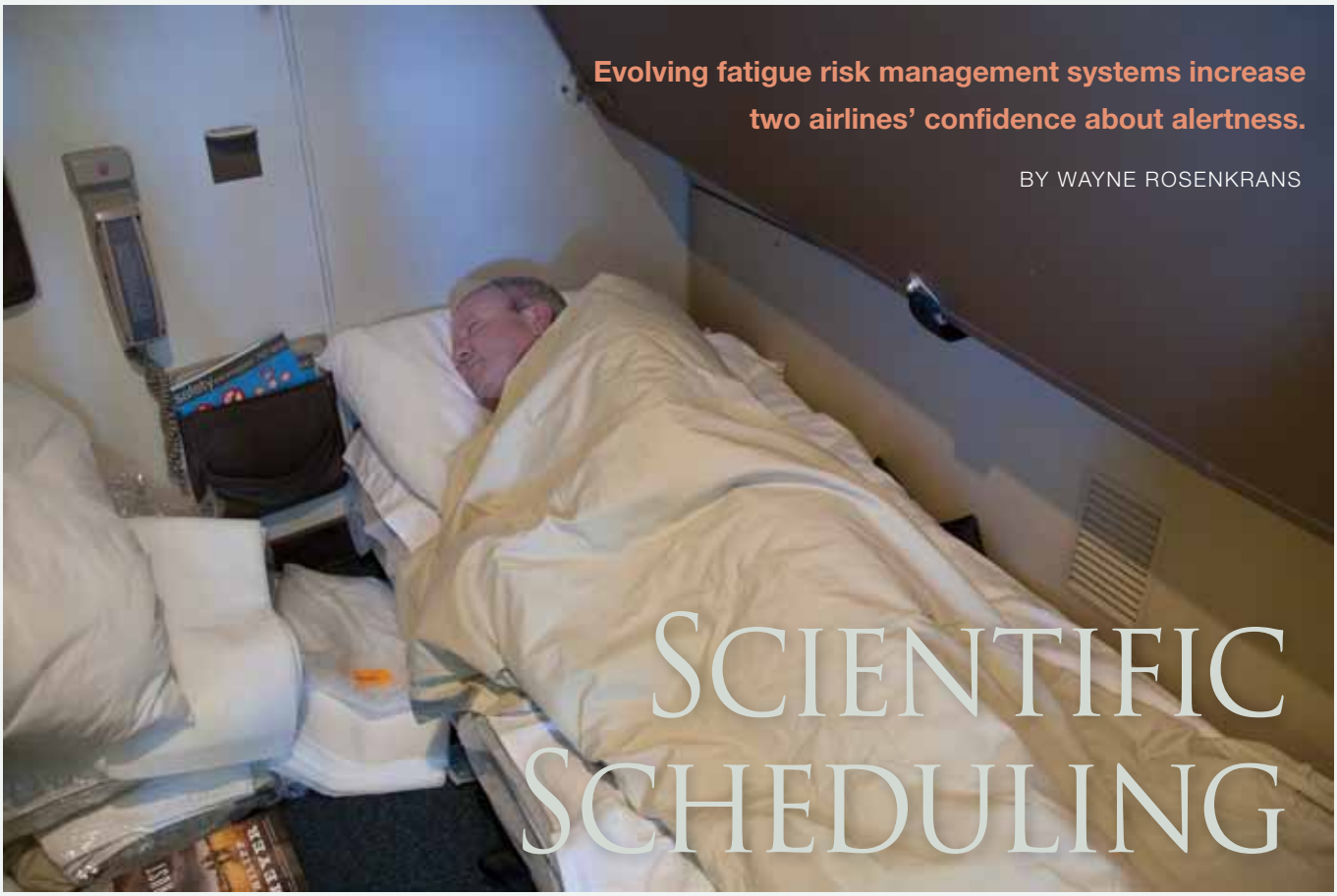


Evolving fatigue risk management systems increase two airlines' confidence about alertness.

BY WAYNE ROSENKRANS

SCIENTIFIC SCHEDULING

For about 15 years, Air New Zealand periodically assessed pilots and flight attendants during flight operations and attempted to scientifically identify links between measured levels of fatigue and safety indicators. Today, fatigue risk management systems (FRMSs) "mirror the pillars of safety management systems," says David Powell, aviation medicine specialist for the airline. Nevertheless, airlines are finding that discussing an FRMS is easy while actually implementing all the elements is "particularly hard to do," he told Flight Safety Foundation's 64th annual International Air Safety Seminar (IASS) in Singapore in November.

A few years ago, a company study focused on two-crew flights for the Christchurch, New Zealand–Brisbane, Australia, city pair, on which the same pilots departed from Christchurch between 2100 and 2200 local time and arrived back at Christchurch at about 0700 the following day. "It is the sort of duty done around the world," Powell said.

"Changing the aircraft [Boeing 737-300/Airbus A320] doesn't make any difference, but providing a night stop in Brisbane makes a big difference. Reaction time [on in-flight psychomotor vigilance tests], compared with that in all of our studies, was quite high towards the end. … [Objective] reaction time data and the [pilots' self-reported] subjective data tend to tell exactly the same story." From such studies, predictive analyses have red-flagged situations requiring changes in the timing of departures, crewing level or details of the pattern to mitigate fatigue. Equally valuable, he said, has been confirmation by both types of data that fatigue levels are reasonable and fatigue predictions are sufficiently accurate.

