Scheduling in a less than perfect world

by Jennifer Zaslona & Dr. Van Dongen

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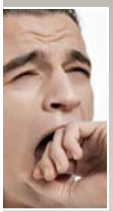
In a perfect world, there would be no need for night shifts or extended shifts. But, no such luxury. The aviation industry is an around-the-clock operation that is driven by passenger needs and profit margins. Given these constraints, the luxury of a perfect maintenance schedule is not a viable option.

Many mechanics have a solution-oriented (plus a little stubborn) "get the job done" mentality. While this approach is admirable and critical for many elements of the aviation industry it also provides the perfect recipe for fatigue and its consequences.

Cause of Fatigue



Sleepiness is regulated by how much sleep you last had and how long it has been since you last slept. The longer you have been awake and the less sleep you have results in an increased pressure or need for sleep. This need for sleep interacts with your circadian rhythm or natural body clock. The circadian rhythm tells your body to be awake during the day and sleep during the night. The circadian drive for sleep can oppose your need for sleep during the daytime hours of wakefulness or it can enhance impairments at night (1) (2).
Your sleep/wake history and circadian rhythm make extended or night shift operations a greater fatigue risk. Although extended or night shifts cannot be completely avoided in our less than perfect world, some methods are available to reduce fatigue risk.

Potential Solutions for a Less Than Perfect World

Solution 1: Mathematical models predict performance based on circadian rhythms and past sleep/wake history. You can use them to identify more fatiguing (dangerous) and less fatiguing (safer) schedules (5). The models can predict optimal performance times and the most beneficial recovery times as well as the cumulative effects of fatigue for a given schedule (6). Keep in mind these predictions don't take into account quality of sleep (i.e., illness or troubled sleep), they assume a best case scenario for a healthy operator under normal sleep conditions (5).

Solution 2: Employee education is another alternative to improve alertness and reduce fatigue. Employees can learn and implement healthy sleep habits. Education/ training has its limitations, for instance night-shift workers may experience difficulties obtaining enough sleep in the daytime due to a misalignment between the periods of wakefulness (during the night) and the circadian rhythms. In these cases circadian pressure for wakefulness occurs during the day and disrupts day-time sleep (1). To improve daytime sleep it may be necessary to use prescription sleep aids and avoid light at the end of a night shift to help circadian re-alignment (6) (7). On the flip side, lighting can also be used to improve alertness and performance, particularly during the nighttime hours, due to its effects on the suppression of the hormone melatonin (6) known to cause drowsiness.

Solution 3: Napping is another method of optimizing available rest opportunities. The timing or placement of the nap, both in regards to circadian rhythm, and previous sleep, is important as is the length of the nap. Taking a nap during the day before a night shift and with no prior sleep loss has been shown to improve performance when compared to performance in the absence of a nap. Although naps taken following sleep loss are also beneficial, studies have indicated a dose-response relationship between the length of the nap and ensuing performance benefits. Additionally placement of the nap with regards to circadian rhythm should be considered. Naps placed during the circadian low (3-6 am/pm) are easier to initiate and maintain due to increased pressure for sleep and are beneficial to later performance. However they show increased sleep inertia (drowsy feeling) upon waking which means you need to allow 15-20 minutes to fully wake-up before you begin any task. (6) (7).

Solution 4: Limiting the time on task and introducing short activity breaks can help improve subjective fatigue ratings, though they don't seem to effect the objective performance ratings and their effects are

short lived (6) (7) (8). Additionally “several studies have suggested that a more upright postural orientation inhibits sleepiness” (7) a countermeasure which can be paired with activity breaks to improve subjective sleepiness ratings. Where possible it may be beneficial to include the opportunity for short naps (less than one hour to avoid the negative effects of sleep inertia) during the shift. Studies on planned cockpit napping in pilots have shown an increase in both performance and physiological measures of alertness, despite subjective fatigue ratings showing no difference (8).

Solution 5: Alertness-enhancing compounds can be used, the most common is caffeine. Caffeine is a popular alertness-enhancing compound due to its wide availability and rapid effects (within 15-20 minutes after ingestion), it has been shown to increase vigilance and performance in cases of sleep-deprivation and is most effective when used sparingly (i.e., only when really needed) (6) (7). It is only a short-term solution.

Take Home Message

Even though aviation maintenance occurs in a less than perfect world with less than perfect schedules, there are a number of viable alternatives that can be used to reduce fatigue and improve alertness. As an industry, we must begin to consider scientifically based solutions that can be applied in our day-to-day operations. We will likely never see the day when all aviation maintenance occurs between the hours of 9 am and 5 pm, so we must implement workable alternatives.

We must look for practical, science-based alternatives.

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