

Fatigue Model Comparison Matrix

V1.0 Dec 2014

This comparison matrix complements the CASA [Biomathematical Fatigue Models Guidance Document](#), by addressing a number of additional aspects relevant to take into account when selecting a fatigue model meant to add the predictive/proactive part of a Fatigue Risk Management System. The CASA document is an excellent start, but leaves out a number of aspects critical for real-world application to crew management processes. For feedback or further questions on this document please contact the authors over email frm@jeppesen.com.

Model Aspect	BAM	Model X
1. Validity / credibility		
- Peer-reviewed validation <i>Has the validation of the science in the model passed the quality assurance process (called peer-review) with other scientists scrutinizing both the method used as well as the results?</i>	Yes	
- Publication in well-renowned journal <i>Is the validation published in an international, scientific journal with good reputation (a receipt of peer-review being first class)?</i>	Yes	
- Validation on mixed-operation aviation data <i>Is the data used for validation specific to just one type of operation or a reasonably big cross section of operational conditions (in aviation)?</i>	Yes	
- Number of observations in the validation <i>What is the size of the validation data set?</i>	>8,000	
- Measurement of accuracy <i>Is the model accuracy measured to individual observations (or is the model just delivering an average, with unknown precision)?</i>	Yes	
- Openly published data set <i>Is the dataset used for validation openly published (of integrity reasons most certainly in de-identified form)?</i>	Yes	
- Openly published model (equations etc.) <i>Is the model openly published in its entirety with all equations, constants and mechanisms? Meaning; together with openly published data and validation methodology that anyone, with adequate competency, is able to scrutinize the model validation?</i>	Yes	
- Output of operational relevance <i>Is the model output something that can be directly compared to operational experience (like sleepiness) opposed to a more abstract property like "risk index" or "effectiveness" that cannot be observed (at least not easily)?</i>	Yes	
- Vendor-offered specific validation <i>Is the model vendor offering to measure and compare operational relevance of the model specifically for your operation?</i>	Yes. For free, subject certain conditions.	
2 Applicability		
2.1 Feature set		
- Continuous prediction <i>A prediction of model output at any point in time (also between duties) over a roster or trip.</i>	Yes	

Model Aspect	BAM	Model X
- Open prediction of sleep/wake <i>Clearly stated timings for sleep onset and wake-up (to be compared with operational experience) for check of realism.</i>	Yes	
- Ability to predict also pairings (definable start-state) <i>Customization of the assumption for typical roster context of a pairing, as a function of the pairing itself. (A one-day pairing might typically end up with production prior vs. a long pairing have days off prior.)</i>	Yes	
- Per-chain control of habitual sleep length <i>Can habitual sleep length be set differently for each roster if needed?</i>	Yes	
- Per chain control of diurnal type <i>Can diurnal type be set differently for each roster if needed?</i>	Yes	
- Customizable prediction point <i>When representing holistic risk; can the prediction representing risk for an individual flight be customized to TOD, arrival, lowest point etc. to the wish of the airline?</i>	Yes	
- Acclimatization <i>Is acclimatization built-in and what is driving the gradual adaptation to local time?</i>	Yes. TZ-driven	
- Customization of tactical sleep patterns <i>Can typical sleep patterns in a certain turn-around be customized to operational experience if there is a disagreement with model prediction of sleep?</i>	Yes	
- Detailed control of transfer times <i>Use actual transport times (if available) to precisely model time between duty and sleep opportunity; for example making difference between airport hotel and downtown hotel.</i>	Yes	
- In-flight rest facility classification <i>Modelling of Class I, II, III rest facilities and corresponding recovery prorotation.</i>	EASA, FAA + net method	
- Max number of inflight sleep periods <i>Ability to model different in-flight sleep dispositions (once, twice etc. but also placement.)</i>	Yes, up to three per flight.	
- Mitigation strategies built-in <i>Is the model capable of proposing suitable fatigue mitigation strategies for a certain situation, taking prior sleep/wake, individual settings and work history into account?</i>	Yes	
- Local light conditions built-in <i>Can the model output also local light conditions for fast investigation of sleep prediction realism?</i>	Yes	
- X-percentile capability. <i>Is the model able of not only answering back with the average prediction, but also for a certain percentile (e.g. "what is the alertness level for the 90-percentile of crew?")</i>	Yes	
2.2 Connectivity		
- Loose integration over web-service <i>Is the model easily accessible also via a web-service "bolting on" to an existing solution for crew management requiring only a simple file transfer?</i>	Yes	
- Implementation time <i>What is the approximate implementation time needed in an existing solution (for a skilled programmer) to produce the file formats needed for the web service in case the current format is not already supported?</i>	2-4 days	

