

Scientific Review of FRMS Applications

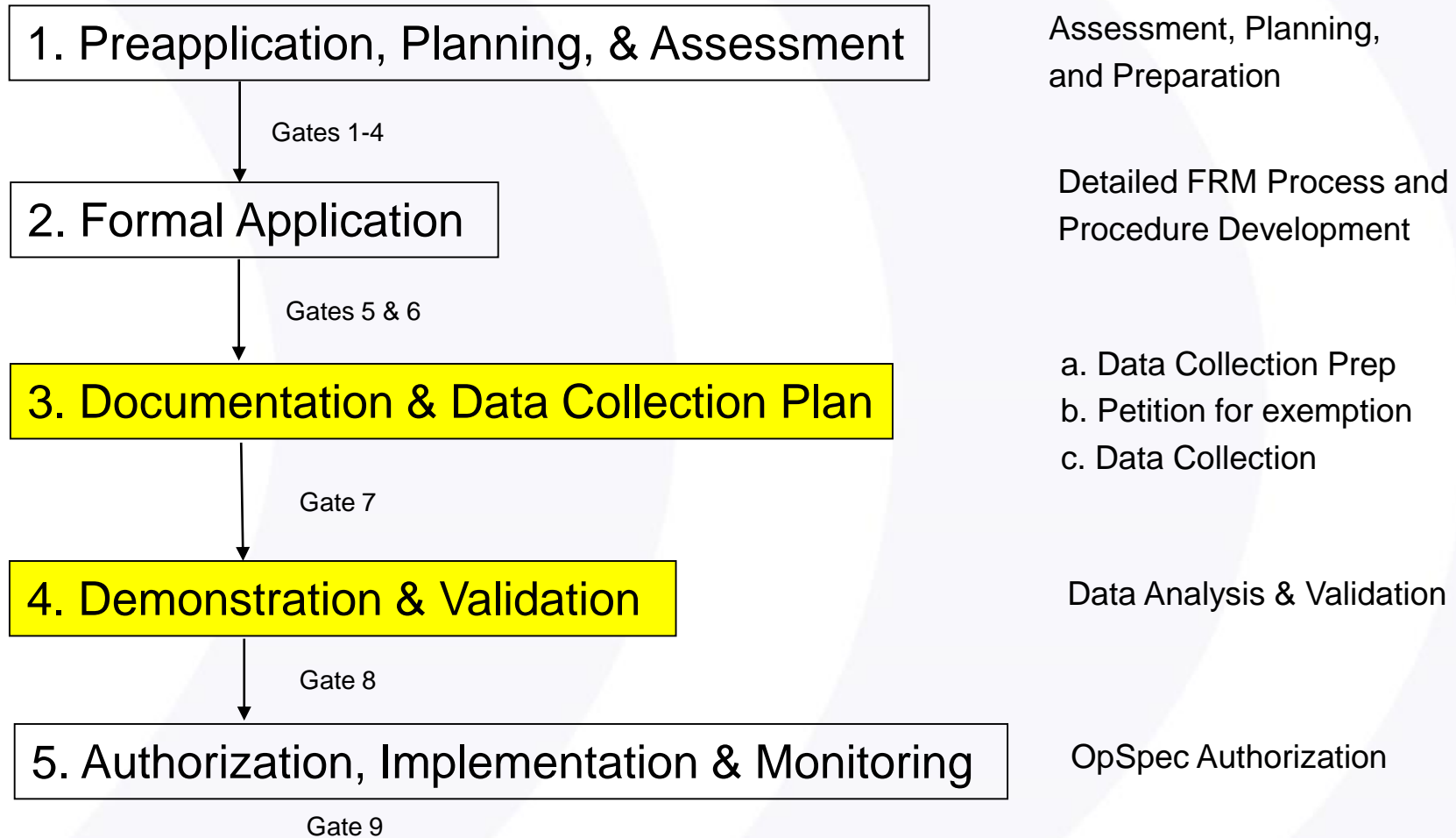
Establishing an Acceptable Alternative Method of Compliance

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Overview of FRMS Authorization Process



Review of the Safety Case and Data Collection

- Establish through prior data collection and/or modelling that the proposed exception to Part 117 can be conducted safely when combined with the limitations and mitigations proposed by the carrier.
- Prepare documentation of the proposed operational procedures and a data collection plan.
- FAA then reviews the application, safety case and data collection plan.
- Once the FAA determines that the operation can be conducted safely for the purpose of collecting validation data, an exemption is issued.
- The purpose is to establish that the AMOC provides a level of safety that is equivalent (equal to or better) than that which would exist under Part 117.



Establishing an Acceptable “Alternative Method of Compliance” (AMOC)

- Under an FRMS, a certificate holder develops processes that manage and mitigate fatigue that serve as an alternate method of compliance (AMOC) to the prescriptive rule.
- The certificate holder must satisfactorily demonstrate to the FAA that their proposed FRMS satisfactorily demonstrates that the AMOC provides an equivalent level of safety to the safety standards set forth in part 117.
- Data collection and analysis are vital in determining the flightcrew members’ level of performance during that operation proposed by the certificate holder.
- A statistical method call “Equivalence Analysis” is used to establish that performance (and/or sleep) provides an equivalent level of safety.



