now is; are the new rules better, and if so, by how much?

In March 2019, EASA published the first of two reports attempting to establish the *effectiveness* of the new EASA FTLs [1]. The executive summary concluded:

'This first phase of the research assessed the impact of 'night duties longer than 10 hours' and 'disruptive schedules' on the fatigue of aircrews. The research found an increased probability of high fatigue levels during nights and duty periods with late finishes, among both pilots and cabin crew. No significant increase of probability of high levels of fatigue at TOD was found for early start FDPs. A marginal increase was found for mixes of disruptive schedule FDPs.'

The research study was designed such that various 'fatigue-related' data was collected from pilots and cabin crew, to then try to connect that back to prove, or disprove, the *effectiveness* of the regulatory rules themselves.

Evaluating rules, by collecting data from volunteering crew, comes with a number of challenges. Let's look a little closer at some of these.

The definition of *effectiveness*

If we are to evaluate the *effectiveness* of a set of rules, would it not be helpful to start by defining what, in this context, we actually mean with the term *effectiveness*? Would leaning on terms often used here, such as *'sufficiently free from fatigue'*, or *'as low as reasonably practicable'*, be an option? Well.., such descriptions do not easily lend themselves to be quantified. They are more digital in nature; yes/no. A more crisp definition would be needed in order to perform measurements.

If the focus was solely to prevent crew fatigue, we would miss out on another important aspect; the rules will need to also allow for operators to (at all) move passengers and cargo (!). If that aspect is not considered, the ultimate effectiveness could easily be achieved by having just one single rule imposing a maximum number of block hours to be zero. That rule would avoid flight-related incidents and accidents all together - as all airplanes would be parked. Perfect effectiveness. Not.

A better definition of *FTL effectiveness* could be something like *ability to limit fatigue risk, while allowing for a certain level of crew efficiency*. A two-dimensional metric. That would be helpful in order to measure on continuous scales, so that we can make detailed comparisons. Because what would it help if we, for example, were to find both the new rules and the old rules to be just '*effective*'? We would like to know by how much they are better or worse, relative to each other. We will go further into detail on a possible metric in later chapters.

Sample size and bias

Collection of fatigue-related data from crew is always difficult. It often requires answering a sizeable initial survey form with questions around general health and sleep habits etc. This is followed by data collection during working hours, often for at least 10-14 days straight, where they report in detail on sleep and fatigue- or sleepiness levels, and potentially perform regular reaction time tests. Actigraphy is also sometimes used to objectively record sleep periods.

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[Chapter 1 - a bold idea](#)

[Chapter 2 - the platform](#)

[Chapter 3 - the metrics](#)

[Chapter 4 – Had we not hoped for more?](#)

Questions?

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www.jeppesen.com/FRM

tomas.klemets@jeppesen.com

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