The company recently monitored for three months the benefits of pilots self-reporting their fatigue level about 30 minutes before the safety-critical top of descent phase on every flight. In all, 9,000 paper-form responses represented long-haul, regional and domestic operations. One finding for regional trips was that starting duty from morning to midday kept the peak fatigue level well within an acceptable range, but starting duty in the evening or the middle of the night could cause fatigue levels to increase quickly toward an unacceptable level. Ability to isolate risk factors within this "wealth of data" then convinced the company to require top-of-descent alertness ratings from each Boeing 777 pilot on the flight deck on every flight.

Using the Samn-Perelli alertness scale of 1 to 7 (Figure 1), flight crews reported a higher fatigue level on the return sectors of out-and-back, daylight flights from Auckland, New Zealand, to Melbourne, Australia, for the 0800 local time departure compared with similar-duration flights at different departure times. "There is probably a little bit of truncation of [pilots'] sleep," Powell explained. Another finding, from a three-crew variant of this flight, was that "the benefit of a third pilot for a daylight sector is less obvious [than assumed]," he said.

Powell told IASS attendees, "You can monitor fatigue across your entire operation easily and cheaply [together] with your flight data analysis programs." Airlines should expect to frequently encourage crewmembers to keep up their in-flight ratings over time; find ways to gauge FRMS effectiveness in relation to measures in international guidance; and produce validated, reliable measures of safety performance.

"In terms of making the call on what is safe enough, we have got a long way to go," Powell said. "There are not enough data out there on fatigue linking with safety, so I'm here to appeal for [research on safety metrics]." A promising avenue of inquiry is how some crews with a high fatigue level or restricted sleep can perform tasks in a flight simulator or line operations safety audit as effectively as well-rested crews, or can exhibit fewer — but more serious — recorded exceedances of normal flight parameters.

Finnair Crew Vulnerability

Tomas Klemets, head of scheduling safety, Jeppesen Systems, described to IASS attendees Finnair's early experience with its evolving, incomplete FRMS in a presentation co-authored with Gabriela Hiitola, the airline's head of crew scheduling. Finnair operates widebody jets connecting Europe with long-range destinations in Asia via Helsinki. In 2007, the airline began to work with Helsinki University to study crew fatigue levels on long-range flights, and in 2008, the researchers expanded data collection to narrowbody aircraft.

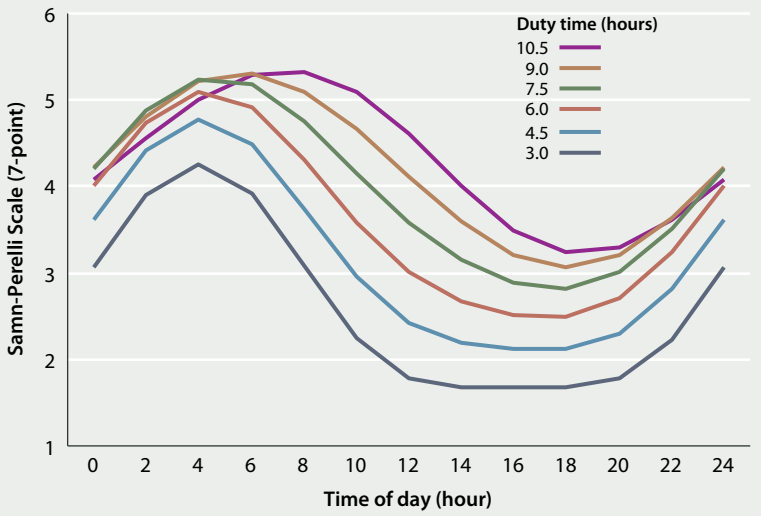
"In 2008, we asked, 'What are the possibilities of introducing a fatigue model to actually influence the construction of the schedules from the very beginning, rather than just measuring fatigue after the process is completed? Could [we] influence those sequences of flights to end up in the best possible context?'" Klemets said. This work led to the design and early 2011 launch of an Apple iPhone application (app) for building alertness into crew scheduling, developed with design input from company pilots.

"Finnair pilots actually fly rosters that have been produced … using a fatigue model guiding the overall construction," he said. Each "planning horizon" is continually revisited and refined from the long-term planning stage to the day of operation under the FRMS, he added.

Some risk factors are inherently tough to mitigate, however. "When an airline decides to operate to a certain station with certain equipment at a certain departure time, that will inevitably lead to a certain level of fatigue that will be very difficult to avoid," Klemets said. Pairing construction, roster construction by automated optimizers and FRMS monitoring have far less influence in those situations, he said.

The airline also has added scheduler and pilot training on key performance indicators (KPIs) of safety. "What Finnair does today is to trend what we call the PA5, the average predicted level of alertness on the 5-percent 'worst' flights," he said. For any dramatic improvement, however, the airline "would need to relax or remove some [regulatory/contractual] constraints or sacrifice some other KPIs," Klemets added.

Two-Crew Fatigue at Top of Descent



Notes: The earliest research using pilot self-assessment on paper forms before top of descent, during two-crew regional operations, enabled Air New Zealand to derive trend curves based on duty start time and approximate duty duration. Higher values on the vertical scale mean greater fatigue.

Source: David Powell, Air New Zealand

Figure 1