



Captain Jim Mangie

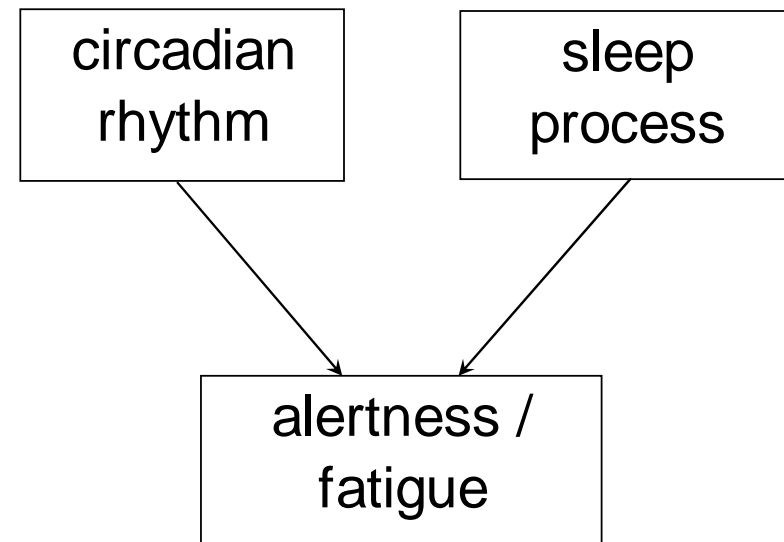
Bio-mathematical Models: Where do they fit?



Background



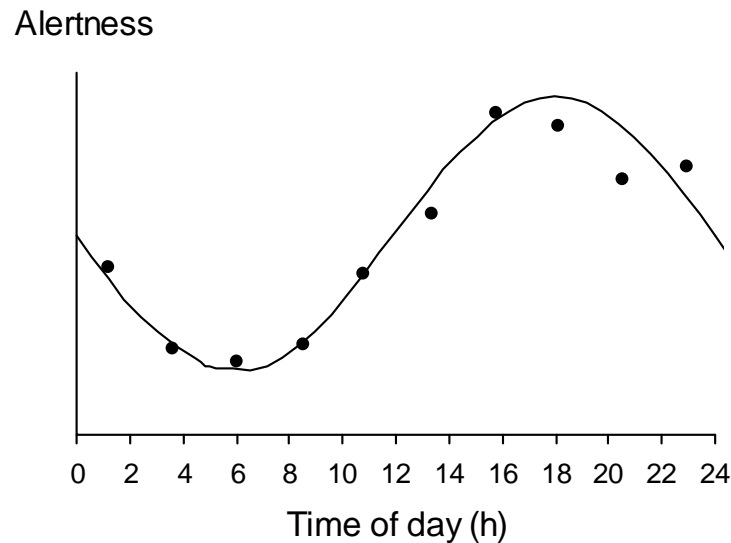
- ➔ The first fatigue models were developed in the 1980s, based on results from laboratory studies
- Two main factors contribute to the development of fatigue:
 - circadian rhythm (the chronobiological process)
 - sleep (the homeostatic process)
- This is known as the ‘two-process model’
 - it is the basis of most fatigue models that are used today





The circadian component

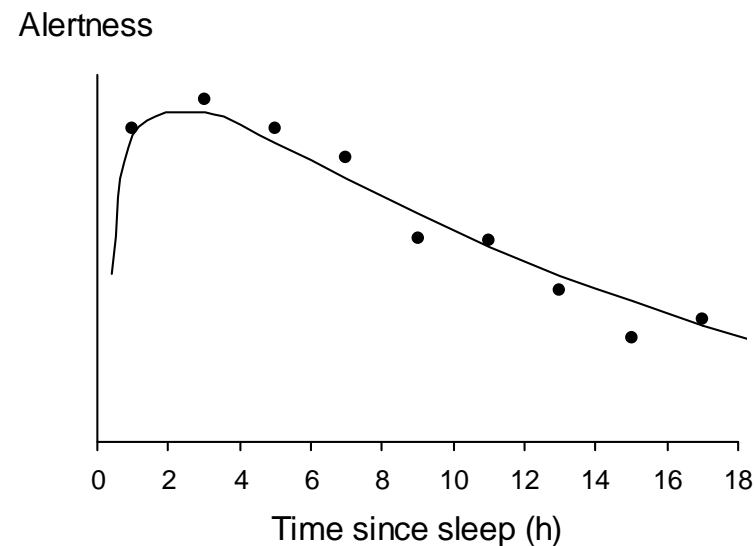
- The circadian component of alertness follows a sinusoidal trend
- The peak in the late afternoon (1700-1800)
- The trough is in the morning (0500-0600)



