



# CASE STUDY:

## PREDICTING FATIGUE IN 24-HOUR OPERATIONS WITH THE FIPS TOOLKIT

### CHALLENGE

Fatigue is a major issue in work environments that involve 24-hour operations and roster/shift systems. Operations that are ongoing around the clock often mean workers have to work and sleep according to a certain pattern for extended periods.



Health sector:  
12-hour day and  
night shifts



Mining and off-shore oil and gas:  
12-hour shifts in demanding rosters  
(e.g. 1 month on, 1 month off)



Naval submarine:  
6 hours on, 6 hours off  
for several weeks



Fatigue that results from long working hours and disrupted sleeping patterns can lead to many negative consequences.

For example:

- Human error & safety risks (Miller, Matsangas & Shattuck, 2008)
- Long term ill-health (Darwent, Lamond, & Dawson, 2008)

A key challenge is how to design working and sleeping patterns to reduce, manage, or ideally mitigate chronic fatigue.

To achieve  
this, we need:

An understanding of  
how much fatigue a  
given work/sleep  
pattern generates



A method that compares  
work/sleep patterns, and  
highlights which patterns  
optimise human capability

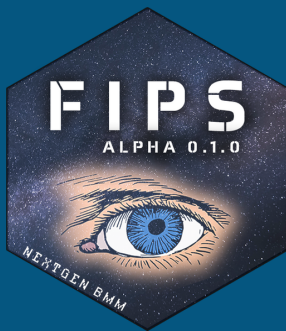
# APPROACH

FOWI researchers have developed a toolkit that can predict fatigue under various work/sleep conditions.

## Bio-mathematical Models (BMM)

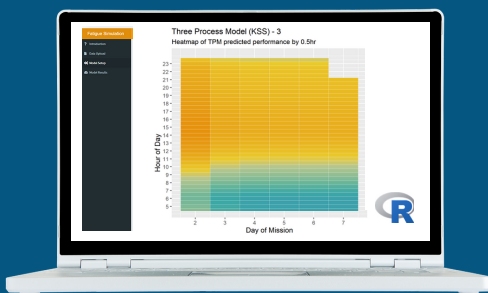
Underlying the predictions are bio-mathematical models that have been developed over decades of scientific research and reflect the current scientific understanding of how the human sleep-wake system works and the impact on fatigue, performance, and alertness. These models are frequently applied by defence and industrial sectors to support system safety and fatigue management strategies.

# RESULT



The Fatigue Impairment Prediction Suite (FIPS) provides researchers and practitioners a comprehensive set of functions for applying bio-mathematical models of fatigue.

FIPS is the first open-source BMM framework enabling practitioners to inspect, validate, and extend BMMs. FIPS is also the first modelling tool that is able to “learn” from user provided data to offer more accurate insights to individuals and domain-specific groups.



FIPS allows for:

- Prediction and forecasting of fatigue
- Visualisation of results and simulations

Simple data requirements:

- Date & time of roster, project or operation start and end
- Worker's sleep history (e.g. sleep and wake times)

# IMPACT

FOWI researchers have used FIPS to predict fatigue in naval operations. FIPS has allowed researchers to assess and compare the impact that different watch-keeping systems have on operational effectiveness and endurance, using a data-driven and evidence-based method. This gives invaluable insight into areas of operational risk, as well as the optimisation of human performance and capability.

