FAID® | Quantum
Fatigue Assessment Tool

FAID Quantum is an internationally recognised fatigue assessment tool utilising two biomathematical models to estimate fatigue exposure of an "average" individual associated with hours of work.

As part of an overall company Safety Management System, FAID Quantum can assist in identifying fatigue exposure and tracking the effects of associated risk improvements to hours of work.

The association between hours of work and occupational health and safety outcomes is widely accepted (Caruso, Hitchcock, Dick, Russo & Schmit, 2004). FAID Quantum allows policy makers and organisations to manage and audit work-related fatigue in a systematic and practical way.

InterDynamics' FAID software and Biomathematical Model (BMM) has been a global standard for fatigue exposure prediction and fatigue management since its introduction in the late 1990s. In 2016, InterDynamics set a new standard with FAID Quantum, which offers a whole new level of scientifically-verified alertness prediction with the addition of a new BMM. FAID Quantum software can be customised according to the users' needs to include:

- FAID Score - using the FAID Standard BMM
- Sleep prediction and predicted Karolinska Sleepiness Scale (KSS) Score - using the FAID Quantum BMM
- Time zone adaption (for adjustments when travelling over multiple time zones)
- Crew augmentation (for resting pilots on long flights)

A user of a BMM is responsible for understanding how it works and its suitability for the purpose it is being used for. Please read BMM Warning for further details.

FAID Quantum has been developed using scientific research and knowledge gained over several decades on circadian factors, the effects of shift lengths, timing of shifts and the importance of previous work periods on fatigue and performance.

About InterDynamics

InterDynamics is a leading provider of decision support and risk management methodologies and software. Servicing an international market, our extensive client base spans the spectrum of shiftwork and safety-critical industries, including transportation, mining, logistics, healthcare and manufacturing.

Fatigue Risk Management Solutions: Helping businesses identify, assess and manage the risks associated with work-related fatigue at both operational and management levels.

Decision Support Solutions: Helping organisations plan and schedule their business operations more effectively.

Our collaborative approach to customer service also helps us stand out from the crowd. Our experienced team can call on a wealth of problem-solving expertise to offer advice that is both practical and implementable.

Please contact us to find out more on this or our other offerings

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FAID Quantum products have been used operationally within industry worldwide since the early 2000's, and continue to prove useful as decision support and risk mitigation tools. This is a powerful validation of its usefulness within an organisations FRMS toolkit.

The inclusion of two BMMs provides a richer overall understanding of fatigue exposures as any BMM has its particular strengths, weaknesses and sensitivities.

The FAID Standard Methodology

Using formulae and factors developed and validated by Dr Adam Fletcher and Professor Drew Dawson at the Centre for Sleep Research, University of South Australia, the FAID Standard biomathematical model was created to provide a representative score of the fatigue exposure of a worker based on the following biological determinants of fatigue:

1. Time of day of work and breaks
2. Duration of work and breaks
3. Work history in the preceding seven days
4. Biological limits on recovery sleep

A FAID Score indicates the likely sleep opportunity that a work-pattern allows. As the relative sleep opportunity associated with a work-pattern decreases the FAID Score increases.

To assist the interpretation of FAID Scores, consider the following benchmarks:

A 40 hour standard work week of Monday to Friday 0900 to 1700 hours would achieve a FAID Score of 41.

By comparison, a 40 hour week that was also Monday to Friday but with work hours from 2300 to 0700 would achieve a FAID Score of 97.

Scores between 80 and 100 are equivalent to the predicted level of work-related fatigue achieved after 21-24 hours of continuous sleep deprivation (Dawson, Reid, 1997). Performance impairment at such a level of sleep deprivation is comparable to that experienced at blood alcohol concentrations over 0.05% (Fletcher, Lamond, van den Heuvel, Dawson, 2003).

The FAID Quantum Methodology

The FAID Quantum BMM was introduced in 2016 and incorporates sleep prediction together with results in the more familiar Karolinska Sleepiness Scale (KSS).

The FAID Quantum BMM sleep prediction is based upon formulae developed by Dr David Darwent in conjunction with Professor Drew Dawson and Dr Greg Roach of the Appleton Institute, Central Queensland University. These algorithms are the best sleep-wake predictors that have yet been published (at the time of writing) in international peer-reviewed literature (Darwent, Dawson & Roach, 2012).

The FAID Quantum BMM is able to determine a KSS Score from predicted sleep periods utilising an implementation of the Three Process Model of Alertness (Akerstedt & Folkard – 1995). The implementation in FAID Quantum BMM does not include the sleep inertia component of that model.

Most importantly, the FAID Quantum BMM allows organisations to see each of the steps in predicting fatigue. That is, the work-rest schedule, the estimated sleep-wake schedule and the resultant fatigue expressed as a predicted KSS Score.

