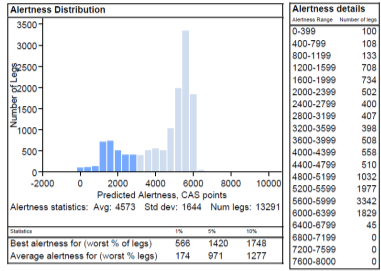


A Fatigue Risk Management System Visualized

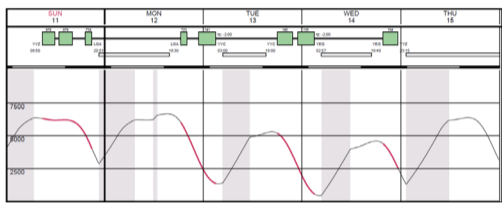
The ICAO definition of an FRMS: A data-driven means of continuously monitoring and managing fatigue-related safety risks, based upon scientific principles and knowledge as well as operational experience that aims to ensure relevant personnel are performing at adequate levels of alertness.

1 In network planning (commercial department), new flight schedules can be evaluated using a pairing optimizer and compared with the predicted fatigue from previous periods. The scenarios can be assessed using CFAS and tracked month by month for each crew rank.



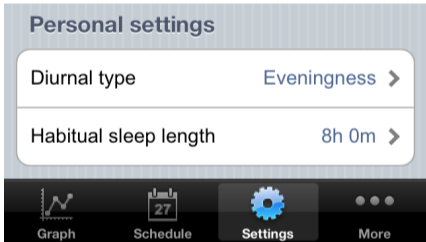
2 During planning, several pairing and rostering scenarios on the same flight schedule can be assessed using either:

a) CFAS, b) direct influence by BAM building solutions that minimize fatigue, or c) checks on individual patterns using manual modelling with CrewAlert.



3 In day of ops and maintenance, control of fatigue can be exercised through assessments over CFAS or direct model connection to BAM, allowing also for evaluation of trip swaps or selection of most suitable stand-by crew.

4 Crew, crew schedulers and scheduling managers obtain training from SMEs and the FSAG on basic fatigue science. CrewAlert can be used extensively to understand science and learn about reporting etc.

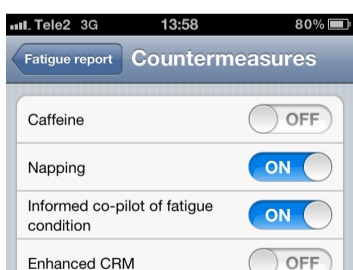


5 Already when receiving their rosters, crew can review which of their duties/flights that are likely to be the most fatiguing. This enables them to plan their sleep opportunities in a better way.

6 Using the fatigue mitigation advice functionality in CrewAlert, crew can plan their mitigation and get practical advice when in doubt on the coping-strategy.