Measures used for Equivalence Testing

- The kinds of measurements required for validation of an AMOC depends on the kind of exception to Part 117.
- As a general rule, these are the approaches followed:
 - ◆ For exceptions that focus on the conditions governing in-flight rest with augmented crew, the FAA has required data to establish an equivalent duration and quality of sleep. This is general established using actigraphy, sleep logs, and subjective ratings of sleep quality.
 - ◆ For exceptions that focus on extending flight and duty time beyond those established by Tables A, B, and C, measurements are required to establish an equivalent level of sleep and performance. Measures include actigraphy, sleep logs, PVT performance testing, and subjective ratings of alertness.
- Since this application focused on the requirements for inflight rest, the FAA requested data collection on sleep duration and quality.



Establishing an AMOC involves a Comparison

- The performance under the AMOC is compared to a safety standard operation (SSO).
- In this case, comparison is made between the second and third rest opportunity using a three person crew.
- By comparing the second to the third rest, characteristics of the SSO and AMOC operations were similar:
 - ◆ Similar crewing
 - ◆ Similar aircraft
 - ◆ Similar rest facility
 - ◆ Similar time of day
 - ◆ Similar direction of travel and similar duration (within Part 117)



Non-significant difference is not Equivalence

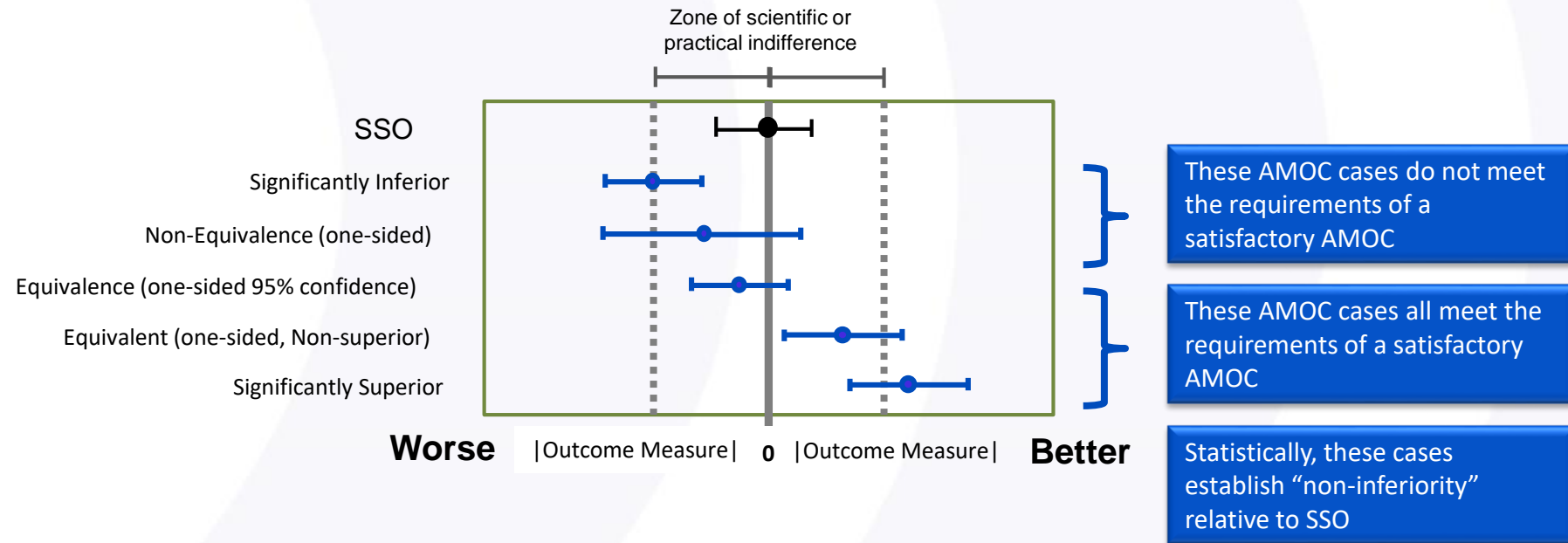
- Showing that the measures from the AMOC are NOT statistically different from the SSO does not establish equivalence.
- What is required is a test that shows that the AMOC is at least close enough to the SSO that there is 95% confidence that it is above a margin of practical indifference.
- Note: if the AMOC is statistically SUPERIOR to the SSO, then it is not equivalent “statistically” but it still meets the requirement of providing an equivalent level of safety.



Establishing AMOC Equivalence to SSO

- Equivalence is a significance test on proximity to the standard.
- Equivalence tests whether there is 95% confidence that the actual performance is within a zone of indifference relative to the SSO or better than the SSO?