By making the predicted sleep/wake schedule explicit, it is possible to review the degree with which the model is reflecting the real world experience of workers. This creates a direct measurable feedback mechanism for verifying FAID Quantum based on unique organisational data. This is a critical element of audit and compliance of a BMM as required under many regulatory environments.

FAID Quantum sits as one of the flagship tools within Our Risk-Based Approach to managing fatigue.

FAID Quantum can assist in the analysis of:

- Roster plans and the comparison of different potential work patterns

- Fatigue exposure impacts of various start and finish times

- Appropriate overtime selection, in conjunction with other risk-based controls

- Compliance of actual and planned rosters against organisational fatigue tolerance levels

- Changes in estimated fatigue exposure within shifts based on the hours worked

Our Risk-Based Approach has been developed in partnership with Zurich Risk Engineering.

FAID Quantum is recognised and used by regulators and key industry players around the world within the Aviation, Rail, Road, Mining, Marine, Customs, Police, Health, and Emergency Services sectors.

Simple and Easy to Use

Data requirements are simply:

- Staff or work pattern ID
- Shift start date and time
- Shift end date and time

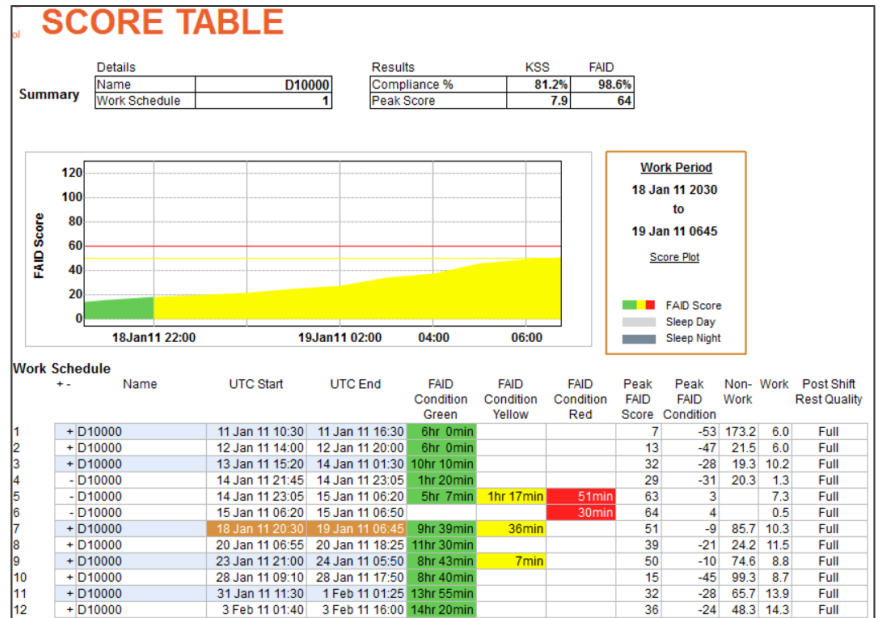| ID	Start date & time	End date &time
10142	24/08/2010 17:30	24/08/2010 04:30

Data can be easily copied to and from spreadsheets

Additional optional inputs:

- Fatigue tolerance levels
- Sleep periods
- Duty type
- Task risk
- Departure/arrival time zones and locations
- Rest quality (for inflight rest)
- Sleep buffer prior/post
- External results

Data outputs:

- Continuous fatigue status on two scales – Karolinska Sleepiness Scale (KSS) and FAID Score
- Sleep/wake prediction
- Compliance with set tolerance levels
- Sleep in prior 24 and 48 hours
- Individual and group plots and data tables of all data and KPIs
- All outputs can be copied and pasted, saved to external files or printed directly to printer or PDF printer

SCORE TABLE

Summary

Details		Results	KSS	FAID
Name	D10000	Compliance %	81.2%	98.6%
Work Schedule	1	Peak Score	7.9	64