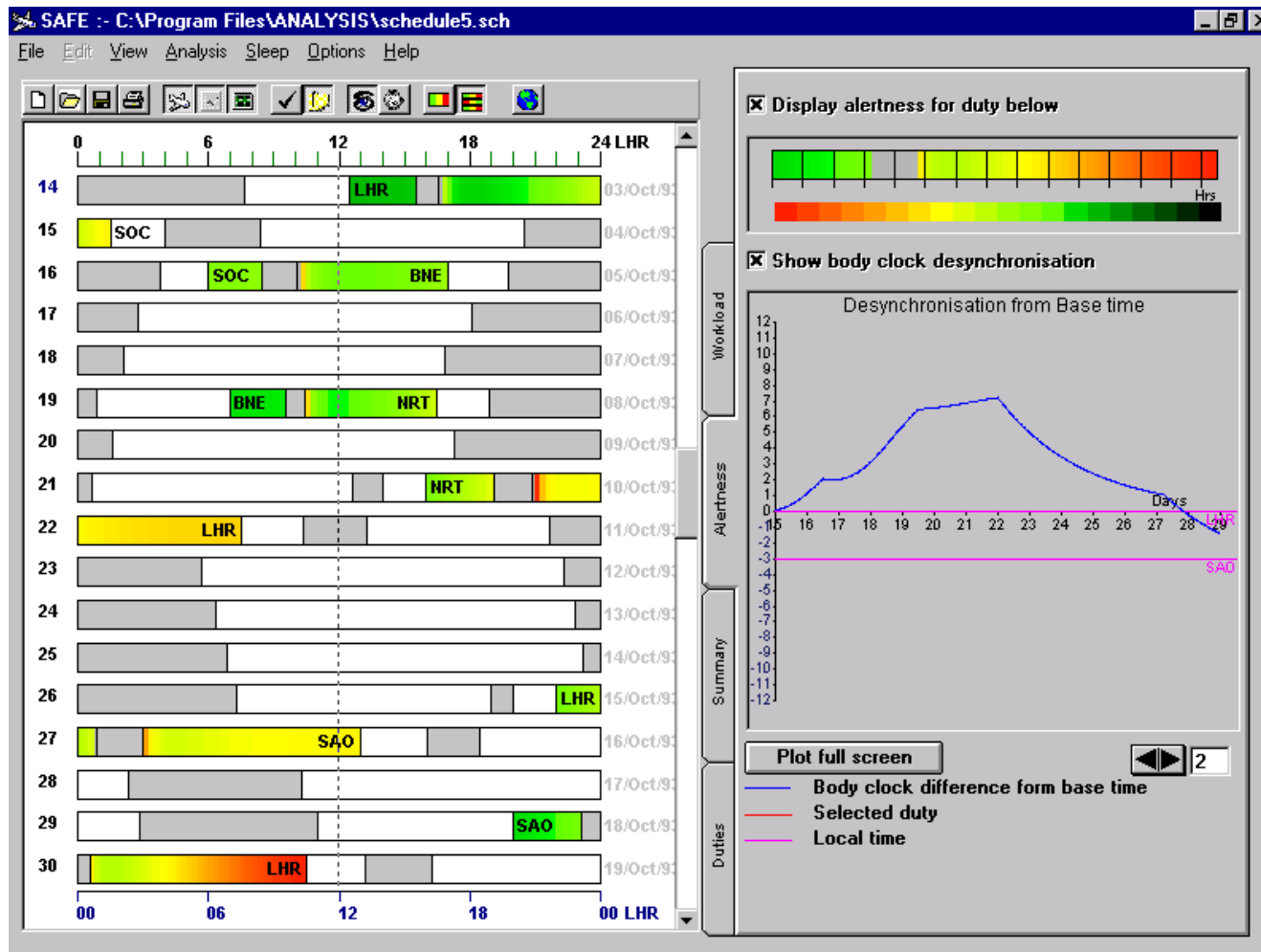
The component related to sleep



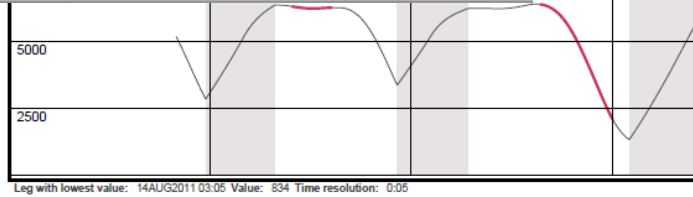
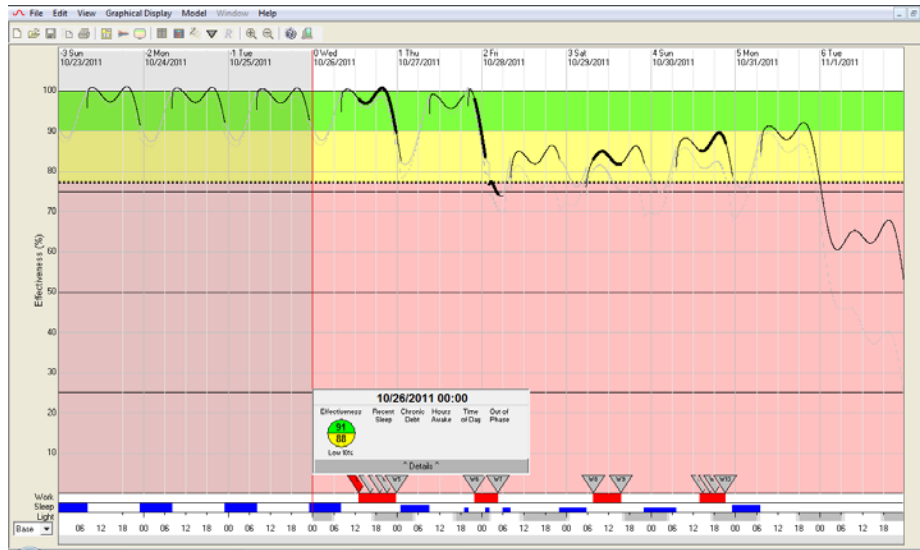
- Alertness is low immediately after waking
 - effect of sleep inertia
- It increases to a peak 2-4 hours after waking
- Thereafter it decreases exponentially



Examples



Examples



Jeppesen Crew Fatigue Assessment Service



Bio-mathematical Models



Used for:

- Pairing/Roster Comparisons
- New Routes
- Evaluation of Mitigations
- Incident Investigation
- Complaint Resolution
- Evaluation of New Regulations

Not Used for:

- Firm Go/No Go Decisions

Possible Future Uses



✈️ Pairing/Roster Construction

- Pre-Optimization
- Post Optimization

✈️ Day of Operation

- Pairing Evaluation
- Pairing Construction

Current State



✈️ 5 Models Commercially Available

- BAM
- CAS
- FAID
- SAFE
- SAFTE/FAST

✈️ 3 Models Public Domain (maybe more)

✈️ 1 Model Operator Produced

✈️ More Being Discussed

Current State



- No International Standards
- No International validation process
- Experience with most has been outside of aviation

Challenges



- Straight science vs. reality
- Which Model is the best?
- Over reliance by stakeholders
- User education
- Accuracy of predictions-limited data
- Validation
- Accounting for crew mitigations
- Additional constraint during optimization

Questions/Discussion