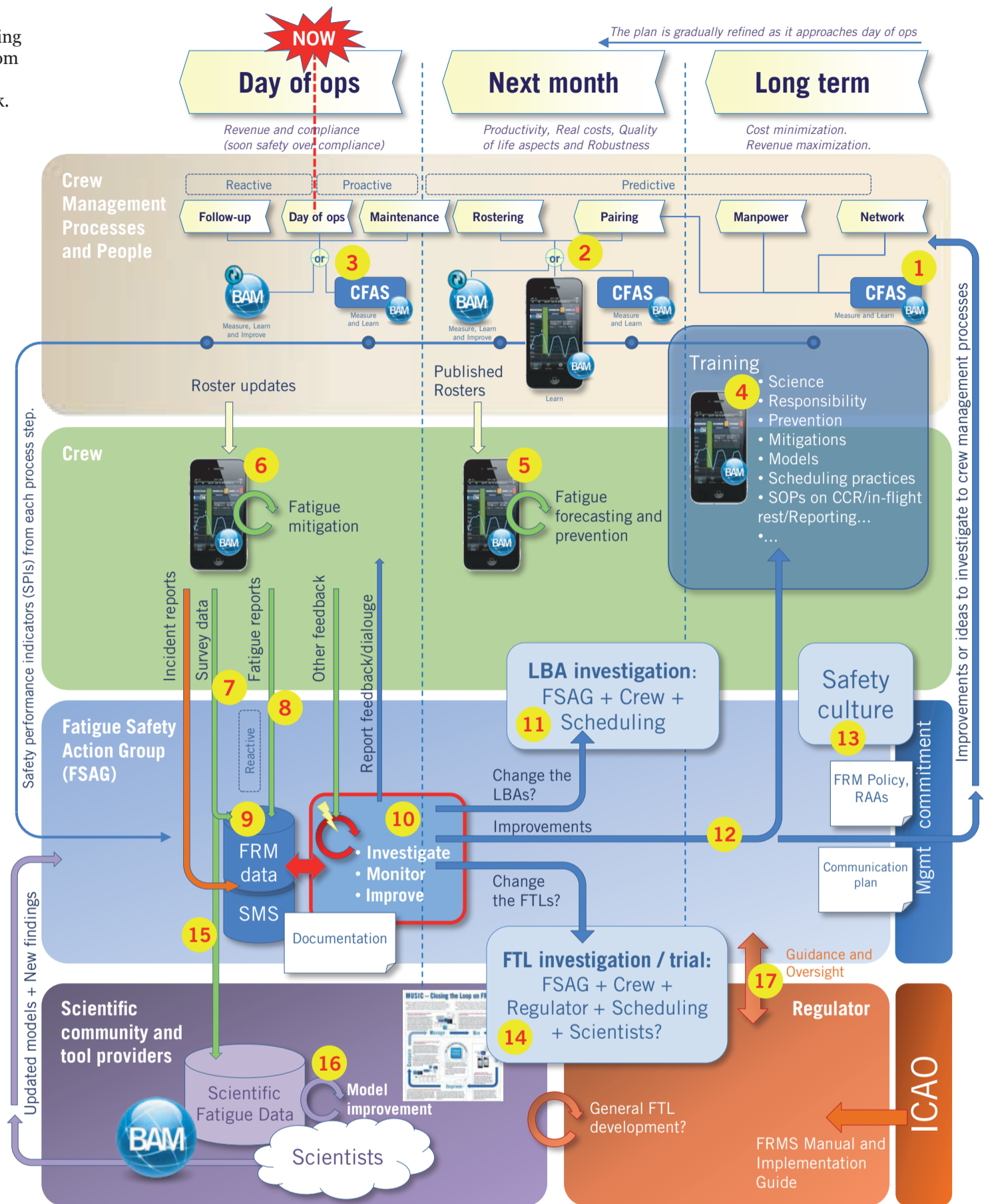
7 Crew can use CrewAlert for collecting operational fatigue data in surveys initiated by the FSAG – reducing time and hassle dramatically for these surveys.

8 Fatigue reports are easily issued and submitted in CrewAlert – enabling best practice safety reporting but also minimization of workload for crew and safety officers.



9 Collected data is stored and used together with other SMS data for analysis.

10 The *heart* of the FRMS; the Fatigue Action Safety Group (FSAG). This groups is responsible for investigations, corrective actions, improvement work and documentation. They will also initiate changes to rules – Labor Agreements (LBAs) and FTLs.



11 The LBAs and scheduling practices can be revised as a consequence of fatigue, but also for boosting efficiency. The planning department can assist with what-if's, measuring a safety KPI like PA5 using CFAS/BAM.

12 The FSAG will use internal findings as well as external influences from science to adjust training and SOPs.

13 The FSAG together with top management is responsible for creating a strong safety culture that encourages reporting of all safety related events to build data to act from.

14 As FTL exemptions are more frequently used, modelling and what-if's can be used to identify those positive for both safety and efficiency. An approval can be granted by a regulator for conducting a trial, followed by a data collection showing an equivalent level of safety. The planning departments' (hopefully) direct model integration with scheduling tools can be used to identify and tighten loop-holes through reformulations of LBAs, FTLs, and scheduling practices.

15 Sharing collected data allows Jeppesen and scientists to advance modeling and science best possible. Fatigue surveys where data is collected with CrewAlert are automatically fed back to scientists and used for model validation and improvement.

16 Jeppesen has developed methodology for improving BAM from collected data continuously and have collaborations with scientists in place.

17 An operator will be able to show the regulator:

- Statistics on fatigue reports as well as modelling of each report
- Continuous alertness predictions (per month and rank) on *planned* pairings and rosters, as well as on *actual* rosters flown
- Strong and *quantified* safety cases on proposed changes on LBAs/FTLs
- Well performed data collections from crew and correlation back to the model used
- An approach where the fatigue prediction model is changed/updated as better science becomes available
- The same science used *throughout the process*: training of crew, planning of flight schedules + pairings + rosters, analysis of fatigue reports, as well as for fatigue prevention and mitigation advice used operationally.

www.jeppesen.com/FRM