Work Period
18 Jan 11 2030
to
19 Jan 11 0645

Score Plot

FAID Score
Sleep Day
Sleep Night

Work Schedule

	+ -	Name	UTC Start	UTC End	FAID Condition Green	FAID Condition Yellow	FAID Condition Red	Peak FAID Score	Peak FAID Condition	Non-Work	Work	Post Shift Rest Quality
1	+	D10000	11 Jan 11 10:30	11 Jan 11 16:30	6hr 0min			7	-53	173.2	6.0	Full
2	+	D10000	12 Jan 11 14:00	12 Jan 11 20:00	6hr 0min			13	-47	21.5	6.0	Full
3	+	D10000	13 Jan 11 15:20	14 Jan 11 01:30	10hr 10min			32	-28	19.3	10.2	Full
4	-	D10000	14 Jan 11 21:45	14 Jan 11 23:05	1hr 20min			29	-31	20.3	1.3	Full
5	-	D10000	14 Jan 11 23:05	15 Jan 11 06:20	5hr 7min	1hr 17min	51min	63	3		7.3	Full
6	-	D10000	15 Jan 11 06:20	15 Jan 11 06:50			30min	64	4		0.5	Full
7	+	D10000	18 Jan 11 20:30	19 Jan 11 06:45	9hr 39min	36min		51	-9	85.7	10.3	Full
8	+	D10000	20 Jan 11 06:55	20 Jan 11 18:25	11hr 30min			39	-21	24.2	11.5	Full
9	+	D10000	23 Jan 11 21:00	24 Jan 11 05:50	8hr 43min	7min		50	-10	74.6	8.8	Full
10	+	D10000	28 Jan 11 09:10	28 Jan 11 17:50	8hr 40min			15	-45	99.3	8.7	Full
11	+	D10000	31 Jan 11 11:30	1 Feb 11 01:25	13hr 55min			32	-28	65.7	13.9	Full
12	+	D10000	3 Feb 11 01:40	3 Feb 11 16:00	14hr 20min			36	-24	48.3	14.3	Full

Fatigue Risk Management System: A data-driven means of continuously monitoring and managing fatigue-related safety risks, based upon scientific principles and knowledge that ensures relevant personnel are performing at adequate levels of alertness.

The International Civil Aviation Organization

FAID Quantum is not a difficult product to use, however we do recommend **training in the context and functionality of FAID Quantum** to assist in its most effective and appropriate usage.

How FAID Quantum can contribute to your Organisation's Fatigue Risk Management System (FRMS)

Organisations use FAID Quantum as both a starting point to assess indicative levels of Hours of Work related fatigue by providing scores that are a measure of the sleep opportunity available within the Hours of Work, and as a powerful integrated tool within their ongoing FRMS program.

- FAID Quantum provides a scientifically validated metric of indicative fatigue exposures within Hours of Work, allowing organisations to apply appropriate levels of risk mitigation treatment/controls to ensure work is performed within acceptable levels of risk.
- In conjunction with a Fatigue Hazard Analysis Risk Assessment and organisational safety metrics, FAID and KSS Score benchmarks (Tolerance Levels) may be set and rostered against, as an Hours of Work-related control. This complements other controls that form part of an organisation's fatigue management procedures within its Safety Management System.
- As a compliance monitoring function, comparison of actual Hours of Work against the plan (including reference to the Tolerance Levels) can be made, providing information for exception investigation, and a measure of system integrity.
- Roster planning decisions, including the allocation of overtime, can be enhanced by the use of FAID Quantum in conjunction with consideration of other work-related fatigue factors, to ensure levels of fatigue exposure in Hours of Work are within appropriate boundaries
- FAID Quantum outputs assist in the process of Accident and Incident investigation by assessing the potential contribution of Hours of Work related fatigue to a safety event.

FAID Quantum outputs provide an indicative measure of exposure, and do not necessarily indicate the level of individual fatigue. Exposures need to be assessed in relation to individual risk factors, the tasks being undertaken, existing mitigating treatments/controls, and the potential likelihood and consequence of an occurrence in order to gain an understanding and appreciation of the risk involved.

FAID Quantum Training Workshop

In order to make the most out of FAID Quantum, it is important to receive proper training. For this reason, we have developed FAID Quantum software user training that also includes:

- Introduction to the science of human fatigue
- The basis of biomathematical models (BMM), their features, strengths and weaknesses
- How to use a BMM and what it should not be used for

The training sets three clear objectives

- Learn the functionality of the FAID Quantum software
- Understand the use of FAID Quantum within the context of a Fatigue Risk Management Solution
- Interpret and use the output scores from FAID Quantum correctly

Training can be up to 4 hours in duration and can be delivered as an on-site workshop (best suited to groups of 8 or less), or webinar training (best suited to groups of 4 or less). NOTE, these webinars can be delivered over several sessions (minimum 1 hour blocks).

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Other Variants and Customisations

The FAID Quantum Roster Tool is designed to assist organisations that are currently planning or building rosters within spreadsheets. The FAID Quantum Roster Tool provides a significant step up in terms of efficiency and functionality, and offers the ability to:

- Import or manually build rosters across numerous groups or depots
- Compare and store auditable planned and actual Hours of Work data
- See immediate feedback of FAID and KSS Scores as shifts are allocated
- Quickly change shifts or implement shift swaps by a simple 'click and select' method
- Manage designations and availability of staff
- Retain the analytical power of the outputs currently available within FAID Quantum
- Utilise easily created roster templates and publish rosters with a click of a button

FAID Quantum Enterprise

FAID Quantum - Enterprise is a compliance-monitoring tool that quickly analyses hours of work data from across the whole organisation. It allows for both high level and drilled down analysis at the organisational, regional, service location, role type or activity level. Comparisons between locations or groups become possible to see where 'hot-spots' with relation to hours of work fatigue exist, for timely treatment.

