



AUTOMATION AND THE CHALLENGE OF **AVIATION** **CREW FATIGUE**

THE US FEDERAL AVIATION ADMINISTRATION introduced new regulations for aviation crew flight time and duty time in 2013, known as FAR 117. Those changes incorporated the latest in fatigue science, but similar rules have not been adopted worldwide and the science continues to advance, keeping crew fatigue a priority for airlines.

Fatigue is not just about being tired. Tiredness can be remedied by sleep. Fatigue is cumulative, the product of an incomplete recovery from days of insufficient sleep. It affects people who consistently work long hours under stressful conditions. In aviation, its consequences include declining health and productivity of flight crews, rising attrition, and safety concerns.

While regulations need to better reflect the diverse factors that affect fatigue, automation also may hold part of the answer. As aircraft design and flight deck capabilities evolve through technologies such as machine learning, more opportunities are emerging for task automation that could impact crew fatigue – as is happening in other industries with routine or repetitive operations, such as trucking and heavy machinery operation.

INNOVATIONS ON THE HORIZON

For airline pilots, automation could reduce the pressure to manage and monitor parallel and routine tasks in the cockpit, freeing up their mental capacity for more complex computations and judgments. For example, researchers are currently testing resilient machine learning-based autopilot systems that can adapt to changing conditions. These systems “learn” from experienced pilots how to react to situations, rather than having to be explicitly programmed with instructions for every conceivable circumstance.

Ultimately, technology is likely to evolve over time to the point where one crew member is able to handle a sizable chunk of a flight, with automation as the co-pilot – a potential boon given an anticipated pilot shortage in the future. Eventually, a remote pilot on the ground could take the second seat on some flights or flight segments.

Technology is even tackling the fatigue question through the development of devices that can monitor fatigue and adjust the level of automation to ensure sufficient crew engagement. For instance, the trucking industry already uses a system to monitor eye and eyelid movements of drivers to make sure they are alert.

THE RISKS AND REWARDS OF AUTOMATION

While automation could relieve a crew from having to attend to certain routine tasks, it is not a panacea. When it comes to fatigue, automation may also introduce unexpected risks.

Research suggests that reducing or eliminating the stimulation of manual tasks may slow reaction times and bring other fatigue symptoms to the fore. One danger is the

POSSIBLE FUTURE AUTOMATION IN THE COCKPIT

AUTOPILOT WITH ARTIFICIAL INTELLIGENCE

Uses machine learning to learn from experienced pilots, can adapt to changing conditions and crises

AI-BASED WEATHER AND RADAR MONITORING

Continuously assesses weather and radar imagery and makes recommendations to accommodate changing conditions

ELECTRONIC STABILITY AND PROTECTION

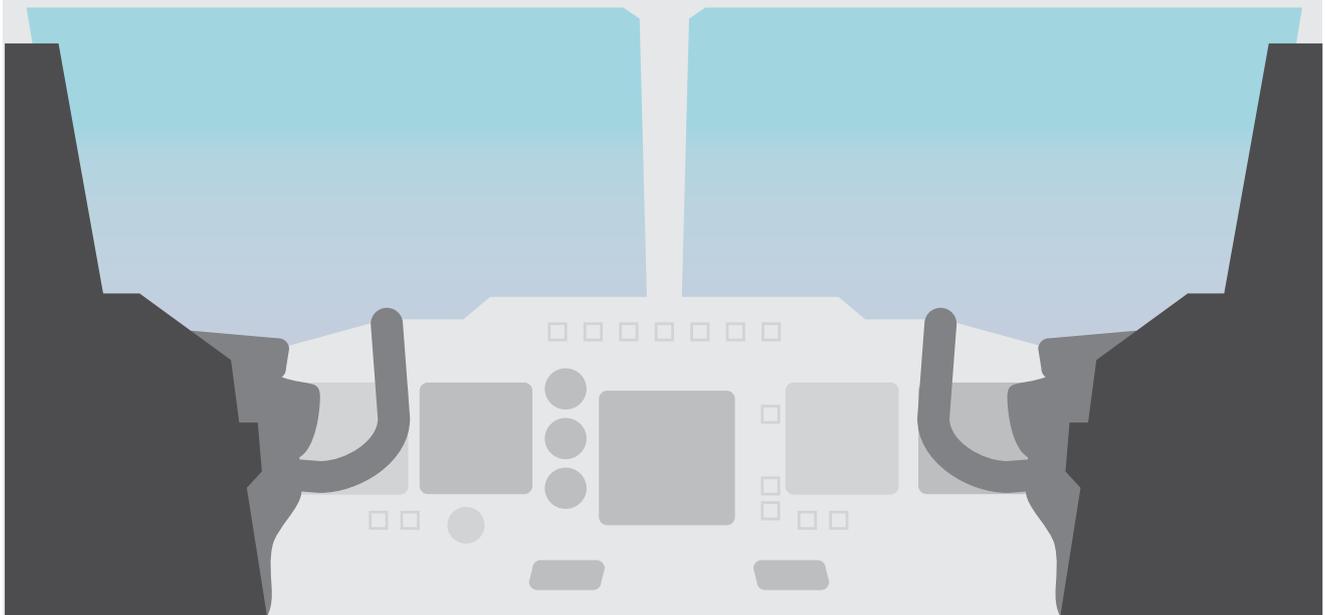
Monitors and maintains the airplane's altitude (even when autopilot is off)