Model Aspect	BAM	Model X
- What crew solutions are supported “out-of-the-box” for the web service?	AIMS, AOS, IBS, Jeppesen, Netline, Sabre	
- Tight integration over run-time interface <i>Is the model available for tight integration with existing crew solutions interacting “live” over a run-time interface with high performance (providing a possibility to connect to UI visualization, business logic, decision support etc.)?</i>	Yes. Compliant with CAPI 2.0	
2.3 Performance		
- Predictions per second <i>How fast is the model measured in flight-predictions per second [per CPU core of certain model] when being sent 50-leg rosters over a 40 day period?</i>	>250,000	
- Scalability <i>Will the model also run, thread safe, on parallel CPUs like our optimizers ensuring performance also on really big or complex crew planning optimization jobs?</i>	Yes	
- Proven to work with crew optimizers <i>Are there operators today that consistently and successfully use the model to pro-actively reduce crew fatigue <u>during</u> pairing and roster optimization? [Opposed to only doing after-the-fact analysis.]</i>	Yes	
- Response time if accessing the model via a web-service <i>What is the response time in seconds, excluding transfer of files over internet, if sending 10 100 1000 rosters, 40 day long with 50 flight legs each, for batch processing assessment? Including producing detailed predictions graph day-by-day for each roster (or pairing).</i>	5 20 200	
3. Long term viability (future-proof or not)		
- Connect over a standard interface (interchangeable for other models) <i>Can the model be replaced in the future with another model if needed? Is the model using open standard interfaces (with hope of being) embraced by the industry?</i>	Yes and yes ¹ .	
- Strategy and methodology for continuous improvement <i>Is the vendor willing to share a detailed description of the improvement methodology used for keeping the model current and even improve over time?</i>	Yes. Data driven improvement.	
- Vendor size / years in domain <i>What is the size of staff dedicated to work in the crew management domain at the vendor / and how many years have the vendor been delivering solutions in this domain?</i>	>500 / 25 years	
- Parent company / years active <i>Which entity is backing this solution in the marketplace and for how long has it been delivering solutions to the aviation industry?</i>	Jeppesen / 80 years, Boeing / 98 years	

¹ BAM is compliant with the (so far only) proposed standard for communication between crew management solutions and fatigue models called CAPI (the Common Alertness Prediction Interface). Other crew solutions and models are also compatible; please enquire with your vendors. (Jeppesen is assisting parties to comply and is governing maintenance and development of the CAPI standard.)

Model Aspect	BAM	Model X
4. Support and training		
- Support locations <i>What are the main support locations for the fatigue model?</i>	Gothenburg, Denver, Singapore	
- Support also available 24/7 <i>Is the model supported also 24/7 if needed (as it may be used in mission critical applications)?</i>	Yes, on request	
- Training locations <i>In which locations are training centres available offering training in Fatigue Risk Management and model application?</i>	Gothenburg, Denver, Singapore	
- Industry-grade regression testing and release management. <i>Is the vendor prepared to share documentation proving the release management process regarding in-depth structured unit-, regression-, performance- and integration test?</i>	Yes	
5. Availability / affordability		
- Available also for crew (on mobile devices) <i>Does the model scale outside of crew management processes, e.g. is it possible to use also for crew to predict, prevent, mitigate and report fatigue on mobile devices?</i>	Yes. (iOS only).	
- Cost for individual use <i>What is the cost for crew using the model (per individual)?</i>	Free ² on iOS (CrewAlert Lite)	
- Cost of web service <i>What is the cost for connecting existing crew solutions to a web-service for fatigue assessments?</i>	<Quote on request>	
- Price for tight integration <i>What is the cost for connecting existing crew solutions tightly to the model?</i>	<Quote on request>	
- Supported architectures for tight integration <i>What computer architectures are supported for a tight connection?</i>	RHEL 5 and above, Windows, AIX, HP-UX, Solaris, iOS	
6. Customer base		
- Crew planned with solution suite <i>In total how many airline crew are planned with the vendor solutions?</i>	>300,000	
- Monthly usage in total (# flight predictions) <i>In total how many predictions per month are processed by the model?</i>	<On request>	
- Reference customers <i>What are the main reference customers using the model from a predictive/proactive approach?</i>	<On request>	
- Endorsed by regulator <i>Is the model endorsed by any regulators? If so, which?</i>	No	

In-detail information about the Jeppesen Fatigue Risk Management portfolio is available at www.jeppesen.com

² There is also a more powerful version called CrewAlert Pro, available in most countries with large aviation industries, at a cost of approx. USD 30.