FAID Quantum - Shared Object Library

FAID Quantum can also be supplied as a Shared Object Library for use with third party software. The calling program (typically user supplied rostering or scheduling software) composes a dataset of a single roster and passes it to the Shared Object Library which returns both FAID and KSS Score data back to the calling program.

The process is fast, efficient and enables existing corporate rostering or scheduling software to take hours of work related fatigue and its risks into account when creating and managing rosters.

Time Zone Adjustment

Optional time zone adaptation (adjustments when travelling over multiple time zones) and optional crew augmentation (for resting pilots on long flights) are both available in FAID Quantum for any industry where workers are routinely required to operate across 3 or more time zones. The aviation industry, in particular Long Haul and Ultra-Long Haul operations, is exposed to higher frequency rates of trans-meridian adjustment and this factor is considered to result in higher levels of fatigue exposure for aircrews.

The following has been determined by the aviation industry in the USA (Battelle Memorial Institute, 1988) – An aircrew's level of alertness at any time depends upon the complex interaction between a number of variables. In particular, five variables need to be considered:

Our aim is to provide you with the best tools and resources possible. We believe in continuous improvement and flexibility, to ensure FAID Quantum is responsive to client feedback and kept abreast with current research and national and international risk management standards.

In addition to the FAID Quantum Suite of Products, ask us about our other products to support a robust Fatigue Risk Management System – HAZAID™, GRAID FRMS™ and GRAID™ IT.

1. Time on task, including flight time and duty period duration
2. Time awake, since last sleep, when beginning the duty period
3. The extent of circadian disruption caused by transiting multiple time zones, and working at night
4. How quickly the pilot returns to home base – the speed of transition
5. Individual sleep debt, be it acute and/or chronic

Use of FAID Quantum's optional Time Zone features will provide a metric that reports the effect of Items 1, 3 and 4 on the individual's and group of individual's indicative exposure to fatigue.

The method used for calculating the fatigue index when time zone changes apply is to calculate the individual fatigue index for each hour of duty based on the individual's current 'body time'.

An individual's initial 'body time' is based on their starting time zone from the first duty in the work schedule, which is established using the difference between UTC and local time where the first duty commenced. Adjustments to the 'body time' are then made taking into account the rest time and number of time zones crossed.

In the **FAID Standard BMM** the researchers chose to implement rates that differ by direction of travel.

Adjustment begins at the end of the duty, and the magnitude of adjustments is as follows:

→ 1.5 time zones per day when traveling in an Easterly direction
→ 2 time zones per day when traveling in a Westerly direction

There are additional rules and exceptions for adjustments being made:

1. There is no adjustment to an individual's 'body time' when the second of two consecutive duties involves a return to the starting time zone of the first duty in the work schedule and either:

    a. the rest period between the two duties is less than 36 hours[1], or

    b. the time zone difference is three hours or less, and the rest period between the duties is less than 48 hours[2].

2. Any duty performed at the rest period location will not prevent rule one (above) being applied.

In the **FAID Quantum BMM** the researchers chose to implement resynchronisation expressed as 50% of the remaining difference between 'body clock' and local time adjusts every 48 hours.

While these two methods seem quite different, in most cases they lead to differences in assumed 'body clock' position, at any given time, of less than 3 hours. This would typically be well within the variations seen between individuals and does not lead to significant differences in the calculated model scores.

Please contact us for further details on this product and how crew augmentation and sleep quality adjustments are made within FAID Quantum.

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1 A mid-point of 36 hours has been used within FAID Time Zone to reflect the length of time when circadian disruption begins to occur when the second of two consecutive duties returns to the starting time zone of the first duty, to accommodate the 'grey zone' in research knowledge between 24hrs and 48hrs.

2 Recognising that circadian adaptation is less likely to occur when the time zone difference is three hours or less.

2009 B-HERT Award

Working together to manage Fatigue-related Risk, InterDynamics Pty Ltd, the University of South Australia, and Integrated Safety Support shared an Honorable Mention for Outstanding Achievement in the Collaboration in Research & Development Category.

This innovative collaboration has revolutionised the management of fatigue-related risk and produced an entirely new class of risk management products, which have helped define a new regulatory approach to fatigue management in Australia and overseas, including Canada, Europe, NZ, UK & USA.

Related Peer Reviewed Papers and Books

The following list contains the articles in international journals and books which have featured the research behind FAID Quantum and its validations.

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Time Zone Specific

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