JEPPESEN
A Boeing Company

Global Services

Fatigue Causes

Functionality to Reveal the Reasons Behind Fatigue

Fatigue models are fairly complex mathematical descriptions of human physiology. If you have an interest in modelling and human physiology, you might want to learn more about how model subcomponents and mechanisms are contributing to predicted low alertness. In CrewAlert the answer is just a tap away.

Initiating fatigue causes

In CrewAlert Pro you can easily initiate the detailed mode, found only in analysis mode, by tapping the magnifying glass in the top right corner of the graph view. On the iPhone, it is only viewable in portrait orientation.

Radar chart display

The magnifying glass reveals a screen containing a radar chart displaying the “magnitude” of the contribution of the different subcomponents in the Boeing Alertness Model (BAM). The magnitude is plotted on a scale from zero in the center, to 100 on the outer edge. Note that this visualization is self-relative, meaning zero equals the minimum contribution and 100 the maximum. It does not reflect the relative contributions between the components. (Two components both at 100 may contribute quite differently to the total.)

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What are the different subcomponents?

Sleep inertia. The temporary fatigue contribution that comes from waking up. Sleep inertia reaches its maximum value right after waking up, and then decrease rapidly. A rule of thumb is that after 15 minutes sleep inertia drops by a third, 30 minutes later it drops by an additional third. The last third is typically gone within two hours of waking up. Spontaneous awakenings have a lesser amount of sleep inertia than external awakenings.

Circadian rhythm. The fatigue contribution that comes from the circadian pacemaker. The circadian rhythm is governed by your body's internal biological clock. It is independent of the amount of preceding sleep and wakefulness, but is affected by the light/dark cycle over a 24-hour period. Circadian rhythm not only regulates the sleep/wake pattern, it also regulates feeding/eating patterns, core body temperature, and other biological activities. The circadian rhythm needs some time to adjust to a new time-zone (a process known as acclimatization). It is one of the components of the Two- Process Model of Sleep Regulation, and is a major component in most models of sleep and wakefulness.

Sleep/wake homeostasis. The fatigue contribution that comes from the historic sleep/wake pattern. This comes from the accumulation of hypnogenic substances in the brain, which generates a homeostatic drive for sleep. The longer the time awake, the stronger the fatigue contribution from sleep/wake homeostasis, but missing sleep in the sleep history will also increase this fatigue cause. This is one of the components of the Two-Process Model of Sleep Regulation, and is a major component in most models of sleep and wakefulness.

Time on task. The fatigue contribution that comes from work-time since the last sleep. This component is zero on off-duty days, and increases as work-time increases.

Cumulative effects. The fatigue contribution that comes from working consecutive days. These are work-pattern driven effects that are not related to the actual work-time, but rather to consecutive days of work creating additional fatigue. This component resets after a sufficiently long off-duty period (typically two physiological nights) and accumulates as the number of days since last off-duty period increases.

It is important to keep in mind that models are models, not reality. Significant individual variance around the model output is to be expected. Please contact us via frm@jeppesen.com if you have questions, or suggestions for improvements.

ICAO definition of fatigue – A physiological state of reduced mental or physical performance capability resulting from sleep loss or extended wakefulness, circadian phase, or workload (mental and/or physical activity) that can impair a crew member's alertness and ability to safely operate an aircraft or perform safety related duties.

Learn more about Fatigue Causes at jeppesen.com/frm