FATIGUE MONITORING AND STIMULUS

Monitors crew fatigue and refines automation level to ensure sufficient engagement

VIRTUAL ASSISTANTS

With speech recognition, able to interact with crew and issue voice commands to complete hundreds of common tasks in the cockpit



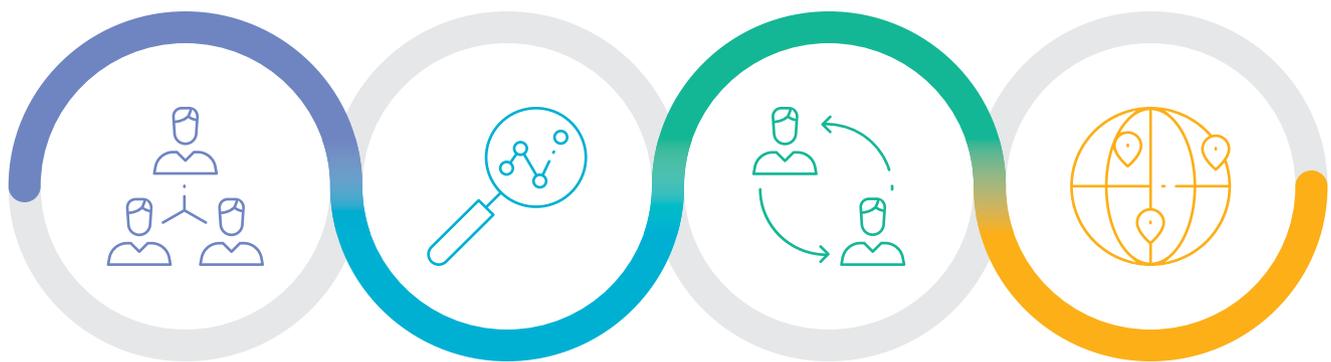
phenomenon of microsleeping – moments when part of the brain goes offline, so to speak, while other parts remain wakeful. The phenomenon has been identified as a frequent cause of automobile accidents.

This suggests that the smart way to incorporate automation means first developing a long-term crew fatigue management strategy that recognizes automation’s risks as well as its rewards. Robust fatigue management includes developing a detailed assessment of fatigue causes, correlating data on actual duty times and activities with fatigue reporting, gathering crew feedback through interviews, and developing a fatigue risk management system (FRMS) that focuses first and foremost on fatigue prevention.

FINDING THE RIGHT BALANCE

A big part of fatigue prevention is developing realistic and resilient crew schedules that incorporate the latest in fatigue science and accurately reflect a challenging operational environment. In the US, FAR 117 has helped launch that process, but in other cases, regulations have fallen short on addressing the full spectrum of issues that lead to fatigue. While rules exist that govern how many hours crews can work (and how often

MANAGING CREW FATIGUE A FOUR-STEP APPROACH



ESCALATE

- Raise to the board or an independent safety committee for fatigue monitoring

IDENTIFY

- Establish an enhanced Fatigue Risk Management System (FRMS)
- Promote a culture of reporting and recognize cultural barriers to reporting
- Determine causes of fatigue and distinguish treatments

MITIGATE

- Clarify accountability; build trust and transparency around fatigue management
- Review OTP causes where they impact crew fatigue
- Create a realistic, reliable, and resilient schedule; incorporate fatigue review into end-to-end planning
- Improve ability to manage fatigue in operational recovery

TRACK & SUPPORT

- Invest in systems, tools, and training
- Embed reporting and agree thresholds or flags for action
- Provide technology and processes to support fatigue management

they can work overtime), regulations vary by geographic market, and limits on flight duty periods do not always take into account more qualitative factors, such as tough routes, cumulative schedule intensity during busy travel seasons like summer, and the impact of standby duty.

Before making decisions on task automation, airlines will need to be able to determine which phases of flight present higher risks for fatigue. And, for days when things don't go as planned, standard protocols need to include sufficient emphasis on crew fatigue and the impact of disruption on crews. As airlines adopt new technology to collect and analyze the reams of technical flight and equipment data now being generated, they have an opportunity to incorporate capabilities into these systems that can gather more information on human factors as well, providing greater insights into fatigue.

No doubt, this is a tricky balancing act for both airlines and regulators. Still, the payoff for good fatigue management coupled with cautious adoption of automation can be substantial: excellent safety records, higher crew productivity, and happier customers.

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