—●— Outcome in SSO, Confidence Intervals
—●— Outcome in AMOC, Confidence Intervals



Equivalence of Sleep Duration by Rest break Number

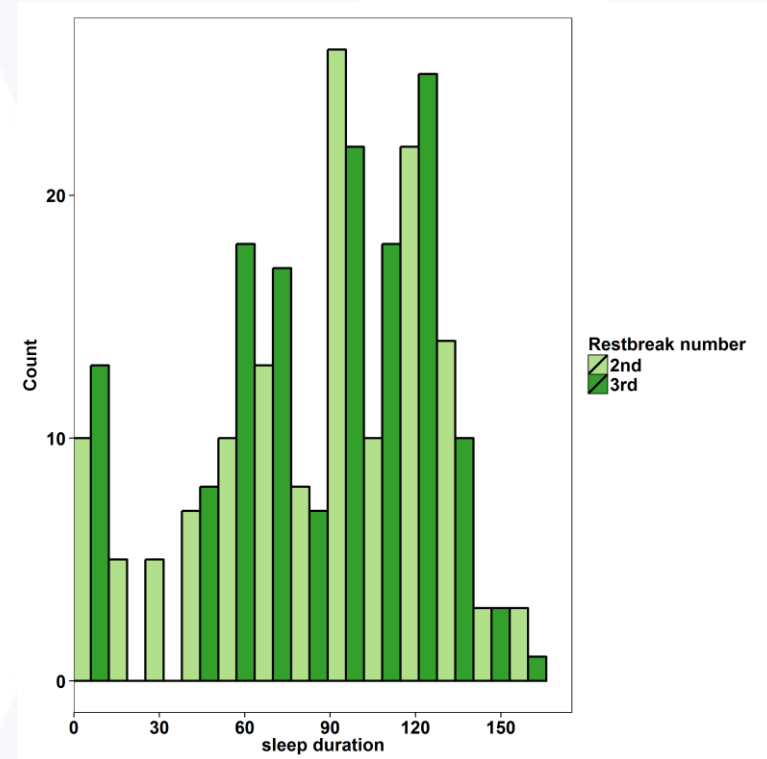
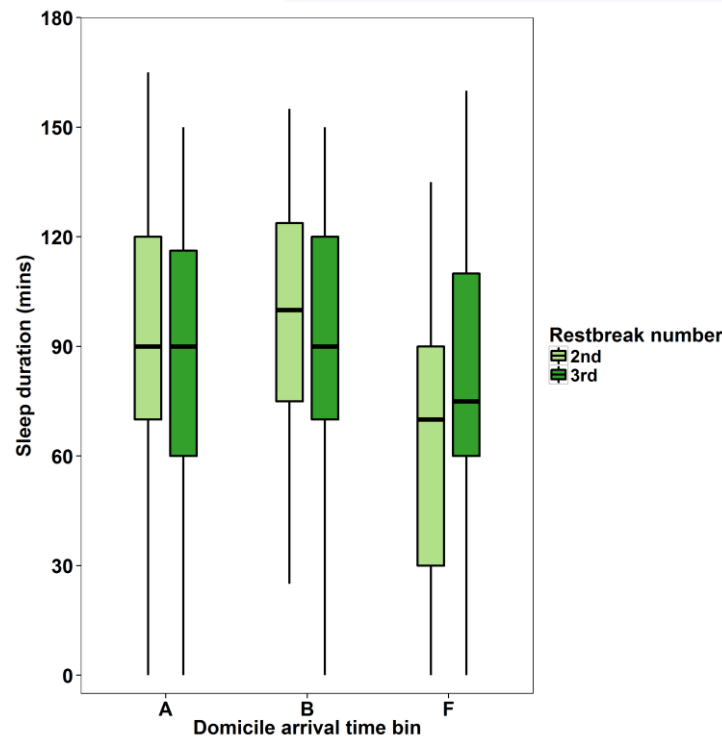


Figure 8: reported sleep duration in the 2nd and 3rd rest breaks in each domicile arrival time bin

Bold horizontal line – median break duration. The vertical box contains 50% of flights. The upper and lower whiskers extend to the maximum and minimum values within 1.5 times the height of the box.

Figure 9: Distributions of total reported sleep, comparing 2nd (n=136) and 3rd (n=142) rest breaks combined across all domicile arrival time bins



Exemption to Collect Data based on the Safety Case Submitted, Subject to Conditions and Limitations

- FAA granted Delta Air Lines an exemption from 14 CFR § 117.17(c)(1) to the extent necessary to conduct the flightcrew member performance and alertness data collection.
- FAA approved conditions under which the portion of CFR 117 may be modified subject to specific limitations, such as:
 - ◆ The flightcrew must consist of a 3-pilot augmented crew with a FDP limit of less than 14 hours.
 - ◆ The data analysis will consist of subjective data collected in-flight to include fatigue ratings (Samn and Perelli, 1982) before and after in-flight sleep and at top of descent, subjective estimates of sleep duration (calculated from self-reported sleep start and end times); and subjective ratings of sleep quality.



References

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